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SOS CLIMATE WATER FRONT

ALONG THE WATERFRONT CITIES IN EUROPE FACING CLIMATE CHANGE

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GDANSK MIASTO NA PRAWACH POWIATU FUNDACJA

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Introduction

Water and land, cities on the waterfront. Throughout centuries human settlements along the water have searched for a well-balanced relation and have produced some of the most beloved European cities, wonderful and prosperous port cities, that are now at risk. They are facing threats brought by the increasing strength of natural phenomena and disasters. To overcome these challenges what needs to be done? The most relevant questions address how, when and what are the priorities.Settled along the waterfront of rivers,seas or oceans, each waterfront city holdsspecific challenges and requires adaptative measures. While new risks emerge, simultaneously new opportunities to re-imagine these cities and their urban waterscapes come forward.

In the early 21st century, communities inherited waterfronts mainly shaped during the 20th century, which were built on landfill, using concrete and creating hard surfaces. New opportunities flourish when these areas envision the transition from such rigid, controlling infrastructures to solutions based on adaptation and integration of natural systems. A critical analysis of human actions on the natural environment has the potential toproduce alternatives that integrate new strategies with ecological functions, favouring smooth systems and a more comprehensive and integrated approach to nature.

The shrinking of bio-diversity, unprecedented climate swings and the raising costs of maintenance are symptoms of a planet struggling with climate change. To re-establish a healthy condition, cities seek to develop strategies of adaptation to make the built environment more resilient to face floods, droughts, high tides, tropical hurricanes and urban heat island effects.

To deal with this topic an ambitious collaborative research network, funded by the Research European Agency Horizon 2020 - RISE Marie Skłodowska-Curie Actions was created to imagine Sustainable Open Solutions on Waterfront Cities facing Climate Change (SOS Climate Waterfront). The initiative acts as a unifying force, drawing together universities and stakeholders spanning Portugal, Poland, Greece, Sweden, Italy, the Netherlands, and Turkey. At its core, the research project summonses the expertise of researchers, PhD students and post-docs researchers to uplift scientific excellence through a global partnership.

Its primary focus lies at the intersection of waterfronts facing climate change in five key European cities: Lisbon, Gdansk, Rome, Stockholm and Thessaloniki, located in the Atlantic Ocean, the Baltic, the Mediterranean and the Aegean Sea. This multidisciplinary project put together a series of workshops, field work and conferences that served for sparkly ideas and enlightened thinking among the international team, municipal representatives, and a diverse array of experts. Participants covered various fields such as architecture, urban planning, environmental engineering, meteorologists, law, economics, landscape, and others. These collaborative workshops involved immersive site visits, in-depth discussions, and targeted efforts on specific sites.

Collectively, the insights produced by this collaborative network offer a wide spectrum of possibilities, earnestly addressing the multifaceted challenges encountered by urban waterfronts in this era of extreme climate challenges. Participants hailing from diverse fields contributed to a cohesive body of knowledge geared towards birthing creative solutions, effectively spotlighting, the material and immaterial, exponentially rising costs,associated with adapting to and mitigating the damages.

The emergent concept of 'urban porosity' stands as a pivotal framework, capable of fostering flood absorption, temperature stabilization, and the curbing of energy consumption. To face these present challenges, resilient urban environments include the integration of circular economy principles and the activation of civil society towards sustainable practices and safeguarding biodiversity, implied through the concept of "porosity". The flow of information between disciplines depends on the interdisciplinary exchange, enhancing the metaphorical meaning of this new concept.

The selection of five European Waterfront Cities aimed to cover a wide range of situations. Lisbon, Rome, Stockholm, Gdansk, and Thessaloniki were the main laboratories. The research on Lisbon's Great Metropolitan Area addressed pivotal queries surrounding sea-level rise, coastal dynamics, and human interactions within waterfront regions. Rome and the river Tiber dealt with coastal systems, historical approaches and dynamics in progress covering current transformations along the seaside and the riverfront. Stockholm, recognized as Europe's fastest-growing city, grapples with pressing climate change challenges at its waterfront. Proposals across three urban sites, were explored, each holding profound implications for the city's waterfront landscape. Gdansk provided insights on how to integrate water management

considerations into urban design and planning, sincethe growing amount of impermeable surfaces results in flooding and pollution of surface waters. The lowering level of the groundwater table impairs the growth of vegetation and saline intrusion into the coastal aquifers. Thessaloniki adopted a comparable approach, emphasizing the criticality of resilience for specific waterfront sites. Here, global and local expertise converged to envision transformative urban design solutions tailored to natural yet-to-be-rehabilitated waterfronts, with a keen emphasis on adaptive strategies amid urgent climate challenges.

In this publication, to address the complexity of this emergent topic, the editorial board selected original high-quality papers presenting current research, accommodating a broad spectrum of approaches ranging from speculative, informal investigations to conventional scientific research, included in the organization of the three chapters of this book. The first regards"sustainable strategies and cultural heritage" as local geographic and historical resources that stand as potent tools geared toward confronting the current and forthcoming societal and environmental conditions. The second chapter, on "urban waterscapes", covers an imperative need to consider interdisciplinarity and consequent emerging challenges. The third and final chapter 'on porosity' explores case-studies and the opportunity to fortify cities with greater resilience amid the dynamic new necessities for a "sponge-built environment".

"Sustainable strategy and Cultural heritage" explore concepts and projects relating water to landscapes and cultural heritage, focusing on the impacts of the contemporary uses.History without geography is meaningless. Each cultural landscape and the way each community relates to its particularities sustains the re-signification of elements of value, new functions or conservation of heritage buildings and sites.

This first chapter gathers articles that privilege the discussion of anthropic transformation, including how tourism and economic factors impact and influence the public space.

Generations that preceded ours have tested and built many solutions which proved to be resilient and some are still active. There are records of artefacts and strategies that were well adapted and yet built with simple low-tech resources.

From the cultural heritage perspective, it is meaningful to analyse projects that were tested over long periods of time, including adaptive heritage, cases that enhance the integration between landscape and heritage. At present, high levels of sustainable

efficiency can be reached by using either high-tech or low-tech solutions, mainly learning from the past.

In the second chapter, dedicated to “Urban Waterscapes”, the critical discussion within the interdisciplinary group is driven by a search for hidden, sometimes forgotten knowledge to shed light on local, resilient and low-tech solutions. New solutions emerge from the exchange of expertise between various fields of knowledge, such as geographic, social, environmental, etc Sustainable transformation is often based on transdisciplinary approaches and emerging strategies, must include the role of the communities, located along the water. Cross visions between cities lead to the exchange of best practices and are used to imagine beyond the vulnerable physical reality. Risks of floods, high tides, obsolete infrastructures are part of cultural sites along the waterfront. Currently blue and green strategies search for low carbon energy, transition to soft edges and resilient design, mitigating urban heat islands effect. Increasingly relevant are some of the recent researchprojects that propose innovative resilience methodologies. At present they are delivered from interdisciplinary teams, also addressing comparative cases that succeed to preserve and enhance the natural setting and the built environment.

In the third and last chapter, “Porosity”articles present systems of resilience to adapt and mitigate effects of climate change, such as environmental planning addressing new patterns brought by extreme swings in the waterfront. The concept has been used across-disciplines, blending architecture, biology, organic forms and processesproviding productive conceptual frameworks.Ithighlights the transition of the built environment from hard edges to soft edges, and focuses on emergent trends of new urban waterscapes that negotiate with nature. It includes future strategies able to act like sponges, that are able to absorb without degrading. In fact, nurturing a “sponge effect” portrays the transition from the 20th to the 21st century.

The concept of urban sponge effect implies porosity, urban waterscapes, sustainable strategy and cultural heritage. It requires a profound shift in the way of thinking, from the prominent position of control over nature to a dialogue with naturethat can be reinterpreted, producing new meaning and applications within a new context. This shift has profound implications in the way cities have been designed, in terms of dealing with green infrastructure, integrating nature, organizing regionalization, transportation; sustainable urban development and circular economy. Sponges take and give, are passive and active, thus opening a new realm of opportunities.

Authors were selected through a double-blind peer review process. Each article reveals a concerted collaboration between academic institutions, local planning authorities and cultural institutions fostering a transformative shift in urban thought. Continually pushing the envelope, this ongoing project serves as a catalyst for innovative approaches, aimed at effectively grappling with and adapting to the multifaceted impacts of climate change within urban landscapes. The theoretical discussion includesthe selection of a series of innovative urban strategies to be implemented. How will solutions to adapt and mitigate can enhance the resilience of cities?

This comprehensive initiative seamlessly integrates cutting-edge technology, meticulous data collection, and imaginative design, culminating in the development of resilient solutions with potential applicability at both local and European sites. Each of the selected cities has water as its backbone, having developed and adapted along the waterline, adding value to its community.

The far-reaching outcomes of this concerted effort have been disseminated through diverse channels, encompassing open-access databases, scholarly publications, and engaging exhibitions. Between chapters, the illustrations consist of design projects that were developed by the collaborative network of experts participating in the research project throughout four years. The five projects on display were conceived as responses to climate change in the five selected cities. Together, they illustrate solutions designed to deal with each city’s specific challenges, offering opportunities to strengthen their resilience, adapting to new climate patterns and minimizing the impacts of the climate crisis on the waterfront.

The projects conceived for the metropolitan areas of Lisbon, Gdansk, Rome, Stockholm, and Thessaloniki demonstrate both sensitivity and intelligence. Sensitivity to the unique geography, history, and local community of each city, and intelligence in integrating new climate patterns in the design, to mitigate their effects. They were developed by multidisciplinary teams composed of experts from academic and non-academic institutions.

They are presented through drawings, including maps and diagrams. The outline of the line, that holds together the solution. Drawings are a universal language that preceded the written word. The ideas illustrated in the five selected projects presented in the book are fundamentally the result of site-specific conditions. The approach itself is multidisciplinary, based upon many different schools of thought.They merge the gap between the ma-

terial and the functional, the pragmatic and the imaginary/visionary looking at the important structures and signs of the problem from the perspective of discovering how they relate to collective activity.

Each design proposal emerges from the methodology adopted. When experts holding complementary disciplines are engaged in dialogue, at first there is a moment dominated by a cacophony while facing a complex number of parameters that need to be combined. It is chaotic and unpredictable before reaching a common ground. Ideas are shared in a cross-pollination of visions among partners from, public and private, academic and non academic sectors in different countries.

The problems and threats are real and expanding rapidly. Solutions emerge from dialogue; they are creative and depend on the combination of such interdisciplinary fertile discussion. Coming from various fields of knowledge, each contribution has its own perspective and need to combine each expertise to the common vision. The formula that sustains each of the five projects succeeds to expand new perspectives and discovers new ways of designing that cannot be described in words alone. Only multidisciplinary teams composed of open-minded experts could develop such pertinent, sustainable and inclusive design.

The richness of the solutions presented is the result of a dialogue process, which opens up new alternatives also useful for other European cities. The proposals aim to build new infrastructures that integrate nature, and its ecological systems, instead of trying to limit and control. They promote solutions where there is a dialogue relationship rather than a power relationship over climate manifestations. The names assigned to the five projects reflect this perspective: “Vine as a Spine” in the Metropolitan Area of Lisbon, “A leaf on the water” in Gdansk”, Let it Ti(be)r” in Rome, “The Arc” in Stockholm and “Clean the soil” in Thessaloniki. All share an innovative approach, promoting contemporary strategies for urban resilience. They are inspired by the geomorphologic conditions of each waterfront area, regarding their transformations by industrialization, throughout the 20th century.

The content produced for this book is the result of a wide international collaboration, aiming to share a body of knowledge through text and drawings. In times of uncertainty, researches have followed a methodology that has been useful for the scientific community, and can be extended to stakeholders, decision makers and to the general public interested in waterfront cities facing climate change. The Sustainable Open Solutions (S.O.S) presented within this publication are different from the common S.O.S meaning (Save Our Souls), which is normally associated with a last call for help. Instead, the premises of the research carried out privilege successful initiatives to highlight positive ideas that may build an inspiration for the future.

Chapter 1

Sustainable Strategy and Cultural Heritage

Claudia Mattogno
Maria Rita Pais
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Sustainable Strategy and Cultural Heritage

Introduction

Climate emergence has become a major concern in urban, landscape, and architectural heritage policies. It is a fact that Earth's climate has changed throughout history. NASA explains that just in the last 800,000 years, there have been eight cycles of ice ages and warmer periods, being the last ice period ended about 11,700 years ago, a date that coincides with both modern climate era and of human civilization (NASA, n.d.). The same variability happens with sea level, which presents itself highly fluctuating and varying usually according to sea levels, higher during warm periods and lower during cold periods. In fact, sea levels about 18,000 years ago were as much as 120 meters below present. Recent measurements show that this "recent" rise in global sea level began with the Industrial Revolution and has the most expression starting in the beginning of the 20th century. Since 1900 up to 2017, the global average sea level has increased between 16 and 21 cm and some more accurate data collected from recent satellite radar measurements reveal an accelerated increase of 7.5 cm in the period between 1993 to 2017, which means a trend of around 30 cm per century. Scientific studies relate this acceleration to climate change, which is causing the thermal expansion of sea water and the melting of terrestrial ice layers and glaciers. Despite the differences in the interpretation of this phenomena, the reality already shows some of its effects with the ocean acidity and coastal flooding in several different ports on the planet.

Meanwhile, as architects and participating together with the scientific community, stakeholders, and as individuals with extended responsibility with the built and natural environment, we should look up to coastal territory with double care: by thinking what and how to build or unbuild in a way to improve the performance of the place in the face of the recognized changing of the climate and of the rise in water levels; and also in a way to reinstall the functional life and the memory of the sites that we are going to lose. Despite the big level of positivity that we, as architects usually see in the future scenarios, the "Inconvenient Truth" is that a large portion of land, architecture, communities and cultural life (material and immaterial) is going to be lost, literally taken with the waves. Many policy efforts, at an international level, have

already been taken, by UNESCO, ICOMOS, ICOFORT among others, to address numerous major problems we are currently facing. We underline recent UNESCO "Convention Concerning the Protection of the World Cultural and Natural Environment" that establishes a "Policy Framework" and a "Implementation Policy Document" that opens a new perspective for heritage regarding an adaptation to the climate impacts and on "climate mitigation", as point 59 describes, by creating "value and inspirational power of World Heritage properties to showcase 'win-win' mitigation practices that both reduce greenhouse gases and safeguard Outstanding Universal Value" (UNESCO, 2021). Despite the optimism and commitment of many authorities and also of many engaged people, there is no universal solution to the question of cultural heritage facing a continuous changing of the planet Earth, regarding its physicality and materiality, but also regarding its memory value or immateriality. The research field deals with some difficulties, linked to the complex positioning of people regarding climate emergencies (Latour, 2018, p. 15), still "scattering in all directions"(Latour, 2021). Additionally, the idea of the global approach is to address the main lines, and local entities have a role to play, by identifying their own specificity, and this is what we are trying to do through integrated research. So this topic also has no universal answer, or either no universal formula.

One of the challenges of the current situation lies in anticipation of the rise of the sea water level, trying to understand behaviors and forecast dangers relating to areas expected to be damaged. During this research, we were gradually realizing that these areas between water and land should be seen as 'places-in-transition' that need to be studied, registered and addressed in terms of strategies to avoid anticipated damage, improve what exists and is maintained and think about improvements for a better future.

This chapter rests exactly in the memory of these 'places-in-transition' considering the amplitude of heritage conditions at the present state and sets the stage for presenting some testimonies of the challenging balancing between a 'Sustainable Strategy' for a future regarding our 'Cultural Heritage'. Among an interesting sample of testimony applications in current cultural heritage research issues, we open an overview of the six articles that contribute to the theme within the research agenda of the SOS Climate Waterfront project.

The Law of Conservation of Mass dates back from 1789 with Antoine Lavoisier's statement that "In nature, nothing is created, nothing is lost, everything is transformed". Despite the beauty of

the idea of circularity of the material world, we understood along these five years of research of SOS Climate Waterfront, the predominance of highly open ecosystems (where inputs and outputs can far exceed internal cycling). For example, with the enormous increase of population, there is also an increase in construction and many of the materials and natural resources (e.g., water, stone, iron) become increasingly limiting over the next century (due to subtracted geologic deposits). We are now facing the challenge of increasing the efficiency of these systems. So, just as mass balance constraints provide a useful tool for ecologists in studying natural ecosystems, it can also ensure that the increase in human population and material consumption that has characterized the past two hundred years, cannot continue indefinitely. We are beginning to understand now, that we are prisoners of a "disposable society" (Desilvey, 2017). "Reduce, Reuse, Recycle" (Petzet, 2012) seems to be the only way to achieve ecosystem cycles.

In Architecture Depends (Till, 2009), Jeremy Till discusses the idea of architecture as an authorial artwork, bringing out its dependence from other disciplines and specially from other humans and the ethics that this relation involves. Although architecture is not determined by its durability, its argument is directly related to its material decline and to its social survival. In this sense, the durability and ephemerality and the use and oblivion of the built world explain the proximity between the "construction and demolition (...) the more new architecture there was, the higher the mounds of waste grew" (Till, 2009, p.69-70). Despite the effort, it is evident that we cannot save all buildings or turn everything into heritage (Desilvey, 2017, p.15), first because we really need to evolve, and second, because it is physically impossible, by weathering, intrinsic materials degradation, new space needs, or even, by the expected rise in water levels, for example. Our point here is to bring the relevance of acting with anticipation to build strategies to avoid anticipated damage, improve what exists and is maintained and think about improvements for a better future, and among these, we are here discussing the value of memory.

In his book The Art of Forgetting, Adrian Forty reminds us another book of Alexander Lúria that described a man with the capacity to remember everything, a mnemonist (Forty, 1999). According to Forty, Lúria explained that his major problem was to forget due to the congestion of remembering everything. This is also a process that we should take into consideration when dealing with our "place in transition": we will need to choose what has the utility to be preserved and what is better to forget. And here

we find the first problematic: one thing is the individual memory, and another completely different is the collective memory. This second problematic is stressed by Paul Connerton in his book How Societies Remember when he says that "past factors tend to influence, or distort, our experience of the present" (Connerton, 1989, p.2). So, we may also stress that choices made today will influence or distort our collective experience in the future.

Following these two concepts related with memory, as architects and planners, we can act with anticipation when planning and designing for the future. We can even legislate this idea, by deciding what materials, technologies or what ideas to use in these "places in transition". But what about the remains of these buildings? We know that architecture is concerned about the future, but in these areas we may also have interest in having concerns about the past. In the end, reusing a construction or a landscape means that we are registering a memory by thinking about its future.

Entrenched on the SOS Climate Waterfront research experiences, present speculative text, aims to raise some ideas to a debate regarding the implications of the meaning of heritage with respect to practices and their sustainability.

The chapter addresses a complexity of emergent topics with five high-quality papers that support a broad spectrum of approaches for sustainable strategies and cultural heritage as local geographic and historical resources exploring concepts and projects relating water to landscapes and cultural heritage, focusing on the impacts of the contemporary uses. Each cultural landscape and each community relates to its particularities sustains and their re-signification regarding value, functions or conservation of heritage buildings and sites is a case-study by itself.

The SOS Climate Waterfront project constituted an important opportunity for scientific reflection on the impacts caused by climate change on urbanized territories at different scales with special attention to places characterized by the presence of water, our "place in transition". Different historical and geographical contexts were compared through a methodological and design lens which allowed us to delve into topics such as resilience, protection and valorisation in the context of plan and project strategies linked to water. In this direction, it has proved essential to combine environmental, landscape and urban planning with highly technological approaches linked to hydraulic engineering under the sustainability framework.

This first chapter aims to underline the value represented by the historical-environmental and cultural pre-existences and their ability to connote as resources in the identification of resilience strategies towards climate change and sea level rise. A greater awareness of the role that cultural heritage can play in this direction is undoubtedly a possibility that still remains partially unexplored and which deserves, instead, to be explored in depth through innovative project paths capable of modifying consolidated points of view to open up to new fields of experimentation as a link between the past and the near future.

Overview of the Thematic Chapter

The contributions that follow demonstrate the desire to broaden the study experiences not only to the large international working group of the research partners (Greece, Italy, Netherlands, Portugal, Poland, Sweden and Turkey), but to extend them to the contribution of other European researchers in order to compare even broader points of view.

The first contribution, "Chasing the Nexus between Sustainable Strategies and Cultural Heritage" is the result of collective work between researchers from the Italian and Portuguese groups and is aimed at highlighting the extent of the challenges facing cultural heritage in fulfilling a contemporary role. After a brief review on the evolution of the concept of heritage in the recent past, the essay explores the expansion of design approaches from purely environmental issues to more complex and inclusive ones of the landscape. Here the project must deal with the supporting role of cultural and anthropic values and prove sensitivity to new awareness capable of applying land care practices to reduce conditions of risk and vulnerability and develop a set of sustainable strategies at different scales and levels of governance.

The second contribution is entitled "Learning by Portolands. Reading and rewriting the built coastline beyond climate change and threatening obsolescence" and is written by Stefano Antoniadis who examines the most recent transformations of coastal spaces, often due to industrialization processes, the creation of mobility infrastructures or the presence of different equipment, from port to tourist equipment. Many of these artifacts are today unused because they are obsolete and no longer meet current needs, but their presence has now generated new landscapes and new experiences from which it is impossible to independently activate environmental redevelopment strategies. The author therefore invites us to draw up a sort of new Portolano as spatialized of these heterogeneous pre-existences as an opportunity to

raise new design paths of re-signification and re-use.

The third contribution is written by Dimitra Babalis with the title “Heritage Waterfronts and Well-being Strategy for a Dynamic Urban Transformation and Place Value” and introduce the notion of health and well-being as an additional component in the urban transformations of sensitive contexts such as those linked to the presence of water. It takes inspiration particularly from the specific conditions of a qualified context such as the Arno riverfront in Florence and proposes some design hypotheses that give value to the presence of open spaces as a component for an environmental redevelopment that is also attentive to the well-being needs of citizens.

The fourth contribution is entitled “Life Between the Cliff and the Sea. Post-Industrial Waterfront Heritage as a natural system: a comparative approach between heavy industry and local ecological, cultural and leisure systems in Fiume (Rijeka)” written by Spela Hudnik. Also in this case, the attention is focused on the continuous natural and anthropomorphic transformations that determine contemporary structures in continuous evolution and in continuous oscillation between past and future, between commodification and patrimonial value, between environmental needs and needs of use. From this perspective, the various possibilities for the regeneration of territories require renewed attention to the needs of the contexts, as they have transformed over time, to the heritage values and to the new conditions dictated by the changed climatic conditions.

The fifth contribution is written by Hugo Nazareth and is entitled “The Consecration of Water through Architecture in the Eternal City Contributions to the Art of Memory in the Anthropocene”. The author focuses on the profound link between water and architecture and on the role played by memory as a lever to give value and support to cultural proposals capable of representing a sustainable strategy for the regeneration of water landscapes in urban contexts with a strong historical identity.

The chapter concludes with two meta-design experiments developed during the research as exemplifications of contexts and recurring problems in European territories from the Baltic to the Mediterranean where the challenges of climate change must necessarily deal with the historical sedimentation of urban structures and the diversity of geographical conditions.

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Chasing the Nexus between Sustainable Strategies and Cultural Heritage

1. The sense of heritage from ‘historic centre’ to ‘historic city’

“Cultural heritage is, in its broadest sense, both a product and a process, which provides societies with a wealth of resources that are inherited from the past, created in the present and bestowed for the benefit of future generations. Most importantly, it includes not only tangible, but also natural and intangible heritage [...] however, these resources are a ‘fragile wealth’, and as such they require policies and development models that preserve and respect its diversity and uniqueness since, once lost, they are non-renewable” (UNESCO 2014).

It is useful to start these short reflections from the above-mentioned definition in order to argue about the paradigm shift which occurred in time in the perceiving evolution of the built territorial and urban domain from general interpretations of basic terms as ‘heritage’, ‘monument’, ‘artifact’ to complex items (and issues) as ‘historic centre’ and ‘historic city’.

1.1 The ontology of Heritage

The term heritage has been inherited from the past in the most diverse fields: both natural (in terms of flora, fauna, landscape and natural resources which are recognized as having a high scientific value in terms of physical, biological, geological characteristics, or risk of extinction, etc.), and cultural (in terms of tangible and intangible artifacts, from food to traditions, from arts to crafts, which are recognized as having a high historical, aesthetic, archaeological, scientific, ethnological or anthropological value).

Heritage, with the exception of the immaterial one, is something physically present, that represents the legacy of history but is at the same time, undeniably, part of our present. Inside the heritage concept it is possible to distinguish a material reality (landscapes, cities, buildings, monuments, works of art, etc.) and an immaterial dimension (the historical, artistic, cultural value that these material entities express and represent). UNESCO classifies as World Heritage Sites places (such as, for example forests, mountains, deserts, etc.) or artificial complexes (such as, for example, buildings or urban ensembles) of natural or cultural significance such as to make them an integral part of the common heritage of all humanity.

In Architecture and Urban Planning, heritage mainly designates the built historical legacy, both at the scale of the single building and at the entire urban scale. From an evolutionary point of view, it is a relatively recent conception, which spread following the rapid changes caused by the industrial revolution, from the last part of the 18th century onwards, and strongly developed starting from the end of the Second World War following the architectural and urban destruction in Europe. Even more recent is the idea that the value should not be referred only to the single monument or building but, for the most part, to the context as a whole.

1.2 From 'historic centre' to 'historic city'

The modern concept of 'historic centre' was born at the beginning of the 19th century, in the midst of the industrial revolution when, in opposition to the idea of urban modernity, the urban fabric of the historic city collided with the new organizational needs dictated by urban growth. Despite the attempts to give the definition of 'historic centre' an absolute value, the impossibility of extending its meaning to a universal level was soon clear. Easily identifiable for European cities, more generally it remains difficult to recognize it in the vertiginous expansions of new metropolises with recent stratification where - between dispersion and super-concentration - development seems in many cases to herald the recession of the historic notion of city itself. Within the 20th century, therefore, attempts were made to avoid the use of the 'historic centre' concept beginning to introduce 'historic city' as a topographically non-limiting term, precisely to escape the problem of fixing the edge between historical and non-historical areas. The progressive evolution of the concept of 'historic centre' therefore, arises from the impossibility of distinguishing, in analytical and planimetric terms, the city centre from its urban and territorial surroundings to which it is linked by mutual and deep relationships; hence the development of the concept of 'historic centre' and related definitions of 'historicity' and 'recovery' to be extended up to include an extremely broad cultural value which is not always confined to precise portions of the urban domain.

Regarding the evolutionary definition of historic centre, within the last two centuries the cultural paradigm has shifted starting from a limited and traditional dimension towards new inclusive, comprehensive, dialectic perspectives.

The traditional view had proposed a 'monumentalist' approach to the historic centre as the unique identity of urban cultural heritage. Consequently, the historic centre was reduced to its excellent buildings and the preservation of a special symbolism emerging from some major structures. This ideological perspective was grassrooted on the thesis that the past can only be constructed through 'monuments'. In this sense, the historic centre was merely treated as a museum and defined by its market value (Carríon & Guardia 2011). The opposite emerging perspective treats the historic centre as a public sphere with multiple dimensions. Monuments are one asset of many, but the centre as a place of social relations, cultural production and a space where society is constantly re-constituted is the most crucial dimension. The value of the centre as a whole in this case is thus estimated by highly taking into account its performative part (Merlin, Choay 2000).

After the first structured reflections of international masters about the heritage issue (Sitte, Ruskin, Morris, etc.), since the first decades of the 20th century, Italy became the core of innovation ideas on the values and relationship between monuments and historic fabrics. Within this perspective the prophetic vision by Gustavo Giovannoni, in the first decades of the 20th century in Italy, has been the first to clearly interpret the historic centre as an urban heritage comprehensive repository. He outlined and spread out a more extensive idea of 'monument' which, in addition to the emerging episodes, should also include "the set of things of 'important interest' that have a collective value" (Giovannoni 1913, 1931). By addressing the difficult relationship between old historic buildings and new developments, he aimed to satisfy the needs of contemporary times (the beginning of the 20th century) through adjustments that would not damage the identity features of the historic heritage. He pursued the idea that "every city has its own artistic atmosphere ... a stylistic sense ... which should not be ignored, guiding the lines for new works, even in the newest and most audacious inspirations".

After the Second World War the 'Gubbio Charter' (1960), signed by eminent scholars with the support of several Italian municipalities, represents a fundamental milestone treating the entire set of elements that made up the historic centre as a 'monument' itself and established the principle of integral safeguarding of the historical centre, thus giving way to a long line of international reflections on the problem of their conservation. The outstanding Assisi plan (1958) by Giovanni Astengo represented an ideal embodiment of the principles pursued by the 'Gubbio Charter'.

The definition of historic centre has been discussed 'ex post' by

another maitre a penser like Pierluigi Cervellati: «It was a mistake to define the historic centre as the city of the past. [...] The consideration of the historic city as the equivalent of a centre has contributed to distorting the very meaning of the city itself. The centre, however historic, is not equivalent to a city. The periphery has never been qualified as such. There was therefore a transition from city centre to historic centre. It is now a matter of designing/planning a reconversion: from urban centre to historic city» (Cervellati 2006).

Jumping to the end of the 20th century, the necessary transition from the concept of historic centre to the broader one of historic city has taken place within the evolutionary road map for the adoption of the Rome General Master Plan (2003-08). It does not represent a mere exercise of temporal or spatial extension, for instance moving forward the date within which to place the historical values, or enlarging a perimeter. Recognition of the historic city calls for an interpretative need, an ability to read wider and more diffused urban parts in the traditionally 'peripheral' territory and to select, even within more recent urbanization processes, those urban fabrics and single materials that express historical values and therefore require different attention mainly aimed at recovery and valorisation. The transition from 'historic centre' to 'historic city', therefore, does not mean homogenising and flattening everything inside and treating differently what is outside its perimeter, but it means recognising urban diversities by learning how to describe and preserve them, and at the same time suggesting, where necessary, modifications consistent with those differences. It means seeking new strategic relationships between the parts both within the historic city and between it and the city of transformation (Gasparrini 2001).

Why should we save the city of the past? To this question, the first possible answer is looking at the history of values recognition. It is precisely this process which has led to the recognition of what the value of the inherited city is: at the beginning, an aesthetic, artistic, architectural value of some of its components; then, a historical and documentary value of increasingly large portions; afterwards a 'civilizational' value, focused on the notion of 'cultural asset' (Bonfantini 2020). It is the line followed by UNESCO action when assets and sites are inscripted in its lists. For the urban planning project, this meant first taking care of individual monuments; then, of the 'environments' in which they are immersed and of which they are part; then of 'minor' environments even devoid of any excellence peak, but equally worthy of attention; afterwards, of the 'historic centre' to be understood as a 'unitary monument' itself; finally, of the 'historic city', with an expression that dialogues with the 'historic urban landscape', highlighted and recognised at comprehensive level (UNESCO 2011). However, precisely this further passage – that from historic city to historic urban landscape – brings us to a second interpretive answer to the question of saving the city of the past. An answer that is now nourished not by a contemplative value principle, but by a performative one of practical utility. The historic city is, probably, a factor of habitability. Its materials have a potential to improve the performance of contemporary living space. The historic city helps us to live better and nourishes the urbanity of the contemporary city.

2. The value of the unbuilt space from 'environment' to 'landscape'

Heritage however, from an urban and landscape planning perspective, is not limited to the built elements of the territory. As the reconstruction of the gradual transition from 'historic centre' to 'historic city' has demonstrated, the definition of what is to be considered heritage and therefore protected has changed over time. The recognition of the unbuilt space as heritage, and of its value as equal to the built space for the purposes of preservation and transmission, starts from a concern for nature and gradually evolves to conceptualise landscape as heritage.

Natural heritage preservation in the European tradition, unlike the Unites States', originates from a scientific, ecosystemic concern, more than an identity building process (Battilani, 2017). It was the result of a need to maintain the ecological balance that sustains life – an attitude which, from its origin in the 19th century until today, has never lost its relevance to the management of nature and later of landscape.

The natural environment in the international context is object of preservation but in its "integrity", which is an equivocal concept, especially for the European context. Moreover, "nature" and "culture", at least until the introduction of landscape as a concept, are generally considered as separate realms.

The UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO, 1972) defines natural heritage as:

"- natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view;

- geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation;

- natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty" (article 2).

The UNESCO Convention therefore preserves natural elements, not landscapes. For a broader definition of landscape and its components, and an acknowledgement of the interplay and synergy between anthropic and natural elements, we should refer to the European Landscape Convention (ELC) of the Council of Europe. Opened for signature in Florence on 20 October 2000, the ELC has been ratified by 40 European Council Member States, of which 24 are part of the European Union.

The ELC brings together morphological and cultural aspects in the representation of the identity of places when it defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (article 1 - Definitions). Such a definition emphasises the intangible features linked to people's perception – as sight is central to the identification of landscape (Venturi Ferriolo, 2009) – and on material features emerging from natural and human agency.

Spatially, landscape is not defined by physical borders but by perceptive aspects, deriving from the environment but also from the individuals' social context and their history, as it is considered "an essential component of people's surroundings, an expression of the diversity of their shared cultural and natural heritage, and a foundation of their identity" (article 5 – General measures).

The Convention is not only an international legal instrument "to promote landscape protection, management and planning, and to organise co-operation between the Parties" (article 3 – Aims), but, above all, it is expression of a wider cultural and political project aiming to influence policy and stress the importance of the society-territory relationship, including everyday places, industrial sites, degraded areas.

Landscape speaks a muted language, that of nature and the things humans have added in time, season after season, solely to satisfy their needs (Turri, 2005). Cultural and natural heritage building up landscape are a muted expression of the territory as a palimpsest[1], as they represent the continuous writing and rewriting of places, defining an ever-changing landscape, a narrative of its layering, a record of the many ways societies establishes

relationships with the territory they belong to, dwell in, and transform.

The drawback of the emphasis on the immediateness of perception in the definition of landscape is that the notions of history and historicity are notably absent in the ELC, victim of a 'presentist' attitude in the contemporary society, which tends to cut its ties to the past in favour of a rush to development (Tosco, 2021). Landscape however, as we have seen, is imbued with the past, despite being subject to change. Its specific kind of temporality accommodates past actions and transforms them into a material form to be perceived and handled in the present, so that the perception of the landscape also implies an engagement with its history.

Landscape as perception and heritage as historical testimony have long been considered as distant if not opposing concepts. Nevertheless, the spatial extension of the concept of heritage from isolated structures to their context and entire parts of the territory on one side, and the evolution of the notion and practice of landscape itself on the other, have resulted in a convergence of the two concepts (Fairclough, 2016). Common ground between heritage and landscape is being developed as they are increasingly understood as negotiated and processual entities, with representative purposes and identity values, worthy of preservation through actions of conservation, valorisation, and – this is the most recent add – management of change. Allowing change while acknowledging and preserving the inheritance of the past is therefore one of the most challenging tasks we are confronted with when designing for the future-proofing of our landscapes, currently under discussion in policy frameworks such as UNESCO's Historic Urban Landscape approach (UNESCO, 2011).

In this respect, the ELC provides fundamental guidance in stressing that landscape, being common good of the people, is the ground for dialogue and collective decision-making. On a political level, it becomes the privileged field to address the contemporary socio-environmental challenges and collaboratively shape the sustainable future of our territories. On a scientific and technical level, landscape emerges as an integrative field of practice where different disciplines can cooperate to elaborate visions and design solutions which can aspire to a more holistic, less sectoral approach.

3. Identifying the risks to reduce exposure and vulnerability

In recent years climate change effects have occurred most evidently as extreme floods and droughts. The intensification of these extreme events has highlighted the importance of managing natural resources through a multi-sectoral and multiscale approach and the need of reshaping the relationship between public space and the built environment. In the field of water management, for instance, several cities throughout the world have begun a trend of initiatives to become water-sensitive cities, promoting community education and government policies on water conservation, management, and reuse. According to UNESCO recommendations, present and future challenges require the definition and implementation of a new generation of public policies identifying and protecting the historic layering and balance of cultural and natural values in urban environments (UNESCO 2011). In this regard, the relationships between cultural heritage and the surrounding physical environment must be adequately addressed. The UNESCO historic urban landscape approach supports communities in their search for development and adaptation while retaining the features and values linked to their history and collective memory as well as to the environment, eventually providing assistance in managing and mitigating such impacts (UNESCO 2011).

According to the major international institutions, climate adaptation planning and policies are hindered especially by insufficient data and lack of knowledge on feasible adaptation measures (JPI Cultural Heritage & JPI Climate, 2022). For this reason, further research on adaptation strategies, knowledge generation and exchange, and stakeholder engagement all play a crucial role in managing the impact of natural and anthropic geo-hazards affecting cultural heritage and its surroundings (JPI Cultural Heritage & JPI Climate, 2022). The current trend, as requested by JPI Urban Europe's Strategic Research and Innovation Agenda 2.0, is to prepare cities for unexpected, non-linear events, while still ensuring maximum liveability for its inhabitants (JPI Urban Europe, 2019). To this end, the classification of risks is crucial since they occur in a variety of forms and with different degrees of severity. Approaches and methods used to assess vulnerability and risk range from global and national quantitative assessments to local-scale qualitative participatory approaches. A common base is the IPCC Sixth Assessment core definition of risk as the potential for adverse effects to human or ecological systems. A significant evolution and clarification compared with earlier assessments, is that risk applies to both impacts of, and responses to, climate change. Since the term risk refers only to negative ("adverse") consequences, to allow a broader and more value-neutral characterisation of climatic changes without prejudging whether specific climatic changes lead to adverse, neutral, or beneficial consequences, a more general concept of 'climatic impact driver' has been developed. The expression refers to "natural or human-induced climate events or trends that may have an impact (detrimental or beneficial) on an element of society or ecosystems". Risks can range from rare and catastrophic events to daily clearly observable, yet minor, threats (ICCROM, 2016). Risk classification is thus necessary to identify and optimise adaptation measures, prioritise preventive conservation strategies, and rehabilitate affected territories. In recent years, there has been a growing attention for integrating climate change adaptation and resiliency into policies, strategies and decision-making processes (van Veelen P.C., 2017) in which resilience results from cross-scale and cross-sectoral interacting processes of resistance, adaptation and transformation on various system levels (van Veelen P.C. 2016). Overall, adaptation responses related to risk-based classification involve: reduce hazard probability, reduce exposure and reduce sensitivity.

Vulnerability and exposure of communities, societies, or social-ecological systems are dynamic across temporal and spatial scales, and depend on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors. As highlighted by Cross-Chapter Paper 2 of the AR6 IPCC Report (IPCC, 2022), waterfront areas, for instance, face a much greater risk than comparable inland settlements because the concentration of people, economic and cultural activity, cultural heritage and infrastructure combines dynamically with coast-specific hazards. The IPCC's Climate Change 2014 report suggests two closely related categories for classifying risks that rest on waterfronts: climate-driven risks and anthropic-driven risks. Climate-driven risks for waterfronts include (IPCC, 2014):

- Sea-Level Rise;
- Storm surge and extreme weather events (increase in frequency and intensity of extreme weather events);
- Erosion and coastal degradation (loss of beaches, dunes and protective coastal ecosystems and natural barriers, infrastructure damage) that can also result in reduced resilience to future climate impacts;
- Hydrogeological instability;
- Salinisation of freshwater resources: as sea levels rise, salt-

water intrusion may become a concern for urban areas that rely on freshwater sources near the coast. Salinisation of freshwater resources can impact the availability and quality of drinking water, agricultural activities, and ecological systems;

• Heatwaves and urban heat island effect, as urban waterfronts are often highly urbanised and the significant presence of concrete and asphalt absorbs and retains the heat.

Indirect related risks include: disruption to infrastructure and services (floods, storms, and other climate-related events can damage transportation networks, power grids, sewage systems, and water treatment facilities; ecological impacts such as habitat loss, reduced biodiversity and ecological imbalance); existing community abandonment and retreat; cultural heritage damage.

Anthropic driven risks include (IPCC, 2014):

• Soil consumption and soil sealing;

• Pollution;

• Tourism pressure (increase in users' fluxes; gentrification, ecc.).

Adaptation and risk management policies and practices are expected to be more effective if they take into account the dynamic nature of vulnerability and exposure (Cardona, O.D., et al., 2012). The common decision-making process to plan for an uncertain future is based on the prediction of a future state (or multiple states) and the design of plans or projects for the conditions of that state (Hallegatte et al., 2012). In scenario-based planning approaches, scenarios are used to analyse the effect of plausible futures on short-term decision-making processes and prepare adaptation strategies for the conditions of that state (Walker et al., 2010, Hallegatte et al., 2012). Approaches that have been developed include scenario planning, exploratory scenario planning and backward planning, or back casting, in which a preferred future state is defined and used to identify operational goals backward to the present situation (Hooimeijer et al., 2001). These approaches share the assumption that the future, although uncertain, can be explored by developing potential futures based on extrapolations of past long-term trends.

To effectively incorporate resilience into urban design and planning of coastal waterfronts it is necessary to understand under what conditions the system is no longer able to recover and needs to adapt. Several researches have explored to what extent climate adaptation and resilience can be integrated into processes of urban development to enhance resilience at relatively low costs. For instance, designing for adaptation in waterfront areas

requires understanding causes and character of several types of flooding in terms of probabilities, duration, depths, water quality (i.e. salinity) and velocities (Jha et al., 2012), as well as an understanding of the effectiveness of measures related to urban typologies, such as typology, size, age and construction of the building, and urban density (NYCDCP, 2013).

4. Developing sustainable strategies

The question we ask ourselves here is clear, even if it doesn't have a single answer: can we fight the anticipated consequences of climate change, with heritage protection in mind? And how?

Our framework for this question is linked to a series of strategies to be undertaken with diversified approaches at multiple levels and simultaneously. We mention here four of them: the institutional level with guidelines and policies; the procedural level with funding and legislative provisions; the planning level with more sensitive design approaches to incorporate resilience; and finally, on a cultural level, through the diffusion among the communities of new awareness.

4.1 FIRST: Guidelines and policies at the institutional level.

The framing for the question we pose here is particularly linked with the UNESCO guidelines that regulate local national policies regarding action on the heritage of cultural and architectural interest, in the current scenario of climate crisis and forecast of rising water levels.

Climate emergency has become a significant topic in urban, landscape and architectural heritage policies and many international policy efforts have already been undertaken to solve several important problems we are currently grappling with. UNESCO has been addressing the issue with a broad gaze since many years. Starting with the 1972 World Heritage Convention, UNESCO brought together, in a single document, the important concept of nature conservation and conservation of cultural heritage. The Convention recognised how people interact with nature and the fundamental need to preserve the balance between the two. Certainly, the threats of climate change in 1972 were not yet so clear and the Convention limited itself to questioning the anthropic nature of the degradation and destruction of the world heritage.

Over time, UNESCO has periodically updated its operational guidelines for the implementation of 1972 Convention, aware of the broader threats posed by global warming, driven by growing concentrations of greenhouse gases in the atmosphere and by

deforestation. A first revision dates from 1977 and others have followed over the years, also implementing a useful database (State of Conservation, SOC) for monitoring the various changes in different contexts.

International organizations, on another hand, seem to have a lack of, or at least a weak, perception of how much climate change is a “threat multiplier”: initially registered as an environmental issue, it has proved to be untangled from its social consequences, such as, for example, extractive capitalism, mass consumption and governance failures, which give rise to wars and episodes of terrorism, migrations and deliberate destruction of cultural heritage.

The real change can happen when we stop considering the effects of climate change as “simply” natural and recognise that it also involve social mechanisms of impact.

4.2 SECOND: Legislative and financial drivers.

Cultural heritage is a precious and irreplaceable record of human activity and provides a tangible link to the past, connecting intangible stories with people and places. Cultural heritage also provides many social benefits, environmental well-being, feelings of identity and stimulation for community engagement, learning, leisure, and recreation. These benefits represent a value that we must not only protect but also increase, with the necessary legal and funding provisions. In fact, cultural heritage is strongly linked to economic and touristic activities and its preservation also entails significant social benefits for the communities. However, while statutory provisions provide a fundamental juridical basis, they fail to ensure the physical protection to the assets. This must necessarily be supported by adequate funding and procedures to make desired interventions operational, guaranteeing their implementation, maintenance, management and monitoring over time.

The challenge we face now requires developing management strategies, actions, treatments and interventions that respond to the impacts of climate change for specific landscapes. And, for that, it is essential to adopt a new organisation attitude to ensure a territorial planning approach for the protection of cultural heritage rather than a traditional untidy conservation approach. This is possible through a more comprehensive and accurate understanding of the relationship between cultural heritages, landscape resources, and social environments.

4.3 THIRD: Planning and design to address climate change

To understand climate change, it is essential to perceive it, not only as a threat, but also as an opportunity to activate a closer dialogue with environment. Consequently, it is also necessary to renew our approaches in territorial, urban and landscape planning and to put into practice an evolution of cultural heritage concept. It is also important to bring the existing gaps and redefine cultural heritage from a dynamic and territorial planning point of view, not only for its protection against climate change, but also for emergency preparedness and disaster risk reduction. This means operating on a territorial scale to identify the available resources, to prepare the networks of connection among the cultural heritage, natural, environmental, and landscape resources.

We can do it through stewardship, as a set of actions from ongoing preservation and maintenance, to repair and replacement in-kind, having in mind that deteriorated resources are more vulnerable to further degradation than those maintained in good repair with healthy growing conditions.

We can also implement adaptation and mitigation strategies. Adaptation is the process of answering the question of what is to be done about the specific situations. It requires one to identify a range of options and test them within a variety of hypothetical scenarios, from national policy to managerial on-site decision making.

Adaptation strategies can use all the innovation potential that our cultures have implemented over time, but also draw on the traditional and holistic knowledge that local communities have sedimented. Local potential for problem-solving, which rests upon the application of methods rooted in intangible cultural heritage can support modern resource management. An example of adaptation is the Dutch “Room for River” Program aimed to improve the safety of delta areas, through hydraulic engineering and landscaping operations. As we well know, the risk of flooding in the Netherlands is steadily increasing because the floodplains of rivers are shrinking. The water level is also rising because rainfall is more frequent and more abundant.

In order to lower water levels in rivers, the Netherlands is increasing space for rivers in many different locations. For example, moving dams further inland and building high-water channels, or in other cases lowering floodplains to flood them during periods of high-water levels, thus temporarily giving the river more room and easing the pressure on the levees.

The interventions are technologically innovative and are not limited to engineering solutions, but always incorporate the creation of usable public spaces. Therefore, they also contribute to

increasing the quality of people's experiences.

Mitigation too, addresses the reduction of greenhouse gas emissions and the overall environmental footprint around cultural heritage. The activity in this area has focused on the historic built environment and cultural landscapes, since historical buildings and landscape maintenance can be energy intensive, while archaeological sites are generally not. In some cases, cultural resource managers have recognized that cultural heritage can assist carbon mitigation efforts, given that historic houses and landscapes often had to incorporate passive environmental controls that managers can identify and restore.

In terms of research projects focused on climate mitigation from the point of view of cultural heritage, it is worth to mention the project Footprints of Monumental Structures, Landscapes, and Buildings (ReFoMo 2017) involving Dutch, Spanish and Italian partners. ReFoMo investigates the carbon footprint of cultural heritage and generates strategies to reduce such footprints. ReFoMo also examines the level of demand for climate-based refurbishment of cultural heritage structures as well as the barriers to achieving reduced carbon footprints within these cultural heritage resources. The ReFoMo website contains many of the results of this ongoing project in publicly accessible form.

Another solution for mitigation can be offered by the creation of a green and blue infrastructure network. These have the objective of restoring and enhancing natural ecological networks in order to satisfy many functions that go beyond environmental issues as a tool for sustainable territorial development, providing ecosystem services to communities.

Blue and green infrastructures are defined as a network made up of networks: the ecological and water networks, the network of peri-urban and extra-urban rural spaces, the network of cultural heritage and leisure services and, finally, the slow mobility network that integrates pedestrian, cycle paths, and dedicated lanes for public transportations. In this way, green and blue infrastructures not only constitute a network of connections capable of recomposing fragments of the contemporary metropolitan areas together, but also determine a network of permeable and semi-permeable spaces. Their main characteristics can be recognized in their multifunctionality, their connectivity and their multi-scalar approach. Added to these are those of contrasting the waterproofing of the soil by facilitating the penetration of water and thus contributing to the defence against hydraulic risks.

Green and blue infrastructure design integrates with other closely related approaches in the field of green design at different scales, such as nature-based solutions and ecosystem services. These approaches share a theoretical and operational background consistent with the conditions required by climate change and can contribute to defining a methodology to support territorial, landscape and urban planning and design. They require nature-based solutions considered as design approaches that are inspired by nature and derive their own operational support from nature: their usefulness is the ability to provide both environmental and socio-economic benefits, helping to build resilience.

4.4 FOURTH: Spreading new awareness and involving communities

Making possible adaptation and mitigation measures requires an intricate combination of policies, guidelines and approaches to planning and decision-making, but real communication work is also needed. Communication incorporates efforts to share information in a meaningful and useful way, both among asset managers and with the public.

Understanding how stakeholders value cultural heritage will be a key factor in designing climate resilience policies and protection objectives. Cultural landscapes, like all cultural resources, continue to experience the many impacts of climate change. Such valued places benefit from a concerted effort to understand these impacts and respond to the management challenges of protecting them now and for future generations. This requires the joint work of a team that integrates a diverse range of skills, including urban planners, cultural landscape specialists, climate scientists, historic preservationists, ecologists, biologists, resource managers, historical architects, material conservators and others; theirs is the task to directly tackle what may often be an uncomfortable level of uncertainty. The work of researchers, at this stage, is essential, not just to intervene in specific cases in a calculated and safe way, but specially to bring new ideas, more transdisciplinary, more accurate and more creative to undertake such a sensitive matter, as heritage in a climate crises scenario.

These crises that we are dealing with is a severe threat to the long-term conservation of the values of heritage sites. And cultural heritage is a valuable, and irreplaceable, record of human activity. Even if we must deal with the irretrievable or with what we have to let go, we have the moral ethics to register, study and try to preserve our memories shaped in historic monuments, buildings and spaces through our towns, cities and rural areas so

that our successors can look and feel them safely. Our heritage provides us with a tangible link to the past and connects intangible stories to people and places. It provides many social, well-being and environmental benefits, including a sense of identity and a stimulus for community involvement, learning, leisure and recreational activities.

Cultural heritage is intrinsically linked to economic activity. The preservation of heritage and the historical character of a landscape has a positive effect on communities, while the ways in which heritage is managed can lead to a better understanding of the effects of climate change in other areas.

Resilience is the ability to recover quickly from difficulties. As far as cultural heritage is concerned, resilience to climate change can be addressed according to three relevant aspects: resilience of cultural heritage, resilience of communities and resilience of places and the environment in general.

We must therefore implement community resilience. Cultural heritage affects the resilience of communities to recover from impacts or adapt to environmental changes associated with climate change. For example, parks and green spaces provide practical resilience by alleviating the heat island effect and absorbing surface water, but on the other hand they also contribute to health and well-being by providing physical, social and psychological benefits to people. Similarly, cultural heritage increases resilience by contributing to the rooting of people and the development of feelings of belonging capable of implementing and spreading care practices to reduce the vulnerability of people and places.

Decision-makers responsible for heritage assets and their future management are facing increasing pressure to accept changes that could potentially alter the historical characteristics of the assets.

In these cases, it can be helpful to remember the vital role that heritage can play within communities to understand that change and adaptation are often central themes in narratives that have allowed them to be continually used over the years.

Ultimately, we must remember that there is no heritage without people and that it is often the heritage of daily life that has the greatest importance for communities. Before focusing the question, it is useful to dwell on a double issue that particularly links architectural thought (and praxis) and the sea.

Notes

The paper was conceived organically by all the authors, nevertheless the section 1 has been developed by Bruno Monardo, the section 2 by Giulia Luciani and Elena Paudice, the section 3 by Tullia Valeria Di Giacomo and Livia Calcagni, the section 4 by Claudia Mattogno and Maria Rita Pais

1André Corboz, in The land as a palimpsest (1983), argues that the territory is the result of different processes through which the inhabitants continuously delete and rewrite the soil, similarly to ancient manuscripts.

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Learning by Portolans: Reading and re-writing the built coastline beyond the climate change and the threatening obsolescence

KEYWORDS:
Portolans, Coastline, Unacknowledged Architecture

Learning by the sea

Before focusing the question, it is useful to dwell on a double issue that particularly links architectural thought (and praxis) and the sea.

Architecture of the sea (the art of ship building) and architecture, so to speak, of land (the "real one") have always been linked by a double thread throughout the course of history. And, indeed, much of the accumulation process of architectural knowledge, especially in its more technical and operational aspects, descends from the experiences of nautical design.

This was, essentially, because at sea man had to be able to avail himself of the most avant-garde solutions to guarantee adequate chances of survival and effectiveness in his missions, unlike the quieter life on land, in a hut or a cave. It is no coincidence that the etymological genesis of the term "architect" includes the prepositional particle "archi" ("ἀρχι-" in ancient Greek), that means "chief", denoting a degree of superiority, both hierarchical and in thought, and from "tect" ("τέκτων"), which primarily means "carpenter", "axe-master" (in Sanskrit, "taksh-anam" is "to dig with an axe"). A knowledge and technique, therefore, that have much more to do with the ancestral hollowing out - the creation of space by subtraction - of logs to transform them into pirogues (vessels) and with the skilful manipulation of wood to build the planking of a galley, rather than with the construction of foundations and the raising of a building by juxtaposing stone ashlars, blocks or bricks (Antoniadis, Bertolazzi 2021).

Secondly, it is useful to remember that the sea, especially the Mediterranean, but also the ocean in many cases despite its vastness, is truly the public space that unites and mixes (Nunes 2019) our lives and communities. Unlike, on the other hand, mountains and even rivers, which have always divided rather than united (just think of the term "rivals" from the banks of a river, not the shores of a sea).

This is why, once again, even when it seems that a "new" threat is coming from the sea (i.e. the see level rise linked to climate change), it is always from it, and from these challenges, that further opportunities for disciplinary and social advancement are to be found, and will certainly be found. The not-so-difficult-to-

imagine condition of the architectures located along the coastline like ships of different sizes beached on the shoreline [figure 01] amazingly holds together these two ancestral components, the formal-technological learning and collective one, fostering an intellectual speculation on new forms of inhabiting and manage de territory (including in the hinterland) along a successful adaptive path.

Landscapes by the sea

By 2050 over half of the world's population will live within 50 km of major masses of water. If the present trend continued, over the following 50 years, such percentage would climax to more than 75% (Nunes 2019). Recently, the Intergovernmental Panel on Climate Change estimated that 680 million people currently live in the low-lying coastal zone and projected this number to reach more than one billion by 2050 (IPCC 2019). The population potentially exposed to coastal flooding due to sea level rise is projected, in 100 years, to increase by about 20% (IPCC, 2022). A phenomenon, in terms of quantity, according to which it is licit to recognize as a compulsory situation, and not of just an uncalled-for theoretical disquisition. The segments of coastline around the Mediterranean basin and the Portuguese Mediterranean coastlines[1] – though being graced with distinctive geographical characteristics – bristle with objets trouvés, ordinary forms and materials, "unacknowledged"[2] architectures, eyesores, many of which tourism facilities, impacting the environment, often enmeshed in complex issues of environmental risks and of devious and wavering territorial policies.

The nowadays seashore is not made up only by the elements of the historical and consolidated abacus. The vocabulary of objects scattered throughout the coastline has been considerably enriched. The coast silhouette is dotted with intermodal hubs, infrastructural junctions, power lines, pylons, antennas, construction cranes, quarries, landfills, smoking stacks, piezometric towers, hanging water deposits, silos, freight yards, shipyards, terminals covered by thousands of containers, immense docks, extensive car parks, airports, power stations…

That issue pose challenges to contemporary landscape planners, above all with a view to tone the recorded pervasive anthropogenic pressure on coastal belts.

The strategies for bringing back into play this vast contemporary coastal stuff, often declared eyesore, impactful, disordered, must draw inspiration from investigation practices such as those

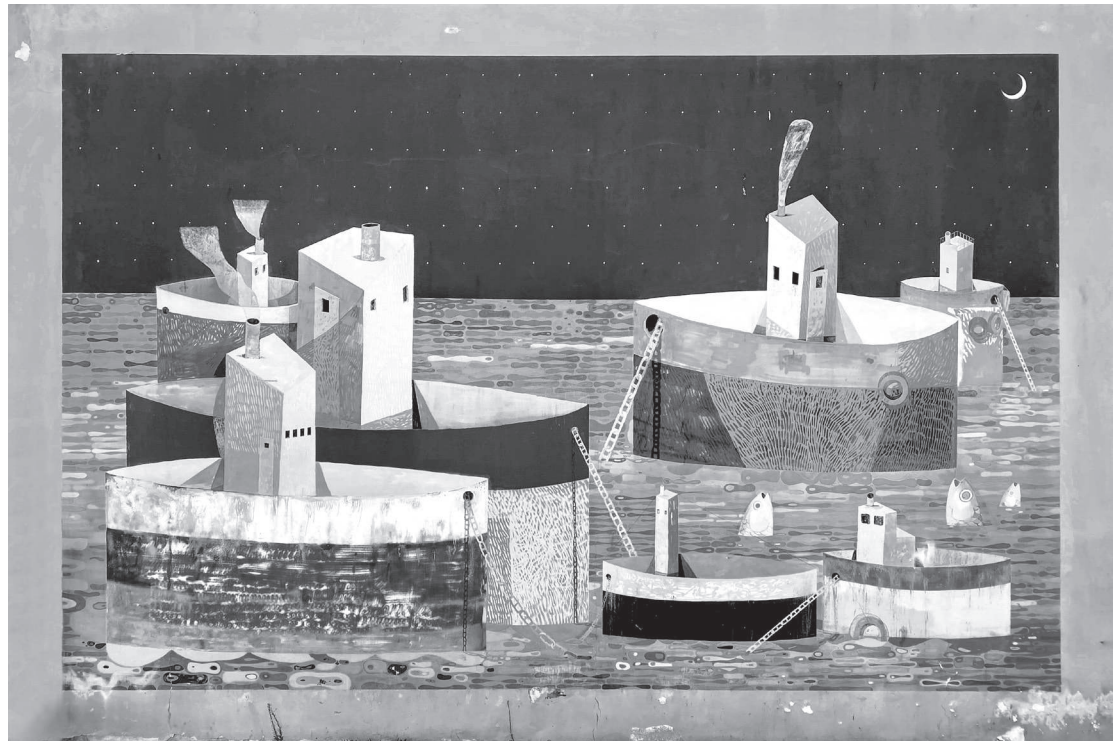


Figure 1 *"Floating cities or stranded ships?"* Street Art on the fish market wall of Vólos, Greece (Photo credits: S. Antoniadis, 2021)

typical of the nautical discipline, represented by the historical and event more recent pilot books, based on experience and observation, containing information relating to the regions to explore: preliminary and forerunner practices that transcended biases.

A portolan, that's the name for this kind of nautical chart, reports useful information for the recognition of coastal landscapes by hybridizing different kinds of representation, keeping together textual descriptions, geographical maps and drawings of coastal silhouettes [Figure 2]. In addition to containing information on dangers and obstacles to navigation such as shoals or wrecks; it counts indications to recognize the entrance of ports, for anchoring and any other information deemed useful for navigation and safety. In it, a medieval watchtower, a hanging water deposit and a spur of bare rock, seen from the water, have the same dignity as elements useful for navigation.

However, transcending the mere utilitarian aspect in the nautical field, we can't ignore the forerunner look on landscape treating all those natural objects and artificial elements by their most basic and true characteristic: they're forms contributing to the construction of a recognizable and transmissible landscape, identity and knowledge. A common ground for the pursuit of a shared, public and cultural heritage.

There is in fact the multifaceted topic of creating – or rather regaining – the Public Space from the reuse of infrastructure, of decommission of facilities, of vacant, abandoned or seasonal

Figure 2 *Portolan of the Iberian Peninsula*, from Portolano Catalán Anónimo, perhaps from the workshop of Cresques Abraham (drawing, approx.1400. Credits: Wikimedia Commons)

architectures, also including those spontaneous processes of reconversion of second homes or hotels into residences, which are transforming seasonal tourist contexts into real cities.

Especially at this time there is a lot of debate and research efforts about the phenomena, reinvigorated by the Covid-19 pandemic, of the smart workers and digital nomads, who clearly often choose the coastline as a congenial and pleasant habitat for their existences, together with the dynamic of the retirement stay in certain European countries as Spain and Portugal which need of course the presence of permanent activities, community services and territorial protection.

All these instances are requiring updated territorial governance tools. The study of the re-asses seashores could bring to the notice of owners, decision-takers, tourists and citizens in general the topic to avoid systematic obsolescence, total demolitions, waste production, or the whole displacements of volumes, and improve an active awareness of the contemporary landscape.

Coastal challenges among post-pandemic reboot and climate change

Nowadays the will to restart after the pandemic provides for strong and coordinated initiatives of financial injections for the revitalization of the affected assets. For this reason, there is no doubt that a speculative reasoning on the formal – and paradigmatic – aspect can amplify a qualitative and sustainable transformation effect of the entire built seashore.

Another critical issue to take into consideration, as well as an actual incognita for any promoter, is often the regulatory one; in this junction it is unthinkable to ignore the directives for the containment of the effects of climate change, especially sea level rise.

The European Union produced The Floods Directive, which «requires Member States to engage their government departments, agencies and other bodies to draw up a Preliminary Flood Risk Assessment. This assessment has to consider impacts on human health and life, the environment, cultural heritage and economic activity» (EU 2007). In Portugal there are already fears of bills no longer allocating economic compensation to owners who will not move their built volumes beyond a certain safe distance from the shoreline after the 2050. In these changing times in which the consolidated urban planning laws presents a non-negligible level of uncertainty, it is better to focus on more immune to sudden changes scenarios. What will be done with all the coastal buildings at risk? Is it at all possible to hypothesize the demolition

of a great amount of buildings along the coastal areas? How to manage the clearing out and hoarding of further billions of square meters of hardly recyclable rubble? Is it financially sustainable? Is it culturally correct? Downstream of these arguments, "acknowledging" the existing built coastline, both in terms of recalling/inventing a sort of heritage component and its effective reusing potentials, can antidote to obsolescence and reduce the number of constructions to be demolished and, therefore, the production of waste (of which the building process is the first cause) [Figure 3].

The strategic guidelines identified by the European Union for 2050 have established the redevelopment of the building heritage as the main objective for the entire construction sector, with a radical impact on land management, the training of professionals and the awareness of property owners.

The recent crisis due to the Covid-19 pandemic, could also represent an opportunity: the financing injections for the economic recovery to rethink and invest in significant redevelopment actions. The challenge is instead to attempt a theoretical and cultural operation of rethinking the opportunity as the occasion not only concerning mere problems of technology and energy-management (most of the economical bonus initiatives for the transformation of the existing building stock are declining into mere thermodynamic compliances), but also the entire paradigm of inhabiting, with formal and experiential repercussions. The goals will be applied hopefully to even more impactful categories of the existing building heritage to pursue and extend strategies to improve the life quality in the transition process carried out by the European Union through the measures of the "New Renaissance" (EU 2009).

Figure 3 *Demolition of the eyesore of Punta Perotti* (APR 2nd, 23rd and 24th 2006), Bari, Italy (credits: Wikimedia Commons, 2006)

The climate change universal critical issue seems to be the main incognita for any stakeholder and promoter investing in property along the coast. In this junction it is unthinkable to ignore the directives for the containment of it effects, especially the intensity of precipitation and the sea level rise or, in any case, of the feared interaction with water along the thresholds (in truth, nothing new under the sun since St Mark's Square in Venice has been remade and raised seven times over centuries). A major awareness of the climate metabolism together with some contemporary green trends have spawned a series of regulations that will influence for sure land planning and management practices.

New scenarios among wrecks and ruins

With certainty, much of the infrastructure, "pieces of engineering", architecture and in general buildings along the coast will meet the irreproachable fate of ruin, or of being partial ruins, or ruins at certain seasons of the year or handfuls of years (in fact, we know that the width of the coastal threshold varies with seasonality).

However, if we look at this phenomenon of ruin as an opportunity instead of a problem, it could open up interesting speculations that, in fact, belong to all architecture itself, but which becomes even more interesting when it comes to sea wreckage. First of all the condition of ruin frees a construction from function, paradoxically making it easier to manipulate the object, both in physical terms (with more or less necessary interventions) and especially in psychological terms (of re-signification, before reuse).

Normally, the unwillingness to overcome the function and abstract the form of things, which end up being defined according to their functional call, leads to a corresponding inability of the buildings themselves to adapt to new features and new lives. In this unusual – though easily understandable – Sapir-Whorf[3] hypothesis applied even to the built realm, the destiny of buildings seems to be unsplittable from the language describing them, piling up cognitive and manipulative staples that condition any possible future re-purposing. And once again ships come to our rescue: vessels change their names a thousand times during their life cycle, but never incorporate that resistance to transformation and their oneiric component, unlike the building as "former-" plus the name of what they have been or have produced, which accumulate inertia among their building stones, betrayed by this established urban cliché of naming, which affects any eventual and subsequent reuse or rethink. And, along with ships, portolans: a sunken

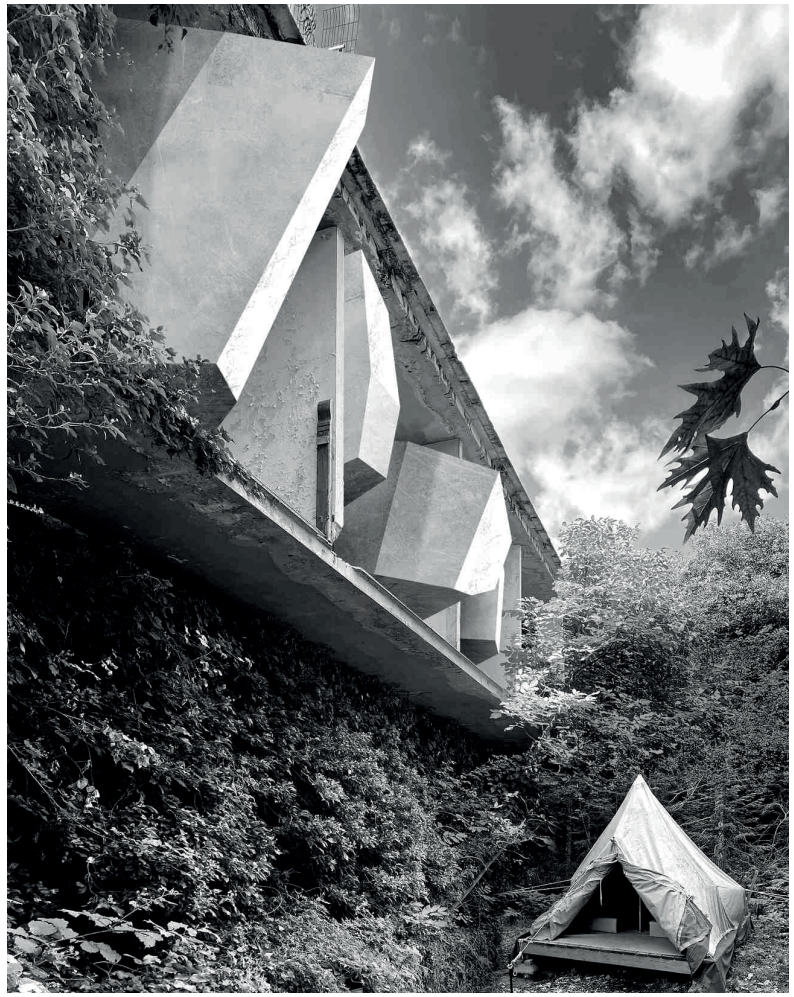


Figure 4 *Good Morning Eyesore*, Unfinished Hotel in Alimuri (demolished on NOV 30th 2014), Naples, Italy (Photo credits: photomontage by S. Antoniadis, 2022).
Figure 5 *Concrete Vaca[c]tions #1*, subversive tourism paradigms in an abandoned Mediterranean coastal eyesore (Photo credits: photomontage by S. Antoniadis, 2021)
Figure 6 *Concrete Vaca[c]tions #2*, subversive tourism paradigms in an abandoned Mediterranean coastal eyesore (Photo credits: photomontage by S. Antoniadis, 2015)
Figure 7 *Hypostyle Hall Temple of Ancient Greece*, reconstructive hypothesis (drawing by I.N. Tráulou, 1930
Figure 8 *Contemporary Temple*, decommissioned cod liver oil warehouse in Ginjal, Almada, Portugal (Photo credits: photomontage by S. Antoniadis, 2021)
Figure 9 *Athena in a Shed*, statue of the Greek Goddess in a decommissioned port storage (Photo credits: photomontage by S. Antoniadis, 2021)

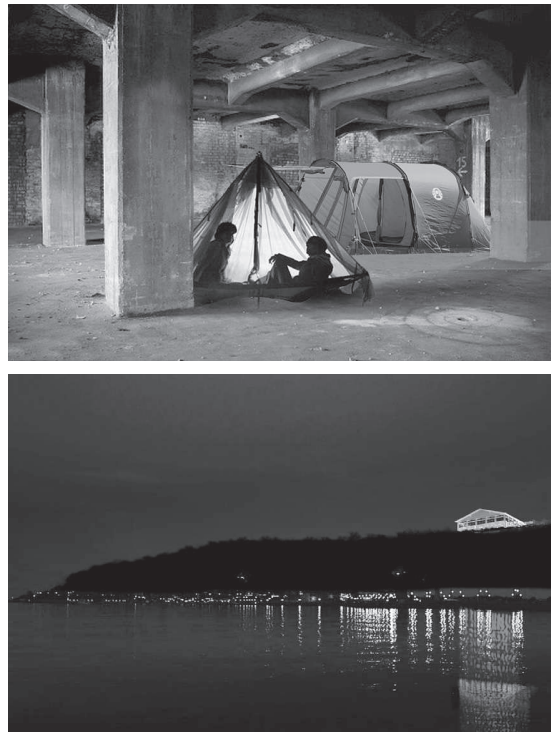
ship is no longer a tragedy, but is coded as an object to pay attention to, an underwater oasis, artificial reef, or simply an outcropping element on a par with a rock, and therefore a landmark. they

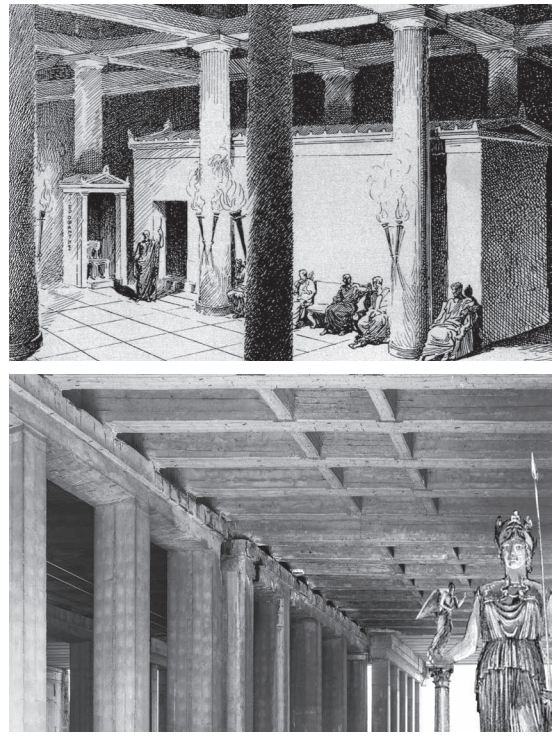
With the same impulse, not only figurative, these charts invite us to carry out operational censuses also of the architectural and infrastructural wrecks of the inland, applying the same pro-active gaze to the decommissioned buildings lying not necessarily on the coastline, in a virtuous process that also regenerates the inland areas from the sea.

This metaphor – actually more than a metaphor: a real process–could inspire new types of interventions (Antoniadis, 2018) for colonizing and reactivating the at-risk coastal built stock, averting the obsolescence of artefact products and the proliferation of demolition debris.

Starting from the layout of the simple elements of the composition, but also from basic types of accommodation, such as that of the campsite, cells or camping tents, it would be possible to re-organise them according to formal configurations consistently and suitably, depending on the case studies. Such transformations are meant to enact a new, flexible spatial set-up that can be applied in different ways, depending on the features of the context[4] .

Tents, pulled-aground boats, containers, insulated cells [Figure





4] – and in this challenge the segments of knowledge covered by the research project come in handily –, corroborated by tangible and intangible services[5], can constitute parasitic and surprising architectures capable of suggesting the traveller an active awareness on contemporary landscape

Let's imagine what it might mean to repopulate existing concrete skeletons, from small basic to large eyesore unfinished buildings, from the ruins of hotels and eyesores to the obtained structural frame of those constructions that fall within a future flooding threshold (for which it would make no sense to envisage a typical retrofit intervention because at risk) [Figure 5 and Figure 6].

The cave of an incomplete residential building, such a typical presence on the Mediterranean coasts of southern Italy and Greece is none other than the contemporary hypostyle hall, so similar to the one in which ancient story tellers and travellers went to steal the truth from an oracle [Figure 7].

The concrete slab of an eyesore along the coastline is nothing more than the brutal, artificial and squared raised platform from which the Magna Graecia colonists plunged directly into the swollen sea of a cove[6]. A decommissioned and ruined cod liver oil warehouse of the last century simply illuminated (such a low-cost operation!), becomes a temple and a landmark for the passengers of a cruise ship that slowly glides in front of the city of Ulysses[7], working as a trigger for the regeneration of a totally unacknowledged riverside segment [Figure 8 and Figure 9].

These are just some of the visions that could stand out as subversive, but which interprets much more deeper the meaning of our histories and geographies, avoiding the usual recourse to the picturesque and to the (invented) vernacular, in a counter-intuitive reading of the phenomena and in a counter-plan answer to benchmarked regenerative solutions. Beyond the not-so-enticing built coastlines, decommissioned, underused, obsolescent and at-risk coastal facilities, lurk opportunities, hospitality and identities requiring updated territorial governance [Figure 10].

Figure 10 *S'adapte et résiste...*, Matco. Mobilier pour collectivités' advertisement (Photo credits: Nouvel Environment, 1969).

Notes

1 Orlando Ribeiro, a well-know Portuguese geographer of the 20th century, supports the thesis of a Mediterranean Portugal for those areas in which where certain tree species grow spontaneously. He considers the parameter of the presence of olive trees as a necessary condition to define a territory geographically and culturally "Mediterranean", starting from the scientific consideration that there is only one other non-Mediterranean country in the world that produces moreover in insignificant quantities, olive oil. According to this parameterization, Portugal falls within the Mediterranean sphere for that southern and central part up to the first northern districts, crossing which one effectively feels to have passed the continental-Atlantic threshold.

2 The expression "unacknowledged"constitutes the key word and semantic basis of many other research works regarding the reading of dismissed and fallen-in-disrepair buildings started with "Beyond Unacknowledged Lines - Landscape, Infrastructure, Urban Regeneration", a cycle of seminars held at the School of Engineering of the University of Padua from Feb to May 2013 on the topic of up-cycling of the existing city (Scientific Board: Luigi Stendardo, Stefanos Antoniadis, and Luigi Siviero) and continued with the author's PhD Thesis "The Form of the Unacknowledged Built Coastline: Objects and Informal Settlements along the Mediterranean Waterfronts between Geography, Landscape and Architecture." (DRACo PhD Programme, Sapienza University of Rome and *formaurbis* LAB, FA PhD Programme, Universidade de Lisboa (supervisors: Luigi Stendardo and Carlos Dias Coelho), Feb 2017, and further postdoc research projects (ROP ESF DATA_Developing Abandoned Transurban Areas, 2017-2018; ROP ESF iWRECKS_Industrial Wrecks: Reusing Enhancing aCKnowledging Sheds, 2018-2019, P.I. Luigi Stendardo for both).

3 The Sapir-Whorf hypothesis holds that human thought is shaped by language, leading speakers of different languages to think differently. This hypothesis has sparked both enthusiasm and controversy, but despite its prominence it has only occasionally been addressed in computational terms.

4 i.e. the outputs of the International Summer Workshop "TOURISM HABITAT. The Reuse oh the Abandoned Xenia Hotel in Tsagaráda, Pelion", held in Vólos, Greece (30.08.2021 – 04.09.2021) at the Department of Architecture (TAM) of the University of Thessaly (UTH) in the framework of the Regional Operative Programme (ROP) funded by the European Social Fund (ESF) 2014-2020 "S.O.L.E.H. - Sustainable Operation Low Cost Energy for Hotels" (P.I. Angelo Bertolazzi), DGR n. 1463, 08/10/2019, cod. 2105-0014-1463-2019.

5 One of the most sensational suggestions comes from Archigram's vision LAWuN Logplug & Rockplug devices (1969) by David Greene: connections to the global network, in an earlier era, hidden in fake dry branches and rocks. Nowadays it is not even necessary to resort to these sets, but it would be enough to install a simple and small modem/router on the various floors of a building skeleton.

6 Compare the Tomb of the Diver large-scale Greek painting on the travertine covering slab (Necropolis of Tempa del Prete, Salerno, Italy, 480-470 b.C.).

7 Lisbon (Odyssepolis - Ulyssippo - Olisippo - Olisipona - Lisabona - Lisboa is the etymology evolution of the toponym).

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Heritage Waterfronts and Well-being Strategy for a Dynamic Urban Transformation and Place Value

Introduction

This contribution presents the notion of health and wellbeing that reflects a decision to accommodate dynamic transformation (protection, regeneration, accessibility, active travel for health and well-being) in sensitive heritage waterfront context with associated place values. To this end, it is essential to define a Waterfront Urban Space (WUS) as "a dynamic space to be transformed with evidence to improve health and well-being"[1] . In better defining a WUS "it should be taken into consideration the concept of inclusiveness of an urban space and its transformation towards a place in order to receive sociability and enjoyment, to integrate local cultural and economic values, to promote health and well-being in accordance with urban resilience and urban quality" (Babalis 2020:20). Specifically, waterfront urban spaces with a great potentiality for regeneration must follow specific urban strategies. On the other hand, proposed project methods to design must be based on ecological, sustainable, and smart design solutions. It is recorded that consequences of good decision-making and appropriate local actions can lead to the quality of blue-spaces and can contribute to well-changed urban scenarios. A key consideration is on how heritage waterfronts can identify appropriate strategies to manage change and processes of transformation (Babalis 2019).

Recent studies consider direct links between greenspace and human health and well-being. Newly, there is an emergent body of work which evidences the health improving properties of blue space, generally defined as green-blue space, by providing: Spaces for physical activity and recreation; Spaces for social interaction; Spaces for psychological restoration and stress reduction. The benefits of greenspaces as places that promote stress reduction and mental restoration; as opportunities to increase physical activity, socialization and improved environmental quality have been established for some time (Babalis, Townshend 2018:10).

The purpose of this text is to tentatively respond to the following questions: How to create a common vision on waterfront regeneration? How to create a greening strategy to be used for a well-being strategy? How to develop urban design criteria to optimize accessibility and mobility along and to the waterfront?

How a WUS can be a space-connector within the city and at the same time being an element for climate change and for hazard protection? How to develop a 'well-being behavior' especially for children and the elderly? (Babalis 2020).

The chapter is mainly focused on the UNESCO Florence Riverfront considering the great potentiality of the river Arno that can effectively maximize urban regeneration and recreational potentiality for health and well-being. This sensitive waterfront context can be great challenge for future master planning, specifically with proposed sustainable urban frameworks and schemes for protection, accessibility, quality, and well-being; for change with walkability and cycling activities with new blue-green open spaces for health and well-being such as: parks, gym spaces, urban farming and so on. A Well-being Strategy is proposed that considers several waterfront sections under specific planning and design principles for a more active and resilient riverfront to future events. Finally, knowledge, awareness, temporality, design quality, place value are the key words for an appropriate and meaningful management of a sensitive riverfront context that can strive to prioritize human well-being.

Cultural and Natural Heritage: definition and evolution

Within the UNESCO Convention (UNESCO, 1972: Art. 1,2) has been clearly defined the notion of cultural and natural heritage including monuments; groups of buildings and sites[2] of outstanding universal value to be preserved, protected, and rehabilitated. In turn, to ensure effectiveness and active measures to be taken for the protection, conservation, and presentation of the cultural and natural heritage (Art.5) is fully recommended the adoption of a local general policy and integration of cultural heritage into comprehensive planning programmes to be encouraged by scientific research in this field. More recently, the UNESCO Recommendation on the Historic Urban Landscape, (2011), the expanding notion of Urban Heritage includes concerns of the changing global environment and concept of landscape (Bandarin and Van Oers 2012) possibility to manage environment more sustainably within effective planning and design to achieve quality of life and improvement for health and well-being. Central to the HUL process an urban environment can be considered as a lived space with variations in time and space (Ginzarly et al 2018).

The 2030 Agenda for Sustainable Development (UN 2015) adopted by all United Nations Member States provides 17 Sustainable Development Goals and 169 Targets to be used as a basis for urban and community development and as a baseline when creating visions and developing methods and design principles according to the three dimensions of sustainable development. Specifically, Goal 11: "Make cities and human settlements inclusive, safe, resilient and sustainable"; Target 11.7 "Provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities". Furthermore, the Goal 3 attempts to: "Ensure healthy lives and promote well-being for all at all ages ensuring good health and promoting the well-being of people demonstrating the timeliness, relevance, and importance of the topic".

The World Health Organization (WHO) formulates health as "a state of complete physical mental and social well-being and not merely the absence of disease or infirmity" (WHO 2013). According to McDowell (2006:11), current understanding of health is about to consider health in terms of human survival to a current emphasis on quality of life. However, health-related behaviours are also formed in a person's social identity. It is becoming increasingly clear that health and well-being and specifically Subjective well-being (SWB) is the tag given by scientists to the various forms of happiness taken together. Subjective well-being, including happiness, life satisfaction, and positive affect, is influenced by both internal factors, such as personality and attitude, and external factors, such as the society in which they live (Diener 1984). Research studies have demonstrated that happy people are more likely to be healthier and live longer, to have better social relationships, and to be more productive at work. However, the focus on health and well-being it must be ensured on sustainable place transformation and in terms of sense of place, place attachment and sense of identity (Townshend 2022:118).

Carmona (2018:12) investigates on the importance of place quality for healthy outcomes by using scientific methodologies to explore the field. He underlines that well-designed places including greenery and landscape resources can contribute on positive health benefits in terms of: (a) Better physical health (lower obesity and reduced heart disease); (b) Better mental health (less stress and depression); (c) Better general fitness (increased walking, sport, and cycling) (d) Greater daily comfort (reduced air pollution, traffic noise); (e) Enhanced quality of life (increased happiness and emotional well-being). In addition, better place quality adds greater place value to their users.

Why a sensitive and dynamic transformation in heritage waterfronts?

A sensitive transformability is a strong point for city planning strategies and policies for protection within heritage waterfronts. Preservation and recovery of waterfront open spaces of outstanding universal value seems essential for urban quality and social integration in historic environment: (a) For more greening performance and well-being of open spaces; (b) For better use of technology/smart utility of open spaces. In recent evidence that urban heritage, changing lifestyles and pandemic priorities should be given to waterfront change.

Research findings[3] codified how placemaking strategies and projects in diverse waterfront open spaces can contribute to improving people's mental, physical, and social health. Natural environment can facilitate social interaction and reduce isolation. By increasing access to waterfronts: (a) For social support and interaction; (b) To play and active recreation; (c) To enjoy green-blue environment; (d) To walk and bike safety along the water, one can demonstrate how innovative ways of planning and design can maximize both quality of life and place value. However, to create healthy places is essential to having a measurable impact of placemaking improving health and well-being and revitalizing communities. Further, research studies outlined that the processes of creating good public spaces along heritage waterfronts can offer possibilities for adding permanent or temporary recreational physical activity while walking and cycling can help to improve physical mental and public health.

In this framework, a Decalogue for a sustainable transformation of heritage waterfronts has been formulated by the author as follows:

1. Re-shaping sustainably cultural and natural heritage

2. Facing turbulences of Local Authority

3. Overlapping patterns (urban/environmental/social/economic)

4. Appraisal of the site and considering the S.W.O.T. Analysis

5. Considering protection and preservation/local climate and sustainability principles

6. Adopting local policy and dynamic waterfront transformation (protection/regeneration, accessibility/active travel for health and well-being)

7. Identifying a Waterfront Urban Space for sustainable green-blue open space creation

8. Re-creating urban dynamics for a Well-being Strategy

9. Running with temporality to join people needs for health and well-being

10. Re-creating liveability, urban quality, and place value in heritage waterfronts.

Place and health: relationships

Over the last decades, a growing body of literature has emphasized the importance of place to people's direct health and indirect social and behavioural impacts. In defining active travel as "walking and cycling, and also includes some types of leisure activities that can act as a means of travel such as skateboarding and rollerblading" (Sport England 2015:78), the effects on specific places and attractive scenery such as parks, gardens, well-maintained sidewalks with trees, waterfronts and so on, are also associated with health benefits (Williams 2013). Further, active travel and the environmental factors such as connectivity, urban form, the provision of sidewalks and cycle paths have been shown associated with walking and cycling for transport (Panter et al, 2008:2). It is important, therefore, to understand how the environment in which we live, work and play interacts and influences public health and how these inter¬actions can impact the everyday life and can be favourable for the subjective well-being. This means that the value of roads, walk and cycle paths is intrinsically connected with public health (Harpen 1995).

In recent times there is an understanding of how policymaking by local authorities can take advance of place and health. Developing well-being strategies and design guidelines is a key to reach active design objectives such as: (a) Improving accessibility in terms of easy, safe access in sport and physical activity and active travel; (b) Enhancing amenity by promoting new sports and recreational activities; (c) Increasing awareness of creating recreational facilities and sport opportunities through masterplanning (Sport England 2015:3).

In the face of epidemic emergencies, the fields of urban planning and health must rec¬ognize the role of healthy environment in shaping public health and well-being (Babalis 2021: 26)

Heritage waterfronts, place value and health

To reclaim, promote and regenerate heritage waterfronts strategic masterplan for developing must been creating to reconnect people to the water. Waterfronts can pinpoint opportunities of varying scale to demonstrate improvement, transforming green-blue environment with recreational and sport opportunities for health and well-being. Lessons must be based on valuable criteria and guidelines, best practices for planning and design. "A Waterfront Urban Space must seize moments of opportunity and maximize potentiality of heritage assets by establishing optimal planning and design through consultation with local authorities, planners, and designers"[4]. However, along water edges such as riverbanks, shorelines, riparian buffers, water habitats are critically important for sustainable regeneration, stormwater management, when designing for public accesses, improving open spaces and recreational amenities, including green infrastructure and provision of ecosystem services. Connections to bring people to the water such as sidewalks, public streets, pathways can reinforce the waterfront public realm, re-creating connectivity to the surrounding context. Public activities and events should be taken into consideration for designing special places to accommodate the needs of active travel.

Specifically, within heritage riverfronts feature amenities can increase people's comfort and enjoyment. Amenities can help to establish a convivial setting for social interaction and a good use of place. Connected walkable destinations along riverfronts with a variety of activities can be a great challenge and a key element to attract people to the river on foot and bike. Landscaping can then define local character and protection with green stormwater infrastructures to connect urban environment to the natural one. Proper stormwater management can aid in preventing flooding, pollution and groundwater depletion while restoring the water quality and health of river ecosystems. The revitalization of heritage waterfronts can add value and life to the city and enrich 'sense of place'. So, place and health relationships can influence physical activities for better health and well-being benefits. However, researchers consider regenera¬tion of urban waterfronts a great opportunity for public health.

Florence UNESCO Area and the proposed Riverfront Well-being Strategy

At the current, planning and design for health is important to shape people's living environment and influences decision-making for new lifestyles. Local authorities should take responsibility to promote Active Design[5] by creating walkways, accessible green and blue spaces, safe roads to respond to current health issues. On the other hand, individuals must be aware about their own health and well-being. The way we approach active design for health of future generations is given by creating a healthy urban form, adaptable to urban changes. However, there is a growing body of research highlighting that it is possible to design the green-blue environment for positive health outcomes that will provide: (a) Opportunities for active travel (walking and cycling); (b) Easy accesses to public transport; (c) Social cohesion; (d) Health benefits from services and recreational facilities; (e) Clean air, water and soil and effective waste disposal. In turn, well-designed waterfront spaces can recreate connections, improve accesses to and along the water and places to enjoy and socialize.

Florence UNESCO Area appears of a great outstanding value and continues to experience significant change providing walking, cycling and social interaction. The river Arno has long recognised as a strong ecological, cultural, and social significance to the city's life. Over recent decades, the inner-city riverfront has evolved as the greatest natural asset to be preserved, but the substantial potential of this asset as a living environmental entity remains to be fully realised. Very little is planned for connectivity, recreational activities, and social cohesion. It is therefore clear that opportunities for walking and cycling, and the delivery of change can bring benefits in terms of the environment, tourism, health, and society. There is a need to regenerate and improve the riverfront urban spaces, not only to benefit local community and tourists but also the ecology of the river. Additionally, a key goal is to positively raise a healthy environment.

The proposed Well-being Strategy[6] and schemes are related to developing the river Arno and its edges. Referring to the above-mentioned, the way we design for active travel has been highlighted as the main goal to increase both young and elderly people's physical activity. Access to the riverfront environment is associated with numerous positive health outcomes, including improved physical and mental health while green infrastructure can increase quality of place and protection from risks. An expansive river-edge paved walk and cycle paths can create fashionable places with health-environment benefits including the following: (a) Place value to increase significantly and encourage social inter-

Note: All proposals and drawings in this chapter have been developed and coordinated by D. Babalis at the University of Florence in the framework of the Design Studio of the Degree Course of “Urban Design and Eco-sustainable Urban De¬sign”, (Academic Years: 2018-2019 and 2019-2020).

Figure 11 Lungarno Zecca (Google Earth Pro)
Figure 12 Masterplan
Figure 13 Masterplan’s Render
Figure 14 Fitness Area

action; (b) Riverfront for a stronger identity and sense of place; (c) More physical activity and recreation opportunities, particularly for walking and cycling; (d) Opportunities for visitors to extend their stay and enjoy the walkway; (e) Open space network for better integration and connectivity; (h) Riverfront protection and green infrastructure to mitigate flood risks and water rise.

The Strategy is proposed to be adopted, particularly, into the following seven riverfront's sections. To this end, every key site challenges should respond to specific planning principles as defined below:

_Lungarno Acciaioli-Lungarno Diaz. An Active Multifunctional Riverfront characterised by an urban character. This portion of the river is considered a key environment to provide a multidimensional walkability and a network of multifunctional riverfront open spaces to support sport and recreational activities.

_ Lungarno Cellini. An Active Riverfront to mitigate flood risks and promote physical walkability and cycling paths in this zone. The offering recreational areas can maximize sport activity outcomes and improving accessibility and amenity _ Lungarno della Zecca. A Landscaped Riverfront for leisure and flood protection to continue as a walkable parkland environment with landscape features, sport and fitness areas, piazzas for relax ready to be transform into water squares during a flood event.

_Lungarno Vespucci. An Active Riverfront that must encourage physical activity, mitigate flood risks with the creation of specific green infrastructures.

_ Lungarno Soderini. A Relax and Gym Riverfront with a highly valued context and well-designed urban contemporary landscape to improve smart urban transport, riverfront footpaths, relax areas and gym ways.

_ Lungarno Santa Rosa. An Urban Farming Riverfront to advocate for more improved pedestrian and cycling arrangements in the site; To encourage social interaction with productive landscapes (urban farming activity) and sport facilities.

_ Lungarno Cascine Urban Park. A Sport Riverfront for safe accessibility with floating walk and cycle paths; The site design offers a range of opportunities for sport, fitness and recreational activities that also can work for flood risk.

Places and spaces along the Florence UNESCO Area must have a distinct identity and offer a mix of active experiences. Looking to the future, the river should offer a greater diversity of activities for walkability, sport, and recreation.

At the current, there is a huge interesting on placemaking by studying features of physical and so-cial environments that promotes pub¬lic health. Research studies have shown that the interactions between waterfront urban space and health produce significant social and behavioural impacts. In addition, sustainable revitalization of heritage waterfronts can add enormous place value and quality of life in shaping physical and social waterfront landscape. Active community along heritage assets can generate a greater social cohesion, improved life expectancy to better update the policy process and better healthy places. Nowadays, the place value of adding water features to build environments or arrangements of natural water environment for mental health and well-being should be plenty recognised by planners, designers, and mental and physical health professionals (White 2010:429).




Figure 15 Lugarno Vespucci, Masterplan
Figure 16 Recreational areas
Figure 17 Workout area
Figure 18 Relax area



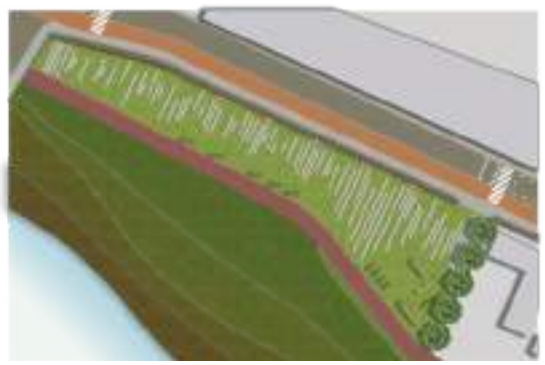


Figure 19 Lugarno Soderini
Figure 20 Riverfront relax area, Masterplan
Figure 21 Gym area
Figure 22 Renders of the gym area

Notes

1 The definition of the "Waterfront Urban Space", (WUS) is formulated and developed by the author in the fra¬mework of the ATE research titled: "Waterfronts and Eco-sustainable Urban Management" funded by the University of Florence, Years: 2017-2018.

2 Convention referred to Art. 1 and 2: "[…] natural heritage: natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view; […] natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty".

3 ATE Research. "Health and well-being for the Post Covid City, Funded by the University of Florence, Year 2021.

4 This is an extensive notion on "Waterfront Urban Space" (WUS) formulated by the author that follows up further research investigations and findings within ATE Research in footnote 1.

5 "Active Design is rooted in Sport England's aims and objectives to promote the role of sport and physical activity in creating healthy and sustainable communities".

6 The 'Well-being Strategy' has been developed at the University of Florence by the author in the framework of specific research and teaching activities to provide a multi-layered understanding of this complex riverfront environment. However, Strategy tries to define a Vision for the Florence city-inner riverfronts and seeks to offer planned responses in preserving, regenerating, accessing and shaping future proposals to and along the River Arno.

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Life Between the Cliff and the Sea
Post-Industrial Waterfront Heritage as a natural system: a comparative approach between heavy industry and local ecological, cultural and leisure systems in Fiume (Rijeka).

KEYWORDS:
Post-industrial Heritage, Waterfront, Ecology, Garden, Public Accessibility

"What is needed now is a transformation of the major systems of production more profound than even the sweeping post–World War II changes in production technology. Restoring environmental quality means substituting solar sources of energy for fossil and nuclear fuels; substituting electric motors for the internal-combustion engine; substituting organic farming for chemical agriculture; expanding the use of durable, renewable and recyclable materials—metals, glass, wood, paper—in place of the petrochemical products that have massively displaced them" (Hall, 1997).

Fiume's phenomena are characterized by its constant contextualization between creation and destruction, the inclusive and exclusive, the global and the local, and progress and collapse.

The city presents a rare fusion of conflicted identities from many political regimes, economic interests, a multicultural and multilingual community, social variety, and cutting-edge technology.

Its strategic location on the Adriatic coast has afforded Fiume a pivotal role as a world port and industrial powerhouse, that sacrifice the coastal territory for modernization since the early 18th century. Due to the demands of modernization, it has led to both cooperation and conflict between industrial infrastructure and the public realm, alienation from the city, and a dramatic topographical transformation, with notable examples of abandoned quarries, cliffs, and the filled-in sea area.

As Mrduljas points out: "This was a linear mechanized environment consisting of the port, refinery, torpedo factory, shipyards, and other industries. It was never meant to be 'human', to be a part of the city" (Minica et al, 2021). It prompts Barry Commoner's discussion of the environmental consequences linked to the imbalance between the circularity of natural cycles and the linearity of economic and industrial processes that operate independently of nature (Egar, 2002).

Today, the shipyard, the torpedo factory, and the oil refinery—the industrial enclaves[1] that occupy more than a third of the city's coastline, with their impenetrable accessibility, features of the last socialist modernisation, and the status of transition—operate under global investments, privatisation, local political and eco-

nomic speculations, heritage evaluations, and political-management principles.

The importance of this research, which examines the principles of socio-ecological reinventions of the productive process, integrated within the context of complex heritage-making and the ongoing alteration of Fiume's post-industrial coastline areas, is justified by the contextualization of the key issues.

The research focuses on constant natural and anthropomorphic transformations that have impacted the city on macro- and micro-levels, and the relationships between restricted/unrestricted, public/private, ecological/non-ecological, heavy/green, commodity/resource, and past/present/future.

This text aims to explain various possibilities for the regeneration of several kilometres of coastline, with case studies of three post-industrial areas: the oil refinery, the torpedo factory, and the 3. May shipyard, within the context of their existing settings and values of these post-industrial areas.

The case studies' proposals provide future-oriented socio-economic and environmental solutions to re-establish the industry's territorial, social, economic, and technological importance as a defining aspect of the city's identity [Figure 23]. Additionally, by drawing lessons from history, by comparative research the scenarios explore re-establishing a connection with the past as a potential future solution. Currently, the coastal area faces a lack of long-term planning for its overall re-programmatic development, with abandoned buildings left unused and invasive short-term investments and speculation occurring in "grey zones" within different status of protected areas. As a result, the area is left to decay uncontrollably without political vision or interest in its regeneration.

Informed by research results, the urban development strategy employs three theoretical concepts of gardens as a fusion of two philosofical principls: humanity and nature, that would reinvent the three abandoned post-industrial areas and the production process—with the aim of creating environmental solution and new coexistence of economic, leisure and social activities. Forming an environmentally and socially productive ecosystem, the new public, cultural, recreational, technological, and leisure production programmes showcase the re-establishment of relationships between nature, abandoned post-industrial structures, and the public domain, both in terms of heritage and socio-environmental solutions, as well as a reconnection with the city.

This paper addresses local and national authorities regarding the future development of Rijeka's waterfront, warning against a distinctly market-oriented society with the fact that these actions not only concern "the market itself, but it is like removing an organ from a body: veins, nerves, arteries, muscles are cut off; nearby organs cease to operate or are seriously disrupted" (Kes, 2018). The global tendencies of continuous urbanisation, spatial and social alienation, and the reshaping of land is done without considering environmental impact.

The objective of reprogramming, repositioning and abolishing production must be reinvented in the future, with awareness of the site and the context creating a new framework of a new post-industrial identity and climate change solutions, the outcome of its reinvention should be a more accessible public zone, a social environment with a high social impact, and an area of ecological, green production.

Past experiences, multidisciplinary approaches, and responsible public policies can address issues such as climate change, political accountability, new technological challenges, and living conditions for future generations, helping address the current environmental crises.

Mediterranean Garden vs the Torpedo Factory

"We can say that the planetary garden has nothing to do with globalisation. Although the scale of impact is the same, the planetary garden protects and develops diversity in all its forms, while globalisation erases it in the name of market forces. The standardisation of urban and rural landscapes is a result of the power of industry lobbies around the globe- why do we live in the same tower in San Francisco as in Shanghai?" (Clement, 2021).

"If you have a garden and a library, you have everything you need"[2], Cicero wrote to gardener Marcus Terentius Varro His sentiment emphasises the value of knowledge and beauty as found in nature, but which is excluded from the neo-liberal economic, scientific, and technological agenda. Stopping the exploitation of natural resources and the overproduction of non-recyclable products means we must respond to climate change immediately with responsible actions and the general formula of 'back to nature'. As Commoner states: "We must learn how to restore to nature the wealth that we borrow from it" (Commoner, 1980: 300).

The torpedo factory is a large industrial and infrastructural complex consisting of a port, a large factory complex with a torpedo launching site, residential and public park facilities and, formerly, a communal bathing area. The chaotic status of varied

ownership hinders a common solution, as do the objects' different statuses (e.g., cultural heritage), bankruptcy proceedings, dispersed ownerships, and short-term investments. These factors solidify the facility's status of stagnation, vulnerability, decay, and vandalism:

"Territories that arise as a chaotic and varied repertoire of infrastructure and unfinished, underutilised, or run-down public facilities; warehouses and industrial infrastructure built and soon abandoned because already obsolete or no longer responsive to market needs... Territory dominated by all that is anonymous, spontaneous, illegal, informal, and by the anarchic occupation and modification of the space of everyday life" (Marini & Corbellini 2016).

Re-establishing the idea of the garden as an important source of aesthetic pleasure, the production adapts to the new context

Figure 23 *Fiume - Back to the public, back to nature.* The proposal provides future-oriented socio-economic and environmental solutions to re-establish the post-industrial city's identity (Nika Bronic, 2022,)
Figure 24 *The Mediterranean Garden vs The Torpedo Factory.* Heritage, nature and leisure-oriented production and consumption, introduces an environmental-humanist solution. (Nika Bronic, 2022)

of transformation and 'repair' of the complex torpedo factory. The Mediterranean Garden can, through accommodation capacities and new types of leisure activities[3], provide the working and living environment with a new production process, multicultural access to resources and knowledge, and create a foundation for different social strata, an 'advanced society'[4], where tourists and locals alike can create a new local mutually beneficial economic cycle for common goods, one not focused solely on profit-driven models. A new opportunity for the Fiume to identify itself as a green tourist destination—and not just of transitions, "which has never been the priority of an atypical coastal city whose urban space is mostly dedicated to work" (Clement, 2021).

The aim is to re-use existing structures and protect heritage as a new perspective on Mediterranean gardening, which invites Clément's vision of the garden, "where the gardener is the 'guardian of the unpredictable', guiding the garden in its evolution and provides clues to the visitor on a journey of discovery among the surprises that nature has in store when it is expressed in its fullness." (Clement, 2021). This approach recalls the illusionary nature of Roman and Greek gardens as landscapes of production, leisure, and beauty. Reference can be drawn to Clément's Planetary Garden, to "living in harmony with nature, appreciating the ecosystem in all its diversity and acting as a gardener and guardian" (Clement, 2021). It also recalls the once innovative Crystal Palace, a type of public space for urban society as a generic and total space, a market system, monument, and recycling process of an inseparable production-consumption relation [Figure 25], and "therefore the real agent of recycling" (Marini & Corbellini, 2016:

Figure 25 The Mediterranean Garden vs The Torpedo Factory. The scenario proposes new opprotunity for Fiume as a green tourist destination, that is povided by accomodation capacites and new type of leisure inside the Medetiranian garden provking the Crystal Palace as a type of urban space for urban society. Nika Bronic, 2022, https://www.fa.uni-lj.si/seminar/hudnik/

616-617). It provides insight into the importance of progress and maintaining the balance between man and nature while ensuring future environmental sustainability and recovery:
“Ecology’s primary concern is nature in its entirety, and not the garden in particular. The enclosure was always an illusion; a garden is bound to be a planetary index” (Clement, 2021).

The philosophy of gardening, as a source of replacing market-oriented production and consumption with leisure-oriented production and consumption, introduces an environmental-humanist solution for advanced society. In this case, the process of reusing, protecting, and reinventing mega-industrial facilities into leisure spaces and the garden into a production space, becomes a tool and source of free time.

The Wild Garden vs the Oil Refinery

“Instead of the metal empire of oil pipes, the omnipresent smell of oil derivatives, and oil workers in mumbled blue work clothes checking the functioning of the driving pumps, listening to the working rhythm of the compressor for the stale air and turning/turning the valves, the scene dominated - a large peaceful green area, arranged with a horticultural hand, more precisely, a baroque garden. It was designed according to French models of that type, which is to say pedestrian walkways (...) It has a pool with water, a dovecote, a birdhouse, and a pavilion with a lookout point, offering an atmosphere for more relaxed, comfortable moments. The garden is surrounded by a long wall, guaranteeing privacy (Velid, 2020:16).”

The French Garden, which no longer exists in the local memory, has been replaced by the oil refinery, which does evoke nostalgia as well as status and pride. The dual heritage of the site can only be gleaned from fragments of buildings and ruins, absorbed by newer, metallic structures, or which were reused throughout centuries of changes to the refinery’s production: sugar, rice, and oil. Changes in ownership, ideology, social relations, private and public spheres, and economic prosperity were also transformative.

The refinery, being one of the first in the Mediterranean (1883), brought great economic potential and environmental impact: “It was a miracle of science, industry and money” (Mimica et al. 2021:135)..Today, it lies abandoned, a polluted reminder, according to Choay, “of ourselves to the future” (Marini & Corbellini, 2016: 263). It exists in a state of stagnation, awaiting a solution while caught between private ownership (MOL), heritage protection, and public interests.

Figure 26 *The Wild Garden vs The Oil Refinery.* The future proposal for the oil refinery presents a landscape of heterogeneity, diversity and ‘wildness’ as a public space and botanical garden with hardy, environmentally friendly plants and indigenous vegetation, combined with cultural, educational and research production (Teja Kranjec, 2022)

Where the linear cycle of artificial production-consumption ceases, it is nature that responds, through overgrowth of native vegetation, setting off the long-term purification process of soil, water, and air pollution, independent of political or lobby interests. However, as Commoner said in a 2007 interview with the New York Times: “Pollution is an incurable disease” (Vinciguerra, 2007).

Ironically, it is nature that begins an autonomous process of re-cycling the diverse types of entities as a socio-ecological solution to regenerate heritage, memory, and identity, with the aim of preservation, recycling and reinvention. The natural transformation of the heavily polluted industrial site of the refinery into an impressive botanical garden, where plants outgrow the abandoned facilities, calls to Clément’s ‘undefined’ territory—abandoned or overlooked spaces as a ‘paradise of weeds’ with unexpected assemblages of species and new aesthetic formations, rather than ‘brownfield sites’ or ‘waste ground’ in the conventional negative sense (Gandy, 2012). Commoner’s critique of man’s paradoxical role in the natural environment (“at once participant and exploiter”) illustrates meanwhile nature’s reclamation in face of the negative effects of human development and exploitation (Commoner 1980:14).

In this context, the solution for the refinery recalls historical relationships between nature, cultivated as a French Baroque Garden, and the heterogenous/diverse man-made landscape of industrial and residential facilities, with the added theme of wildness and indefiniteness that draws mind to Robinson’s image of the wild garden, a critique of the cultivated French garden (Robinson 1870), and Clément’s Third Land as a potential for reinvention

within an existing heritage (Clement, 2003).

The future landscape of heterogeneity, diversity, and wildness is a botanical garden of hardy, eco-friendly plants, and indigenous vegetation, combined with cultural, educational and research production [Figure 04]. Such is one possible scenario for the survival of the ecosphere, as Commoner states in an interview with the New York Times, "that action has to be taken on what is produced and how it's produced" (Vinciguerra, 2007). Such a landscape, as a wild urban space, according to Dierer Ring, offers a long-term solution as an interpretation of changes "in the relationship between nature, landscape and modern culture" (Gandy, 2012:12). It transforms borderlands and heritage into public spaces that, if restored or rehabilitated, have the potential to support an enormous exchange of local and global knowledge and an equal amount of biodiversity.

Dopolavoro Garden vs The 3. May Shipyard

"Once abandoned, a "kava" is becoming an enormous wound, in the topography which nature, for the most part, heals slowly. There is no greenery here; erosion makes a considerable difference, neither. The "kava" is simply there; almost imperceptible despite its spectacularity. In Fiume, the artificial soil was reserved for the industry and the port; the natural flat ground was scarce" (Mimica et al, 2021: 342).

The radical transformation of landscape, following the various phases of industrial restructuring, appears as such: "In the total reshaping of the landscape, hills visibly disappeared, and the sea was reclaimed. What used to be nature became the foundation for the new industrial age" (Mimica et al, 2021:341-342) As for the shaping of future activities, according to Kern and Morin: "The awareness of the community of the terrestrial destiny must be the key event of the end of the millennium; we act in solidarity on this planet, our life is linked to its life" (Marini & Corbellini, 2016: 262).

The extended coastal area was originally designated for exclusive industrial use, with ports and infrastructure serving as a multifunctional economic, technological, and social driver of progress. However, the abandoned quarries—artificial plateaus between cliffs and sea—informally became a new territory for sports culture: "Precisely these abandoned quarries became the first playgrounds for the new space-intensive sports: football and motorcycling" (Mimica et al, 2021: 342).

In the past the shipyard fostered public amenities with playgrounds, communal bathing areas, and the Dopolavoro Social Centre. It served as a popular leisure site among factory complexes, residential areas, administrative buildings, and parks. However, this pragmatic solution and the contemporary tendency to mix diverse programs and social strata, represented rare instances of public accessibility on the otherwise linear industrial coastal territory. Despite this, it helped build a significant social identity and a sense of community:

"However, important spaces of togetherness were situated on the plateaus of the quarries in a recognizable natural-artificial environment stretching between the see and the cliff. Those actions commenced spontaneously and evolved on the strength of individual initiatives and enthusiasm at the time when sports performed socially cohesive roles. The quarries became the sites of collective "joy, pride and thrill" (Mimica et al, 2021:347).

The shipyard, once a centre of technological, economic, and social prosperity, is now desolate, replaced by images of obsolete industrial mega-structures along the coast, no longer affording high-tech progress, local and global skills, social security, workers' affiliations, dopolavoro (leisure and cultural activities), or global competitiveness. Despite a surviving remarkable identity in the area, it searches for new owners amid struggles with production, though it does represent 30% of the area's production and 10% of its workforce.

As a result, the shipyard is exploring new ways to reinvent itself for a socio-ecological future, blending past and future, production and dopolavoro, and promoting circular processes for producing, consuming, recycling and reusing existing structures instead of demolishing them. This approach, as noted by Marco Bovati (Marini & Corbellini, 2016: 206), brings urban life closer to ecology, and as Kern and Moran note, towards solidarity with the planet. Both aspects involve new interpretations of potential and modes of operation, uncovering the latent qualities of space 'that is usually disregarded, rejected, forgotten or in a state of standby (ibid: 303).

The shipyard's complex new programmes, which juxtapose new green productive realities with dopolavoro [Figure 27], rebuild social identity and a sense of community and reshape the territory, reconfiguring private and public interactions, restrictions on accessibility, and the heterogeneity of space.

Conclusion

The critical point of environmental crises and damage to natural systems, with industrial impacts on land and in the air and water, has become globally tangible. Andrea Oldani writes: “We have reached a critical point, a crossroads, in the history of the environment, a situation, which casts doubt on the very potential of survival of the planet and the human race and thus requires us to rethink and redefine the strategies we employ to organise, manage and consume this resource” (ibid, 232).

The shipyard, the refinery and the torpedo factory, witnesses of degraded post-industrial areas, are threatened by demolition or collapse due to highly volatile political, economic, and social interests, the lack of historical reflection or environmental awareness, difficulty of obtaining legal status, and the fact that many of them are under limited authority. These structures are in dire need of open public, academic and scientific research, and evaluation, to determine their status and future ecological direction.

Overall, the comparative research of three case studies, each with slightly unique aspects, comparing the garden system with the industrial system can contribute to a more nuanced understanding of the potential and limitations of these two systems, and highlight ways in which they can be integrated and complement each other to advance social-ecological solutions. This methodology contributes to a more complex understanding and discovery of the latent territorial potentials between the cliff and the sea, their ambivalent character, and their socio-cultural impact. These aspects could be explored, linked, evaluated, classified, redefined, preserved and reinvented within the ecological paradigm of reduce, reuse, recycle.

Figure 27 *Dopolavoro Garden vs The Shipyard 3. May.* The shipyard’s complex new programmes, which combine new green production programmes with sports and leisure activities to rebuild social identity and a sense of community (Gal Lesnik, 2022)

The potential scenarios – The Mediterranean Garden, The Wild Garden and The Dopolavoro Garden - offer a different perspective on the future of abandoned industrial structures. In a strong social, multicultural, public, and ecological context, the projects offer the opportunity to test and reflect on the ideas of leisure, nature, memory, culture, production, and dopolavoro by applying the principles of sustainability and community from the garden to the industrial system or exploring ways to make industrial production more environmentally and socially responsible.

A consensus for the reinvention of problematic post industrial areas and contemporary management principles in the name of unity, in the balance between neoliberalism and heritage, the common good and various political-economic interests, should be accepted as an ecologically responsible planetary future agenda of advanced society, or in the words of Commoner, who believed that an educated public could demand an end to “the corporate imperative for wasteful growth that is the root cause of the environmental crisis” (Dreier, 2017) (...) ”Biologically, human beings participate in the environmental system as subsidiary parts of the whole” (Commoner, 1980: 14).

Notes

1 According to Mrduljas, the development of industrial enclaves began in 1718, when Fiume was declared a free port, located independently of the city, marking the beginning of its modernization: “Until the middle 19th century the focal points of the development of the urban periphery were the autonomous functional units resembling urban enclaves (Mimica et al., 2021: 126

2 This phrase is quoted in the article Hortys & Bibliotheca – Cicero al fresco, in Etre Jardin, 5 March 2018 https://etrejardin.com/hortus-bibliotheca-cicero-al-fresco (last access 26 January 2023).

3 “Leisure is time for creativity and activity that has little to do with daily grind. It is free time of an individual, who can choose to spend it in activity, hedonistic or creative pursuits, or just doing nothing, but get bored. This part of our lives complements everyday work and its time and purpose are just as allocated and programmed.” (Mimica et al 2021: 393).

4 According to Commoner, the ‘advanced society’ where machines allow us to escape our biological dependence on the natural environment seems ‘an almost fatal illusion’, replaced in this scenario by the illusion of the Mediterranean garden. (Commoner 1980: 14-15.

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Hugo Nazareth Fernandes

The Consecration of Water through Architecture in the Eternal City

Contributions to the Art of Memory in the Anthropocene

KEYWORDS:
Sustainable Water Strategies (SWS); Sustainable Urban Drainage Systems (SUDS); historic waterscapes; cultural heritage; urban morphology; urban stream channels; water architecture; water squares; Rome historic centre; water symbolism.

In grateful memory of Luis Conceição[1]

Introduction

The present article aims to understand how water-related architecture - and its memory - can act as a valuing and supportive approach in the cultural and educational axis of sustainable strategies regarding the rehabilitation of historical urban waterscapes.

Based on the case study of Piazza Mancini in Rome, this reflection extends utilitarian and symbolic purposes onto the broader scale of the city centre, enlightening, by topographical and historical analysis, its stream channels and flood basins as some of the essential patterns that have formed the urban fabric ab urbe condita. Through the inspiration of some local examples of water-related architecture and urban spaces, supported by previous case studies, and taking into account some typologies of "architectures of water", this mainly historical approach also refers to external speculative references: as symbols, although not built, some iconic designs are representative of archetypal landmarks and can be quoted locally as poetic drive, through their allegorical virtues and acting symbolically as sources of inspiration in the broader "architecture for flooding" theme.

Although this perception is based on a major basis of a glocal problematic - as seen between global issues versus local threats and opportunities -, it justifies the importance of the "musée imaginaire" concept (as André Malraux conceived it) in the collective memory - in this case, the Latin culture and its undeniable classical identity. Thus, it can be shown how a multi-layered historical approach, as in "collage city" methods and other allegorical cross-references, combined with morphological and topological readings, can contribute to enhancing cultural adaptiveness on global sustainable strategies by focusing on identities, contextualization, site-specific issues, but also affective heritage, imaginary, politics of memory and civic education on historic waterscapes which are increasingly threatened by climate changes.

1. The art of memory

"From the relationship between man and water can be born the dream, the reverie; and from this oneiric imaginary can be born Architecture. Whether in the small or large hydraulic works that, since the most remote times, man has devised to improve the conditions of his survival or in the small and large acts of superstition

and devotion to which man has given himself to revere his awe before the Cosmos, in all eras, in all places, he has consecrated water, building temples to it, using it to conform spaces nostalgic of paradise, of the origin and the end of all things.
By constituting itself as an informal element by nature, the design attitude towards water is that of its containment or adduction because, as already mentioned, it is always situated before and after the form."[2]

From Marcus Agrippa to Giacomo Della Porta, the consecration of water through architecture is one the most coveted themes by the masters who built Rome, as the city's memory blends in the water element from ancient times to modernity. History teaches us that it is by accepting the informal nature of water that we can develop ways of shaping with water. As Theodor Schwenk recalls, motion is the basic principle of water as it tends, because of gravity, to reintegrate its primal spherical form[3]. All movement of water on Earth is due to this basic physics principle of reintegration into unity. At a molecular level, water is not an informal element: we can almost perceive it, as a single drop of water tends to reassemble itself into a spherical form. In non-gravitational space, water assumes the form of a sphere. In fact, it is because of Earth's gravity that we commonly accept water as an informal element, and we can therefore say that motion is the basic principle of water. The restlessness of water, always adaptive to the terrain, is due to its memory of gravity and by extension, a memory of reuniting into its original form: the sphere[4].

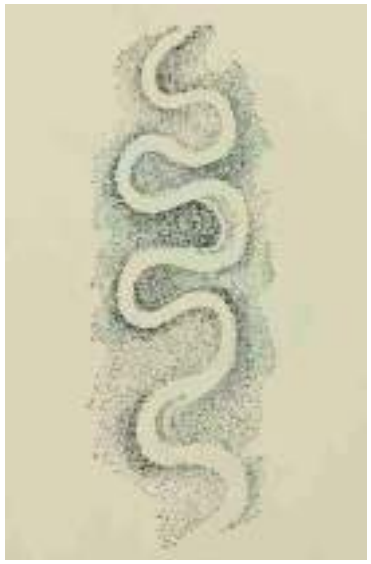


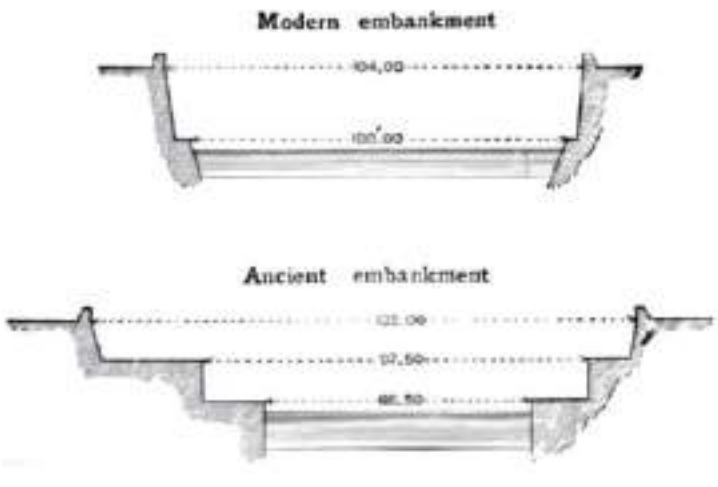
Figure 28 Falling water separates off into drops, in Sensitive Chaos, by Theodore Schwenk, p. 13
Figure 29 Naturally flowing water always endeavors to follow a meandering course, in Sensitive Chaos, by Theodore Schwenk, p. 15

With this in mind, we can commonly conceive that water constitutes itself as an informal element by nature - in its earthly nature[5]- pulled by gravity. Thus, gravity and topography are the key referentials to understanding the memory of water (Figures 1-2).

Water, as an informal element, always situated before and after the form[6] - wild, unbridled, restless, always adaptive - conditions a design attitude of "domestication" which is based on one of two principles: containment and adduction[7]. But for making these principles work in practice, they also need to be - as water is - adaptive. Since the ancient times of the "hydraulic civilizations"[8] (Egypt, China, Peru), mankind has learned how to develop skills of containing and adducting water. However, the industrial era has ever increased the need of restraining flooding in the growth of the modern urban fabric, up to a progressive denying of the natural dynamics of water, through the construction of large-scale engineering artifacts, such as damps and embankments. Since then, given the advance of new technologies, hydraulic knowledge in the XX Century has been used for a pretended absolute domestication of water, almost as "fighting" it. Illusional strategies of "total control" in the "machine age" were mostly preferred, up until recent times, to adaptive approaches. Although these tend to be increasingly favored in the scope of the increasingly extreme weather phenomena such as prolonged droughts and flash flooding events, it was only a few decades ago that inclusive strategies for water management and urban adaptation for climate changes have been considered on a global scale.

According to SOS Climate Waterfront Research Project main goals, as "to expand the realm of possibilities meant to adapt and transform urban waterfronts while also enabling them to become meaningful areas for the community"[9], several adaptive strategies and tools may be valued as examples of water resource management as a new approach to urban design[10], such as the "River Contracts", born in France forty years ago and widely used across today's Europe, considered by many as "virtuous planning boosts public-private partnerships, incorporating adaptation strategies into planned actions through the evolution of sustainable policy tools"[11].

In the context of the Tiber River Contract[12] implemented in 2017 as a tool for "activating a process of re-appropriation by the community and rebuilding the relationship between the river and the city"[13], there is a recognition of two main problems which are most important to our thematic: a) the 8 km embankments whose



construction began in 1876 that have separated a part of the river corridor from the city, preventing proper connections[14], and b) the area's numerous sites of historical-archaeological value, which are in decay and neglected, despite their enormous potential in terms of cultural heritage and attractiveness[15].

Recapturing the case of the Tiber River waterfront in Rome, it is known that the difference between the ancient system (formed by several stepped embankments) and the modern one by Raffaele Canevari (consisting of a steep single-high wall), is a significant example of the shifting attitude towards the flooding problematic[16]. Indeed, the ancient stepped system took into account the adaptiveness to the variations of the river water levels, while the XIX Century modern solution, through the elevation of an 18,75 meter high wall[17] - the muraglione - cuts off the presence of the riverside in the city and has contributed to the growth of the urban fabric detached from the waterfront, as Rodolfo Lanciani had already denounced in 1897 (Figure 30)[18].

In contrast with this attitude, one should remember that, back in the XVIII Century, in one of the Tiber most important piers in Rome, the design of Porto di Ripetta (Alessandro Specchi and Carlo Fontana, 1703) was conceived in adaptiveness to the riverbed and water level variations. This functional multi-leveled pier was formed by curved stairs with deep treads, in a majestic baroque gesture of a theatre connecting the river to the urban square in front of the church of San Girolamo degli Schiavoni with symbolical eloquence (Figure 31). This is the reason why the toponymic name of the actual square is "Piazza del Porto di Ripetta", although the port doesn't exist anymore. It disappeared under the muraglione during the great reconstruction works of the riverbanks that started in 1875. In fact, it was not demolished, as it lies in the underground - and its memory stood. Its original two columns, which served as hydrometers (i.e., for measuring the level of the floods), were dismantled and placed in a warehouse only to be reassembled in 1930, with some modifications, in the latter Piazza del Porto di Ripetta[19].

Figure 30 Comparison between the modern and the ancient embankment of the tiber riverfront in Rome by R. Lanciani, in The ruins & excavations of ancient Rome: a companion book for students and travellers, The Riverside Press, Cambridge, 1897, p. 13, Fig. 5-6 (the adaptation is ours - N/A).

Figure 31 View of the ancient port of Ripetta in Rome, by Piranesi, in the XVIII century, showing the church of San Girolamo degli Schiavoni and the longtime missing two columns who acted functionally as hydrometers (i.e. for measuring the level of the floods), as referred on the caption: "3. Colonne o mete, nelle quali sono segnate le maggiori escrescenze del Tevere." (i.e. "Columns or marks, in which the major excrescences of the Tiber are marked." N/A); Veduta del Porto di Ripetta, engraving, G. Piranesi, c. 1760

Unfortunately, amongst many other consequences of the great flood in 1870[20], the demolition of Porto di Ripetta in 1875 is an example of how the city, through the glorification of the human technique in the industrialization era, has progressively cut off the "memory of water". The symbolic function of the ancient pier, which generously opened itself to the waterfront through a scenographic gesture, is a perfect example of the consecration of water through architecture. Its allegorical imagery, valuing water in several aspects, was an important landmark as being practical, cultural, symbolical, and poetical. One should remember that a related archetypal example, in the form of a sloped pier, can still be seen in the Cais das Colunas (i.e., "the Pier of Columns") as part of the neoclassical design of Praça do Comércio in Lisbon (1755)[21].

Formed upon the morphological footprint of the ancient Roman Stadium of Domitian (80 AD), the Piazza Navona is another paradigmatic case study of how water was celebrated in Rome in the Baroque period. In 1653 Pope Innocent X had the idea of flooding the square for the purpose of water festivities. The square was then concave - as Piazza del Popolo still is today - and people would come to leisure, bath, or simply refresh, and even coach games were organized on the water[22]. The ludic scenery was efficient in its simplicity, and although the level of this artifi-

cial lake was barely half a meter, the concaveness of the ground was sufficient to create an aesthetic miroir d'eau, where the sky and the facades of buildings reflected with poetic drive [23] (Figure 32).

The popular practice of transforming the piazza into an artificial lake, as in ancient naumachiae[24] spectacles, disappeared in 1875, during the city's riverbed great remodeling works, when it was no more possible to flood it, as the ground was paved in a convex shape. Water was no longer seen as a natural element of contribution to the urban ambiance but instead as a force that needed to be "fought" and "expelled".

In some manner, the memory of Porto di Ripetta, as other case studies of architectures of water or related to water, such as the "Navona Lake", as referred by Annalisa Metta[25], are inspiring examples for promoting the rehabilitation of Roman historical "terrains of water", such as the Flaminio district and Piazza Mancini in particular.

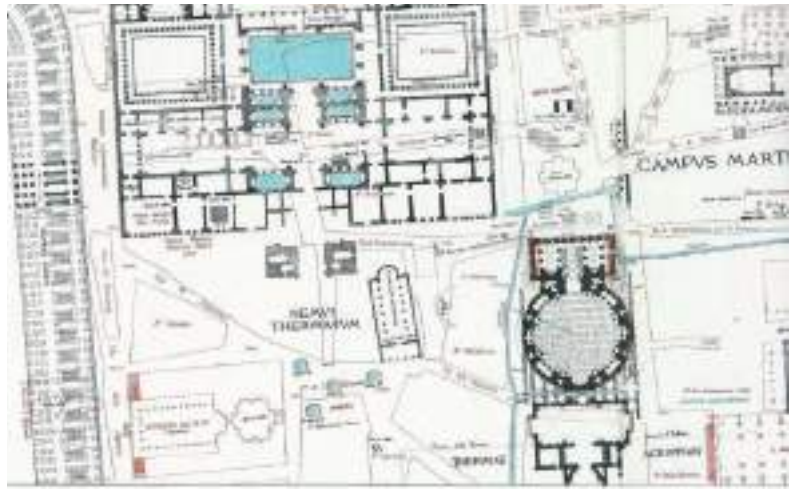
Undoubtedly, many cases of architectures of water still prevail in Rome today. Some are more visible and obvious, namely because they are commonly perceived as "identifiable objects" - as the popular baroque fountains: the Trevi, the Quattro Fontana, the Quattro Fiumi in Piazza Navona, the Barcaccia in Piazza di Spagna, to name but a few - while some other spaces are lesser known or even vaguely understood as urban "terrains of water"[26]. This is the case of some squares, streets, and, by extension, the urban morphology of the city centre by itself, according to stream channels, valleys, and - namely - the flatland area correspondent to the ancient Campus Martius, where the Pantheon, the adjacent thermal baths of Agrippa and the thermal baths of Nero were built, amongst other notable buildings[27]. Regarding the baths of Agrippa, one should mention that they were the first public

Figure 32 Antonio Joli, Piazza Navona Allagata, c. 1750

baths to be built in Rome by the general, architect, statesman, lieutenant, and son-in-law of Roman emperor Augustus, and were completed in 25 BC. With the completion of the Aqua Virgo Aqueduct in 19 BC, the baths were supplied with water and served also as the castellum of water for the city's supply, and a large lake and canal were built at the west (the Stagnum Agrippae)[28]. The remains of the central, domed space of the Thermae Agrippae, vaulting dated to the fourth century AD, can still be seen aggregated with existing buildings in Via dell'Arco della Ciambella[29], two blocks south of the Pantheon[30].

The construction of the doomed iconic form of the Pantheon is generally more directly related to the octagonal doomed hall and oculus in Nero's Domus Aurea, designed by Severus in 64-68 AD and longtime buried in the Esquiline, and is known for having inspired the constructive solution of the rebuilt Pantheon by Apollodorus of Damascus in 126 AD. Nonetheless, one must refer to the large pool in the thermal baths of Baia, the so-called Temple of Mercury (Figure 33), also commonly known as truglio, for its circular shape, which dates from the first century BC (as it has been dated from the end of the Republic era to the beginning of Augustus reign), as the older concrete-made doomed architecture of water that inspired the tholos prototypal form of the Pantheon in Rome and, possibly, its doomed final version as it still stands today. Besides constructive comparisons, the water-related symbolism of the circle and the sphere can enhance the significance of the Pantheon, not only as "water architecture", as part of a long-gone complex of thermal baths in Campo di Marzio -, but also because it marks the urban ending path of the Aqua Virgo Aqueduct as if water, wild, unbridled, chaotic, returns from the hills into its primitive and ordered form: the sphere. Again, let us remember the reflection of Theodor Schwenk about the forms of water: "We see moving water always seeking a lower level, following the pull of gravity. In the first instance it is earthly laws which cause it to flow, draw it away from its spherical form and make it follow a more or less linear and determined course. Yet water continually strives to return to its spherical form. It finds many ways of maintaining a rhythmical balance between the spherical form natural to it and the pull of earthly gravity. (…) A sphere is a totality, a whole, and water will always attempt to form an organic whole by joining what is divided and uniting it in circulation."[31]

This reflection about the shapes of water, shifting between stages of adduction and containment, from flowing serpentine movements and spherical stillness (Figure 28 and Figure 29), can



also evoke the duality between the aqueduct (a linear movement) and the Pantheon (a centered stillness) and may contribute to another hermeneutics about the multiple meanings of its axial, gravitational and archetypal circularity, namely, as the Axis Mundi symbolic foundation of Rome ab urbe condita. The same reasoning also seems to coincide with the conjecture of Filippo Coarelli, about the mythic significance of the Campus Martius - and at its center the wetland named Palus Caprae, "the pond area where, mythically, Romulus ascended to the sky" - originally the lowland area at the north of ancient Rome "between the city and the Tiber", which was, according to the author, the true mythical reason for siting the Pantheon there[32].

2. The paths of water

Based on the Hydro-geological Map of Rome[33], combined with referential research documentation[34] and the support of flooding simulators software[35], it is possible to analyze the exposition of these lowlands to heavy flooding. Focusing on the downtown, on the right side, the most floodable area covers the districts of Della Vitoria, Pratti, Borgo, and Trastevere; on the left side, it covers a north-south axis, from the Flaminio district, down the Via Flaminia to Piazza del Popolo, Piazza del Porto di Ripetta, Piazza Augusto Imperatore (Augustus Mausoleum), down to the ancient wetted area of the Palus Caprae[36] in the Campus Martius - which was, as referred before, and according with Filippo Coarelli, the true mythical reason for siting the Pantheon there[37]. These lowlands[38] also cover the Murcia valley, situated between the Palatine and the Aventine (the Circus Maximus area), the Cloaca Maxima[39] along the Velabrum[40], the Via Sacra, the Imperial Forum, and up the Flavian amphitheater (i.e. the Colosseum) - actually built over a pond - where naumachia[41] events possibly also took place[42].

Figure 33 Giovanni Volpato, Temple of Mercury, large Roman thermal pool, also known as 'truglio' for its circular shape, Baths of Baia Archaeological Park, 1st century [BC], Campania, Italy, engraving by Giovanni Volpato from a drawing by Natali, Naples, 1768.
Figure 34 R. Lanciani, Pianta del Campo Marzio, in Forma Urbis Roma, 1893.

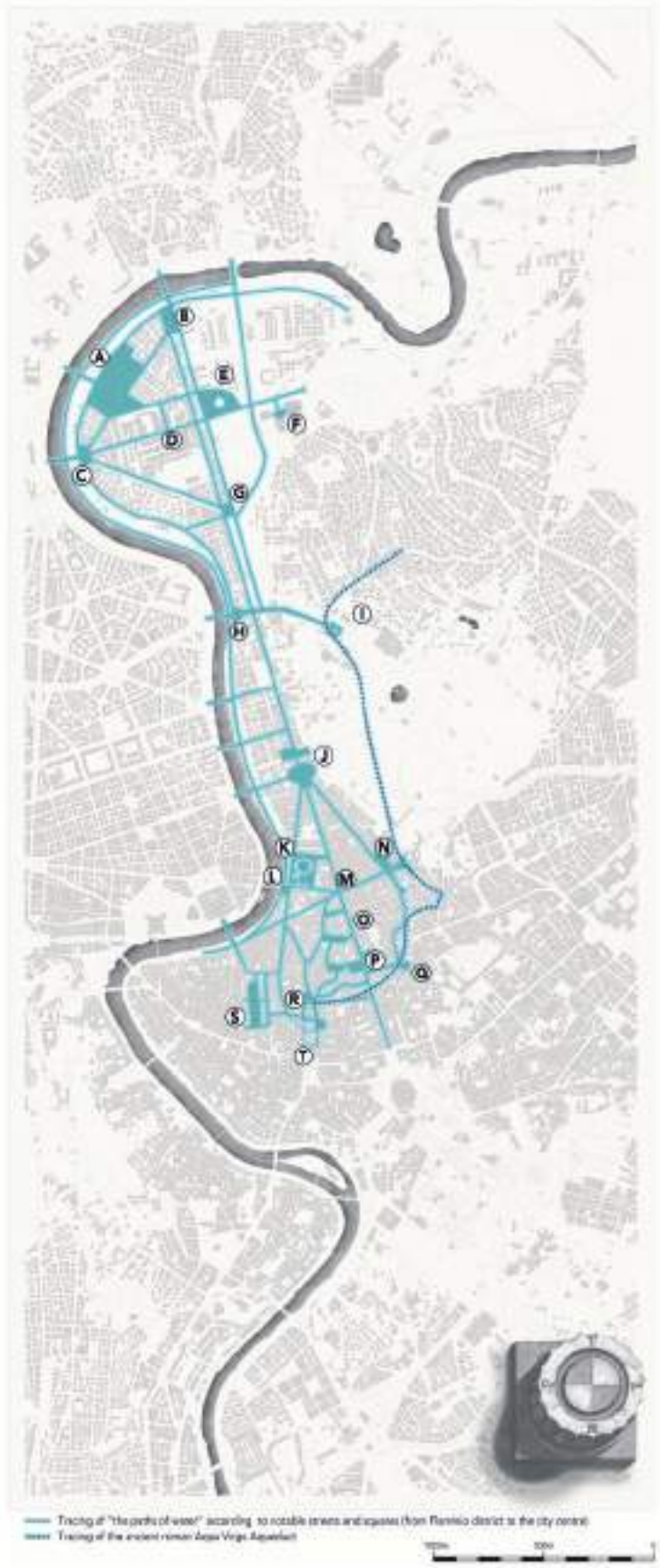


Figure 35 Urban tracing analysis "the paths of water" near the Tiber River and from the Flaminio district to Campo di Marzio, through the Via Flaminia axis, with reference to main notable squares, fountains and buildings, from Piazza Mancini to the Pantheon (author's study / design and artwork by Enrico Capanni) ©Enrico Capanni 2023

A. Piazza Mancini / Giardini Viale Pinturicchio

B. Piazzale Cardinale Consalvi

C. Piazza Gentile da Fabriano

D. Maxxi Museum / Piazza Alighiero Boetti

E. Palazzetto dello Sport / Piazza Apollodoro

F. Parco della Musica / Largo Luciano Berio

G. Piazzale Manila

H. Piazzale delle Belle Arti

I. Ninfeo e giardini di Villa Giulia / Fontana dell'Acqua Vergine / Museu Nazionale Etrusco di Villa Giulia

J. Piazza del Popolo / Fontana dei Leoni / Piazzale Flaminio

K. Piazza Augusto Imperatore / Mausoleo di Augusto

L. Piazza del Porto di Ripetta / Fontana del Porto di Ripetta / Fontana Ara Pacis / Largo di San Rocco / Fontana della Botticella

M. Largo Carlo Goldoni

N. Piazza di Spagna / Fontana della Barcaccia / Piazza della Trinità dei Monti / Scalinatta della Trinità dei Monti

O. Piazza di San Lorenzo in Lucina / Piazza del Parlamento

P. Piazza di Monte Citorio / Piazza Colonna / Fontana di Piazza Colonna

Q. Piazza di Trevi / Fontana di Trevi

R. Piazza della Rotonda / Pantheon / Fontana del Pantheon / Piazza della Minerva

S. Piazza Navona / Fontana del Nettuno / Fontana dei Quattro Fiumi / Fontana del Moro

T. Ruins of the Termi di Agrippa / Via dell'Arco della Ciambella

Due to editing reasons and to present this study in a more understandable form, some urban elements (squares, streets, buildings, and fountains) have been aggregated into a single entity (represented by a letter), according to each location and main site characteristics. In the same way, the names of the streets that compose the main structural tracing have been omitted to improve graphic clarity. Indeed, more complex degrees of urban analysis can be achieved using other graphic scales and/or criteria, thus depending on the pretended level and type of research specificities, by zooming on each locus information and in the scope of the sum of each part. Again, one must stress that this is a very resumed presentation of a broader research theme (i.e. "the waters of Rome") that surpasses the space and the scope of the present article and was designed to serve a specific synthetic purpose (N/A).

The urban tracing analysis "the paths of water" (Figure 35) along the Via Flaminia axis, from the Flaminio district and through the lowlands to Campo di Marzio, shows how Piazza Mancini, as the main square of the waterfront in this northern district, can be related to the city centre, namely the ancient Palus Caprae wetland area where the Pantheon (R.) and the Piazza Navona (S.) stand. These paths, as some notable avenues (such as Via Flaminia, Via di Ripetta, and part of Via del Corso, amongst others), although they may not correspond to the main stream channels in the downtown topography[43], can nevertheless be recognized as tracing references for rehabilitating the presence of water in the urban landscape. Here, the fundamental principles of adduction and containment can be materialized by controlling flooding and heavy rainfall through different and combined solutions, such as a network of street canals, water squares, rainwater collecting ponds, Sustainable Urban Drainage Systems (SUDS), basins, water mirrors and, more generally, shaping ambiances in a broader context of an "architecture for flooding" promoting civic, economic, ecologic and educational strategies for the use and the reuse of water[44]. Although this approach may not be original, as there are, as mentioned before, several planning strategies implemented[45] and built urban projects[46] that prove the efficiency of these combined tools, we believe there is a strong opportunity here for integrating new insights on sustainable environmental solutions and water-related ambiances in a city that is the cultural heritage of all the nations of the world. Overall, we can say that a cultural and historical dimension should be hearted and carefully articulated with the efforts of climate action changes for the implementation of a contextualized strategy.

So, what could be the memory of water on the site? What strategies can gather both natural and cultural values in the Eternal City?

Indeed, Piazza Mancini is one of the main squares in the historic centre of Rome that needs the most rehabilitation. As a case study of the SOS Climate Waterfront research project[47], some academic studies were developed combining green & blue solutions for this area. Here, most proposals were utilitarian in their environmental and ethical purposes: the implementation of Sustainable Urban Drainage Systems (SUDS) through basins with water drainage connected to the river by underground pipes[48], were combined with water mirrors, green spaces, and trees for shadowing and air-cooling purposes. That combination also contributes to reducing the heat island problem on the piazza and,

simultaneously, creates ludic spaces and gives its users new senses for its appropriation and utilization. Mobility issues were also taken into account, as heavy traffic was replaced by light mobility solutions. Yet, the adduction of water remained restrained to the piazza and its waterfront.

What we are focusing on here is a broader approach to Piazza Mancini's urban contextualization and its strategical implementation for controlling flooding and heavy rainfall, taking into account its major importance as the main square of the northern city centre, i.e., the Flaminio district. Thus, on a larger view of an "architecture for flooding" problematic, we can stress that its urban morphological implementation is crucial to understand the possibilities of containment, adduction, and reuse of rainwater and increasing flooding events. This also means that on the broader scale of the district and beyond, some symbolical liaisons may conduct to the historic centre and the most sacred "terrain of water" of Rome: the Campo di Marzio.

3. The consecration of water / vers une architecture d'eau

Based on the previous analysis, we can conclude that the urban connection between Piazza Mancini and the Maxxi Museum public space (Piazza Alighiero Boetti, Figure 35 - D.) is crucial to understand the "paths of water" possibilities, as the Maxxi's smaller square bridges Piazza Mancini (Figure 35 - A) with the Via Flaminia axis and, subsequently, with the city centre. Thus, according to its centeredness and historical relevance, some questions regarding major opportunities may be raised: is it possible to consider the square as a space for the containment of water for the city's water supply network? Can this vast area be capitalized for rainwater storage by building large underground cisterns interconnected on a major scale? Can new green spaces integrate drainable pounds for rainwater reusing? Regarding the piazza's public/ludic forms of appropriation, is it possible to consider a "Mancini Lake", as in Piazza Navona's aesthetic case during the baroque period [49]? What benefits could outcome from assuming the possibility of flooding this major piazza? What sort of new "urban dialogs" can be created by combining extreme weather occurrences and intelligible design? In sum, what sustainable development goals (namely social and cultural) could be achieved by combining different approaches? Could there also lie symbolic connections - through water - with the city centre? Finally, could the consecration of water through architecture on the site be an opportunity to highlight the city's educational, civic, and sustainable memory of water?

Figure 36 The non-gravitational memory of water: Claude-Nicolas Ledoux's Maison des Gardes Agricoles as an architecture for flooding inspiration on Piazza Mancini (author's concept / design and artwork by Enrico Capanni) ©Enrico Capanni 2022
Figure 37 The gravitational memory of water: Claude-Nicolas Ledoux's Maison des Surveillants de la source de La Loue as an architecture for flooding inspiration on Piazza Mancini's Tiber waterfront (author's concept / design and artwork by Enrico Capanni) ©Enrico Capanni 2022

Indeed, the allegorical images presented here (Figure 36 and-Figure 37) don't pretend to be representative of effective design and constructive solutions. As utopias, from which they genetically derive, they act as what they simply are: visions. However, we consider their iconographic symbolism as contributions to the adaptation of ideas and contextualized solutions. As far as we know, Ledoux didn't contemplate the spherical form of the Maison des Gardes Agricoles for Park Mauperthuis (1789) as primarily related to water. Yet, its flooding contextualization seems to reenact the purism of the sphere through a new poetic drive, in a symbolic architecture of containment for the non-gravitational memory of water[50] (Figure 36). In this case, the symbolism of the quadriad water/sphere/unity/purism may recall the water-related symbolism of the Pantheon in many aspects[51] and unfolds new

interpretations of the poetry of water[52], not only because of its circular geometry but also because of the mythical reason of its Axis Mundi's implementation, between sky and earth, in the very center of the Campus Martius, as already referred - the most sacred "terrain of water" in Rome[53].

Conversely, the gravitational memory of water, always situated before and after the form[54], can be evoked in the Maison des Surveillants de la source de La Loue (1789), which enacts the contrast between form and the informal shape of water (Figure 36). Here the water flows, springing from the source and through the house, as maybe one of the most picturesque and peculiar examples of architecture of adduction of water[55]. Again, the riverfront contextualization changes the original significance of Ledoux's project, as the source becomes the city in itself and Piazza Mancini a locus of containment, draining water literally through the building and conducting the flowing downstream to the Tiber. Consequently, the appropriation of the original design changes its meaning into an environmental metaphor of an "architecture for flooding", as a metonymy of building adaptiveness to water drainage - not "fighting" natural phenomena, but rather in a larger context of an XXI Century allegory for resilience to climate changes.

So, our final question is: what more can we learn through these "hybrid visions" of the architectures of water? And, broadly: how many ancient or vernacular examples are inspiring enough for us to develop new sustainable and adaptive models in the Anthropocene?

As referred in the beginning, since the first hydraulic civilizations, many examples of ancient waterfronts, ports, peers, and water-related architectures can be quoted to remember us that some of the most basic principles of sustainability and integrative strategies were already developed and implemented in the Holocene and that the development of site-specific urban design, by our ancestors, was not dissociated from architectural knowledge, engineering and building implementation.

Furthermore, phenomenology intends to understand that the ancient Roman concept of Genius Loci[56] exceeded modern epistemology as we may understand it, thus by the evidence of synchronicity between utilitarian and symbolic functions on ancient sites and buildings. This insight is based on the cognition of a different notion of the sacred through tradition, centuries before the XIX century positivism divided exact sciences, humanities, arts, and technologies into separated domains of human knowledge. We also learn, through cognitive archeology[57], that the conscience of an epistemological bias, here, is fundamental to accept that we may never be able to capture the full essence of our progenitor's psyche and actions, as the notion of the sacred - and its embodiment through nature - has evolved into a more edgewise aspect of knowledge, whereas it was, by tradition, the centredness of the ontological posture of our ancestors in every aspect of life[58]. Paul Ricoeur[59] remembers that the basic function of hermeneutics is to restore meaning which is, as a matter of fact, the concern about the ancient mind as the main theme of contemporary cognitive archeology[60]

Indeed, ancient equivalent concepts such as the Latin term Ars (Art) and the Greek τέχνη (Techne) have diverged from classical antiquity into modernity in such a way that they have become in many aspects antagonists domains or, to the least, mutually exclusive in academia and research, remaining in contemporaneity as different fields of knowledge and by that, difficult to understand in their epistemological primitive corpus[61]. Yet, the syncretic qualities of some ancient buildings and sites can emerge in many forms, revealing different aspects of knowledge, such as utilitarian, technical, aesthetic, and even sustainable/ecological functions and virtues - which could emerge from concerns about some local oikos - that can make us sense the legacy of some ancient form of unitarian knowledge[62] in the mindset of our ancestors in a way that can be difficult for us to understand, with the exception of the regency of wisdom, based on the accumulation of experience, from vernacular empiricism to tradition and the construction of a scientific corpus[63].

As it is not the aim of the present article to present a methodology for the inventory and categorization of ancient urban integrated systems, we will still resume some relevant aspects that should be valued in the scope of the Sustainable Water Strategies (SWS) on historic waterscapes, cultural heritage, urban morphology, and the symbolical importance of water architecture in the Anthropocene.

For the aim of this article, which is based on Rome's waterfront theme, we will only remember some case studies evoked as far, as examples from which we can learn virtues through simple ideas and basic principles, such as flexibility, adaptivity, and resilience.

Firstly, we refer to the ancient stepped system of the Tevere embankments, before the "muraglione" construction, as a mechanism of adaptiveness, flexibility, and resilience to the variations of water levels, which allowed a more integrated urban riverfront, in liaison with the river (Figure 30)[64].

Secondly, we recall that the same principles of adaptiveness, flexibility, and resilience, have been embodied through the form of erudite architecture, as for the monumental stairs with deep treads that functioned as a multi-leveled pier in the ancient Porto di Ripetta (Figure 31)[65]. One should remember that a related archetypal example, in the form of a sloped pier, can still be seen in the Cais das Colunas (i.e., "the Pier of Columns") as part of the neoclassical design of Praça do Comércio in Lisbon (1755)[66].

Thirdly, one must point out the flexibility, adaptivity, and resilience characteristics of some buildings and typologies to extreme natural phenomenae, such as river flooding, heavy rain, and flash flooding, that can be pedagogically valued in both ancient/erudite architecture and in vernacular construction, and that we symbolically evoked in the syncretic and iconographic project of Claude-Nicolas Ledoux Maison des Surveillants de la source de La Loue, as an architecture for flooding inspiration on Piazza Mancini's Tiber waterfront (Figure 36). We also should mention that, for the stake of the present subject, the appropriation of the iconographic qualities of Ledoux's design moves away from utopia, or some form of naivism or vague idealism, but rather stands as a metaphor for the best virtues we may develop in prototyping new resilient buildings and sites adapted to climate changes.

Here we should encounter common architectural virtues as for the traditional typologies of architectures of containment of water (for collection and/or storage), such as cisterns, cloisters, thermal baths and public baths, baptisteries, elevated tanks, public washhouses, water gardens and water mirrors, springs, ponds and fountains and, more recently, recent typologies of architectures of water, such as water squares, amongst other Sustainable Urban Drainage Systems (SUDS) related solutions. In fact, water squares are considered, since the last decade, as a new urban typology, namely since the construction of the Water Square Benthemplein (Rotterdam, 2013)[67], which stands as an exemplary model in its category and has been seen, over recent years, as a new benchmark in this specific SUDS approach. Other exemplary models of integrated green&blue systems, such as the "Sponge Garden" (Rotterdam, 2019) present some very complete SUD research systems, namely regarding the implementation of containment and porosity strategies as they pretend to "test new concepts for collecting, retaining and returning rainwater to the natural environment. For this, experiments are being carried out with soil compositions, planting types, and sponge techniques.[68]" As for the latter, the implementation of porosity strategies through integrative solutions can be regarded as a subtle variation of the traditional principle of adduction, as its basic objective is to allow the motion of water in a collectible, unwasted, and serviceable form.

Conclusion

In sum, after having enhanced the need for a syncretic vision towards a new architecture of water (vers une architecture d'eau), we rephrase our final question, regarding both Ledoux's allegories - as interpreted here -, contemporary water squares and other contextualized solutions: what more can we learn through these "hybrid visions" of architectures of water? And, broadly: how many ancient, erudite, vernacular or pragmatical examples are inspiring enough for us to develop new sustainable and adaptive models in the Anthropocene?

Although this perception is based on a major basis of a glocal problematic - as seen between global issues versus local threats and opportunities -, it justifies the importance of the "musée imaginaire"[69] concept, as André Malraux conceived it, in the collective memory - in this case the Latin culture and its undeniable classical identity. Thus, it can be shown how multi-layered and trans-historical approaches, as in Colin Rowe's "Collage City"[70], the 1970's "Roma Intterrota" exhibition[71] based on Nolli plan[72], up to the theoretical corpus of the city's heritage, from Rodolfo Lanciani[73] to Filippo Coarelli[74], from Aldo Rossi[75] to Françoise Choay[76], amongst other historical cross-reference[77] combined with archeological, morphological and topological readings, can contribute to enhancing cultural adaptiveness on global sustainable strategies - as Sustainable Urban Drainage Systems (SUDS), or Water Sensitive Urban Design (WSUD), Low-Impact Development (LID) and other "green & blue" and/or "soft edge" solutions that are mostly utilitarian in their environmental, economical and ethical purposes - by focusing on identity, contextualization, site-specific issues, adaptiveness, but also affective heritage, imaginary, politics of memory and civic education on waterscapes which are increasingly threatened by climate changes.

Finally, we should add one last thought: as referred before, we may never be able to understand the full essence of our progenitor's psyche and actions in the past, but in the same way, this also applies to the future and our descendant's actions, as we cannot predict the amount or type of evolution in adaptive, resilient and sustainable models and strategies over the next centuries. Whether this will occur under the form of "hard edge" or "soft edge" approaches, we can only expect that the syncretic qualities

of buildings and sites specificities can emerge in many forms, contributing to and reshaping different aspects of knowledge and identities, including IA for building design and territorial planning, water research for supporting life on Earth, R&D and prototyping, on such combined aspects such as utilitarian, technical, aesthetic, cultural, sustainable and ecological functions - as virtues which should emerge from concerns about some local oikos - be it on Gaia… or on Mars[78]. Altogether, taking into account the number of negative reports and predictions regarding climate change, it is our responsibility to leave all scenarios open.

In essence, what we have involved here was, in addition to the need for urban resilience mechanisms and planning adaptiveness, the urgent need for a cultural contextualization for an integrated memory of water, social action for its ethical and local valuation, and the possibilities of new paths for the consecration of water through architecture in the Anthropocene.

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Notes

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1 In grateful memory of Luis Conceição (1952-2019) and in honor of his doctoral thesis, A Consagração da água através da Arquitectura - para uma Arquitectura da água (The consecration of water through architecture - towards an architecture of water), Faculty of Architecture / UTL, Lisbon, 1997.

2 Op. Cit. L. Conceição, 1997, "1.4. The poetics of water", p. 59.

3 "Wherever water occurs, it tends to take on a spherical form. It envelops the whole sphere of the earth, enclosing every object in a thin film. Falling as a drop, water oscillates about the form of a sphere; or as dew fallen on a clear and starry night it transforms an inconspicuous field into a starry heaven of sparkling drops.
We see moving water always seeking a lower level, following the pull of gravity. In the first instance it is earthly laws which cause it to flow, draw' it away from its spherical form and make it follow a more or less linear and determined course. Yet water continually strives to return to its spherical form. It finds many ways of maintaining a rhythmical balance between the spherical form natural to it and the pull of earthly gravity. (…) A sphere is a totality, a whole, and water will always attempt to form an organic whole by joining what is divided and uniting it in circulation." In T. Schwenk, 1976, p. 13.

4 Idem, p. 13.

5 Cf. L. Conceição, 1997, p. 59.

6 Idem, ibidem, p. 59.

7 According to these two architectural principles of containment and adduction of water, as referred to by Luis Conceição (cf. L. Conceição, 1997, p. xi-xii), it is possible to enumerate different typologies of architectures of water: a): architectures of adduction of water (aqueducts and water canals); b): architectures of containment of water (for collection and/or storage: cisterns; cloisters; thermal baths and public baths; baptisteries; elevated tanks; public washhouses, water gardens, and water mirrors; springs, ponds, and fountains). It is also possible to conceive a third typology that doesn't form from adduction or containment but as architectures that actually live with water, as for c): architectures of the limit between land and water (by transposition - bridges; by mechanical use - tide mills and water mills; by confrontation - ports; docks; bastions and coastal fortifications; lighthouses) and d): architectures that use water as a medium or physical support (stilt houses; ships; floating theaters). In that case, it is even possible to speak of architectures on water (cf. L. Conceição, 1997, p. xii), (N/A).

8 Idem, ibidem, p. 17.

9 According to C. Mattogno, B. Monardo, T. V. Di Giacomo and L. Kappler, 2021, p. 16.

10 According to C. Mattogno, B. Monardo, T. V. Di Giacomo and L. Kappler, 2021, p. 16.

11 Id. ibid., p. 16. The same authors also refer: "More specifically, the most common approaches in different geographical areas are as follows:
– the French policy of 'permeable cities', connected with the 'green and blue frame', which provides for specific urban planning instruments (SDAGE) to reduce pollution, prevent flood risks, and anticipate the effects of climate change;
– the 'Sponge City' concept initiated in China in 2014 to address urban water issues, including surface water floods;
– the Sustainable Urban Drainage Systems (SUDS) approach, which implies an increasingly important role of green infrastructure in the United Kingdom, minimizing the outflow of surface water and flood risks in an ecological way by imitating natural water systems such as ponds, wetlands, swamps, and basins;
– the Water Sensitive Urban Design (WSUD) strategy being implemented in Australia since the 1990s, integrating engineering design with the principles of the urban water cycle to provide sustainable results for cities;
– the Low-Impact Development (LID) used in Canada and the United States to describe a land planning and engineering design approach to manage stormwater runoff as part of green infrastructure." Id. ibid., pp. 17-18.

12 Id. ibid., p. 24.

13 Id. ibid., p. 24.
14 Id. ibid., p. 24.

15 Id. ibid., p. 24.

16 "The construction of the embankments of the Tiber, called walls, was carried out following the 17 m high flood that flooded Rome on December 28, 1870 (…) The construction of the walls ended in 1926; in the meantime there were floods like that of 1915 which did not cause any damage, confirming the validity of Canevari's work. The walls of the Tiber certainly solved the drama of the floods, but at the same time they interrupted the dialogue between Rome and its waters, depriving the city of some very important architectural episodes, above all the wonderful system of fronts along the Via Giulia and the port by Ripetta by Alessandro Specchi." In https://archidiap.com/opera/muraglioni-del-tevere/ ArchiDiAP - Department of Architecture and Design - Sapienza University of Rome, accessed 09/08/2022. "As part of the many cost-saving measures implemented during the construction process, the embankment walls were built as steep as possible in order

to use less travertine during their construction", in Carlson, The Past, Present, and Future of Flood Control in Rome [article], 2019, according to G. S. Aldrete, 2007.

17 "(…) the embankments were therefore designed 18.45 m high above the Ripetta zero level." In https://www.isolatiberina.it/index.php/en/tevere-e/muraglioni-e?showall=1 accessed 22/08/2022.

18 "We have seen how the Tiber is subject to differences of level, which reached 12,86 meters in the flood of Clement VIII., increasing fourteen times the volume of its waters. To give such a capricious river a regular outlet, modern engineers have built a uniform bed 100 meters in width, which has to serve for both droughts and floods. Their predecessors, on the other hand, had adopted a triple section, the narrowest to serve in time of drought, the second in moderate, the third in extraordinary floods (…). The advantages of the old over the modern system are obvious. With the old the river was obliged to run in every season of the year within limits well defined, and proportioned to its volume, without raising sandbanks and depositing silt and mud. The moderate height of each of the three receding steps allowed the river to preserve its pleasing aspect, as is the case in many of the modern capitals of Europe; while the huge walls between which we have transformed it into a deep and unsightly channel, with nothing to relieve the monotony of its banks." In Lanciani, 1897, p. 13.

19 Cf. s 18; 20.

20 "The construction of the walls, which in the urban stretch extend for a total length of eight kilometers, has drastically changed the building fabric and the road system of the ancient coastal districts: Campo Marzio, Ponte, Regola, Sant'Angelo and Ripa sulla left bank; Borgo and Trastevere on the right, destroying entire blocks that faced the river. With the works, numerous popular houses that stood on the river bed, noble palaces, churches, the Aurelian Walls overlooking the Tiber from Porta del Popolo to Testaccio are demolished and the port of Ripetta, built in 1704 by Alessandro Specchi, is destroyed. In reality, part of the port was only filled in and today it is still under the asphalt of Lungotevere in Augusta." In https://www.roma2pass.it/tevere/muraglioni/ accessed 12/08/2022.

21 Here, the two columns mark the entrance of the city by the sea, and act as an allegory of the two twin pillars, Jachin and Boaz, at the porch of the Masonic temple (in accordance with King Solomon's Temple, cf. Bible, 1 Kings 7:15-22). Here again, a symbolical eloquence that emphasizes an entrance, materialized, in this case, in the form of a neoclassical monumental "U" shaped river square - the Praça do Comércio - with one side open to the river, and hereby defines the axial urban design of all the city's downtown, which is currently known as the Baixa Pombalina. Here again, one must point out that this lowland is another most symbolic "terrain of water", as it was built over an ancient wetland area that was progressively drained by the Romans in Antiquity and can therefore be easily understood by direct analogy with the Campus Martius and the Palus Caprae in Ancient Rome (cf. F. Coarelli, 1997 and s 27; 32), (N/A).

22 As referred by Annalisa Metta. The author also quotes the paintings of Antonio Joli, Piazza Navona Allagata (c. 1750), Giovanni Paolo Panini, Veduta di Roma con piazza Navona inondata d'acqua e giochi di carrozze (1756) and Francesco Corsi, Il lago di Piazza Navona (1845), as testimonies of this ancient practise (cf. A. Metta, 2022).

For a contemporary example of this ludic concept, we can refer to the monumental miroir d'eau in the square of the Palais de la Bourse at Bordeaux, as the largest design of this type of architecture of water, built in 2006 by landscape architect Michel Corajoud (N/A).

23 Idem, ibidem.

24 Many sources point to large artificial basins created in the Roman period for this kind of spectacles, which were known in Latin as navalia proelia, as Ceaser's naumachia (possibly situated in the Campo di Marzio), Augustus naumachia in the Trastevere, or Tranjan's naumachia (Naumachia Vaticana), amongst others (N/A). Cf. https://en.wikipedia.org/wiki/Naumachia; https://en.wikipedia.org/wiki/Naumachia_Vaticana; https://pressbooks.bccampus.ca/spectaclesintheromanworldsourcebook/chapter/naumachiae-and-land-battles/ accessed 20/08/2022.

25 Cf. A. Metta, 2022. From the same author, see also https://www.youtube.com/watch?v=XfKzqJLy1Nw accessed 12/08/2022.

26 According to A. Metta, 2022. See also D. Da Cunha, 2018. As an example of the memory of water in Rome's toponymy, one should point out that the famous street named Via del Condotti (literally: "the street of the conduits") has this name because of the major underground pipes that were laid by Giacomo della Porta in that urban axis to bring water from the ancient aqueduct Aqua Virgo (built by Agrippa in 19 BC) and its successor, the Acqua Vergine (built under Pope's Nicholas V hydraulic reform that started in the Renaissance period), to the renaissance and baroque fountains (cf. Rinne, K. W., The Waters of Rome: Aqueducts, Fountains, and the birth of the Baroque City, Yale University Press, New Haven, 2011, and https://waters.iath.virginia.edu/acqua_vergine.html, accessed 20/11/2022, amongst others).

27 The Campus Martius (not to be mistaken with the actual fourth rione of Rome - Campo di Marzio - R. IV., which covers a smaller section of the original area) was originally the lowland area at the north of ancient Rome "between the city and the Tiber". At the center of that wetland was the Palus Caprae (meaning "Goat Marsh" or "the Goat's pool"), the pond area where, mythically, Romulus ascended to the sky. "The marsh was fed by a stream called Petronia Amnis, but by the Augustan period it had disappeared or been drained. The Palus Caprae was in the small basin where the Pantheon was later built [Cf. Richardson, 1992, p. 66 - N/A], west of the Altar of Mars supposed to have been established by Numa Pompilius, Romulus's successor. (…) [Filippo Coarelli conjectured that] "the mythic significance of the Palus Caprae was the reason for siting the Pantheon there." Cf. F. Coarelli, 1997.

28 Cf. Lanciani, R., The ruins & excavations of ancient Rome: a companion book for students and travellers, The Riverside Press, Cambridge, 1897, in https://archive.org/details/ruinsexcavations00lanc/page/138/mode/2up, accessed 20/07/2022 and https://www.digitalaugustanrome.org/records/stagnum-agrippae, accessed 20/08/2022, amongst others.

29 Arco, i.e., "vault" in Italian, hence the toponymy (N/A).

30 "Notwithstanding various repairs that clearly date to the later empire, the baths continued to be rebuilt along an asymmetrical plan (…) Some have argued that, since the imperial architects and their patrons eschewed a more modern, symmetrical layout, the later reconstructions must have preserved the initial Agrippan plan; the scale of the dome of the Arco della Ciambella, which aligns with Augustan comparanda such as the so-called Temple of Mercury at Baiae, could further support this reasoning. And while that is an appealing notion, based on the surviving physical evidence it is ultimately impossible to reconstruct anything more than the location of the original bath complex. Both the size and the layout of the late first-century B.C.E. Thermae Agrippae must remain speculative." In Kontokosta, 2019, pp. 53-54.

31 Op. cit. T. Schwenk, 1976, p. 13. Cf. 3, id., ibid.

32 Filippo Coarelli conjectured that] "the mythic significance of the Palus Caprae was the reason for siting the Pantheon there." [Cf. Coarelli, F., Il Campo Marzio: dalle origini alla fine della Repubblica, 1997], In https://en.wikipedia.org/wiki/Palus_Caprae, accessed 14/08/2022. See also 24.

33 Carta Idrogeologica di Roma/ Hydrogeological Map of Rome, September 2015, Publisher: Roma Capitale (Municipality of Rome), in https://www.researchgate.net/publication/281966009_Carta_Idrogeologica_di_Roma_Hydrogeological_Map_of_Rome, acceded 20/07/2022;

34 Cf. G. B. Brocchi, Topography of Rome, 1820; R. Lanciani, Hydrography & Chorography of Ancient Rome, 1897; Mario Bruni & Marco Mauti, Rome. The terrains of water, 2021; Matteo Polci, Rome. The terrains of water, 2016, according to A. Metta, 2022. The map of the 1870 exceptional flood (17,22 m at Ripetta) is quite demonstrative of the inundated Palus Caprae area in Campo di Marzio (N/A): cf. Plan of the Rome areas flooded by the 1870 flooding (dwg drawing by S. Pascolini; Bencivenga, M. et al., 1995, accessed 22/08/2022). The picture shows the areas flooded either by river or sewer overflow (N/A). See also the research project AQUAE URBIS ROMAE, created by Katherine Rinne in 1998, as "the first comprehensive, interactive study to examine water as a living system related to the 2800-year history of the urban development of Rome. Currently available as a prototype publication that is still under production, it is published on the world wide web by the Institute for Advanced Technology in the Humanities at the University of Virginia." In K. Rinne, Aquae Urbis Romae: The Waters of the City of Rome [article], in https://www.academia.edu/32924256/Aquae_Urbis_Romae_The_Waters_of_the_City_of_Rome; Idem, La Cittá Nuova: proceedings of the 1999 International Conference, ACSA, 1999, in https://www.acsa-arch.org/chapter/aquae-urbis-romae-the-waters-of-the-city-of-rome-2/; https://www.hiddenhydrology.org/aquae-urbis-romae-the-waters-of-the-city-of-rome/, accessed 12/09/2022; See also https://engineeringrome.org/2019-student-projects/ accessed 14/09/2022, amongst others.

35 Cf. https://www.floodmap.net/, amongst other flooding simulators.

36 Cf. 27

37 Cf. 27

38 The focus here is the city center: more down south we can also refer the districts of Testaccio, San Saba and Navigatore, amongst others (N/A).

39 Cf. https://commons.wikimedia.org/wiki/File:Map_of_downtown_Rome_during_the_Roman_Empire_large-annotated.jpg; https://wellcomecollection.org/works/v78dw9qd/images?id=uapg7wz7 accessed 19/08/2022.

40 The Velabrum is the valley located between the Capitolino and the Palatino hills (N/A).

41 "naumachia, (Latin, derived from Greek: "naval battle") plural naumachiae, in ancient Rome, a mimic sea battle and the specially constructed basin in which such a battle sometimes took place. These entertainments also took place in flooded amphitheatres. The opposing sides were prisoners of war or convicts, who fought until one side was destroyed.
The earliest naumachia recorded (46 BC) represented an engagement between the Egyptian and Tyrian fleets and was given by Julius Caesar on an artificial lake that was constructed by him in the Campus Martius." In https://www.britannica.com/technology/naumachia acceded 14/08/2022.

42 Cf. R. Lanciani, 1897. One must point that the naumachia spectacles in the Colosseum aren't completely as certain: "Martial, too, commemorates the display in what presumably is an eye-witness account, and certainly the image of the Colosseum arena being flooded is evocative. But, assuming that the spectacles occurred there and have not been confused with the naumachia Augusti, which would have taken too long to fill and likely never was drained, one wonders how it might have been accomplished." (…) Although it is possible that the venues have been conflated, Suetonius and Dio both are explicit in recording that naumachiae also occurred in the Colosseum." In The Naumachiae of Titus and Domitian, https://penelope.uchicago.edu/~grout/encyclopaedia_romana/gladiators/naumachiae.html accessed 14/08/2022. Actually, it is accepted that the flooding and drainage of the Colosseum was effectually possible. According to Martin Crapper: "Naumachiae are widely attested in ancient Rome (…) and there are references in the classical literature which appear to indicate that such water spectacles were mounted in the Colosseum. Martial and Cassius Dio make reference to this at the Colosseum's opening in 80 AD, whilst Suetonius writes that the emperor Domitian arranged mock sea battles in the amphitheater around 85 AD. (…). [The author's conclusion is:] "An engineering analysis has been carried out to determine if it were possible to flood and drain the Roman Colosseum in a reasonable timescale to allow the re-enactment of naval battles for entertainment. While there are a considerable number of missing links in the archaeological evidence, which preclude a fully detailed treatment, it is concluded that the amphitheater could have been filled in a time of 2–5 h, and drained again in a similar timescale." (Crapper, 2007).

43 For the hydrological maps of stream channels in ancient Rome and its topographic and urban morphological superposition, see the study in ACQUA URBIS ROMAE: K. Rinne, Hydrological setting, 1998-2001 in https://www.hiddenhydrology.org/aquae-urbis-romae-the-waters-of-the-city-of-rome/ accessed 13/06/2022.
44 We that several possible Sustainable Urban Drainage Systems (SUDS) strategies can also be implemented in Campo di Marzio (namely according to an adequate use of cladding materials), where a large number of streets are paved with the permeable traditional Sampietrini pavement. Although Sampietrini is a permeable bricked type of pavement, its maintenance, efficiency, and overall sustainability are somewhat questionable (N/A): "Despite their permeability being helpful in preventing floods, Sampietrini pavement is not the most structurally sound form of pavement, and will often take heavy damage from water. Heavy rainfall in the city has, over many years, eroded away the sand located between the joints of Sampietrini bricks, subjecting the pavement to many forms of distress that can harm the structural integrity of roads. (…) Furthermore, erosion from both water and vehicles on Sampietrini roads can lead to the formation of depressions in the pavement. During a minor flood event, water can gather in a depression and create a risk of hydroplaning for vehicles that drive over the depression." In J. Carlson (2019), according to P. Zoccoli, G. Loprencipe and A. Galoni, Sampietrini Stone Pavements: Distress Analysis Using Pavement Condition Index Method. Applied Science, vol. 7, no. 7, p. 669, 2017. doi:10.3390/app7070669.

45 See above, cf. C. Mattogno, B. Monardo, T. V. Di Giacomo and L. Kappler, 2021, amongst others, and 11.

46 Focusing specifically on water squares built projects, we should refer two paradigmatic case studies in Rotterdam: Benthemplein (De Urbanisten, 2013) and Bellamyplein (Rik de Nooijer, dS+V, 2012). On Benthemplein: "The water square combines water storage with the improvement of the quality of urban public space. The water square can be understood as a twofold strategy. It makes money invested in water storage facilities visible and enjoyable. It also generates opportunities to create environmental quality and identity in central spaces in neighborhoods. Most of the time the water square will be dry and in use as a recreational space." In https://www.urbanisten.nl/work/benthemplein acceded 9/09/2022; "The City of Rotterdam has completed a unique project which aims to control flooding and heavy rainfall. The Benthemplein, Rotterdam's first full-scale water square includes an outdoor sports venue, green areas, and even a theater for locals and visitors. The water square collects and stores rainwater in basins that are visible to the public. The stored water is diverted through steel gutters that run along the square in patterns. The design is centered around a multi-use sports field surrounded by graduated layers of stadium-style bleachers. Instead of hiding runoff water in underground pipes, the square has been designed to make water the main feature. During heavy rainfall, the water square can retain up to 1,700 cubic meters of water. The design also incorporates a self-irrigating water system to maintain green areas." In https://ec.europa.eu/environment/europeangreencapital/rotterdams-water-square/ acceded 9/09/2022. See also https://www.publicspace.org/works/-/project/h034-water-square-in-benthemplein: "Water Square in Benthemplein - Rotterdam (Netherlands), 2013 - A once-empty, monotonous square now holds three large rainwater collection ponds which, when the weather is dry, can be used as amphitheaters, basketball and volleyball courts, or skateboarding rinks." acceded 9/09/2022. Also, the same architectural office created the "Sponge Garden" (Rotterdam, 2019) as a very extended Sustainable Urban Drainage System in the same city: "(…) to test new concepts for collecting, retaining and returning rainwater to the natural environment. For this, experiments are being carried out with soil compositions, planting types, and sponge techniques." In https://www.urbanisten.nl/work/sponge-garden-dhkxw accessed 9/09/2022. See also https://www.urbangreenbluegrids.com/projects/green-water-square-bellamyplein-rotterdam-the-netherlands/ accessed 9/09/2022; See also F. Boer, J. Jorritsma and D. Peijpe, De Urbanisten En Het Wondere Waterplein, Rotterdam: Uitgeverij 010, 2010; J. Carter, G. Cavan, A. Connelly, S. Guy, J. Handley and A. Kazmierczak, Climate change and the city: Building capacity for urban adaptation, Progress in Planning, 95, 2015, pp. 1-66, and A. C. Bisschop, Spatial design as a tool to prevent pluvial flooding: a Rotterdam case study, Rijksuniversiteit Groningen Faculty of Spatial Sciences, July-2020, amongst others, accessed 12/08/2022.

47 We are referring here to the results from the workshop at Sapienza University, SOS Rome, March 2022 / SOS CLIMATE WATERFRONT - Horizon 2020 Marie Skłodowska-Curie Research and Innovation Staff Exchange (RISE) European Union.

48 As for SUDS contextualization and problematics on urban waterfronts, see D. Babalis, 2021.

49 As referred by Annalisa Metta. Cf. A. Metta, The Navona Lake and the eels of the Pantheon. Architecture and landscape for flooding / seminar Roman coastal system - architecture and landscape between history and climate change, [poster presentation] Faculty of Architecture, Sapienza University, 03.15.22, SOS Rome 2022 / SOS CLIMATE WATERFRONT. Regarding the same author, one must point its own design for the Flaminio district, Poste Urban park Rome 2018-19. See also 21.

50 As Theodor Schwenk remembers (cf. T. Schwenk, 1976, p. 13). See also 3 and 4.

51 As referred by Annalisa Metta (cf. A. Metta, 2022). See also https://www.youtube.com/watch?v=XfKzqJLy1Nw acceded 12/08/2022. To name but a few of these water symbolism of the

Pantheon: let us remember its duomo oculus, opened to the rainfall that drops in the marble concave pavement of the temple. There, twenty-two discreet holes drain water to the original sewer system that is still in use today (N/A). The same author also refers a Pannini's XVIIIth Century water-color representing the inside of the Pantheon flooded by the Tiber (Giovanni Paolo Pannini, Pantheon. Interno allagato con barche, ca. 1730) which was in possession of Rodolfo Lanciani and was mentioned in the author's book The ruins & excavations of Rome: a companion book for students and travelers (1897). As we have seen earlier, and according to our point of view, the flooding theme of this painting can also be related to an engraving by Volpato representing the "Temple of Mercury" from about the same period (see Figure 7). As we have recalled, this actually was not a temple, but the swimming pool of the Roman bath complex at Baia, and has a large domed structure that predates the Pantheon by more than one hundred years (N/A).

52 Cf. G. Bachelard, L'eau et les rêves. Essai sur l'imagination de la matière, Librairie José Corti 18, Paris, 1942

53 Cf. F. Coarelli, Il Campo Marzio: dalle origini alla fine della Repubblica, Quasar, 1997. See also 27.

54 "By constituting itself as an informal element by nature, the design attitude towards water is that of its containment or orientation because, as already mentioned, it is always situated before and after the form." In Conceição, p. 59. See also 2 and 5.

55 Idem, ibidem, pp. xi - xii; see also 7..

56 Cf. C. Norberg-Schulz, Genius Loci: Towards a Phenomenology of Architecture, Rizzoli, 1979, amongst others.

57 Cf. C. Renfrew (ed.) and E. Zubrow, (ed.), The ancient mind - Elements of cognitive archeology, Cambridge University Press, 1994, amongst others.

58 Cf. M. Eliade, Le sacré et le profane, Gallimard, Paris, 1965 and Traité d'histoire des religions, Payot, Paris, 1953, amongst others.

59 Cf. P. Ricoeur, De l'interprétation - essai sur Freud, Seuil, Paris, 1965.

60 Cf. C. Renfrew (ed.) and E. Zubrow, (ed.), 1994. amongst others

61 About the dichotomy between art and technique in modernity, see L. Mumford, Art and Technics, Oxford University Press, London, 1952, amongst others.

62 Or holism, the interdisciplinary idea that systems possess properties as wholes apart from the properties of their component parts. Cf. J. Smuts, Holism and Evolution, Gestalt Journal Press, 2013 [1st ed. 1926].

63 As it is not the aim of the present article to relaunch the debate between art and technique, artistry and craftsmanship (cf. Lewis Mumford), or reconsider the apologetics on tradition, ancient buildings, and vernacular architecture (cf. John Ruskin), or the attempts for the restoration of a "unified tradition" (as within the Arts and Crafts movement - cf. William Morris) or the Gesamtkunstwerk concept (cf. the Vienna Secession, the Bauhaus manifesto and modernism - cf. Walter Gropius), amongst others historical examples, although we mainly focus the "learning from the past" approach through the study and the possibilities of reusing ancient knowledge in the pursuit of innovative, ecological and sustainable solutions in the modern world, as defended by modern ecology pioneers such as Patrick Geddes and Hassan Fathy (H. Fathy, 1986, 1999 - cf. bibliography), amongst others (N/A).

64 Cf. Fig. 3-4 and 18.

65 Cf. Fig. 5 and 20.

66 Cf. 21.

67 Cf. 46.

68 Idem.

69 Cf. A. Malraux, Le musée imaginaire, Gallimard, Paris, 1965 [according to the author's homonymous essay from 1947].

70 Cf. C. Rowe and F. Koetter, Collage City, MIT Press, 1979, pp. 151 and 179.

71 "Roma interrotta" - Mostra organizzata dagli Incontri Internazionali d'Arte, Mercati di Traiano, Roma, Maggio-Giugno 1978 - Ed. Incontri Internazionali d'Arte, Officina Edizioni, Rome, 1978. Based upon the interpretation of Nolli's plan of Rome (1748), this 1978 exhibition in Rome and the resulting catalogue had contributions from Piero Sartogo, Costantino Dardi, Antoine Grumbach, James Stirling, Paolo Portoghesi, Romaldo Giurgola, Robert Venturi and John Rauch, Colin Rowe, Michael Graves, Leon Krier, Aldo Rossi, Robert Krier, Giulio Carlo Argan and Christian Norberg-Schulz. In https://monoskop.org/images/a/a5/Roma_interrotta_1978.pdf accessed 10/09/2022.

72 Pianta Grande di Roma, which Giambattista Nolli began surveying in 1736 and engraved in 1748, and is now universally known as the Nolli plan or the Nolli map. Cf. https://en.wikipedia.org/wiki/Giambattista_Nolli#Nolli_Map. For an interactive study of the Nolli plan, cf. Interactive Nolli Map Website 2.0 https://web.stanford.edu/group/spatialhistory/nolli/ accessed 31/08/2022 (N/A).

73 R. Lanciani, The ruins & excavations of ancient Rome: a companion book for students and travellers, The Riverside Press, Cambridge, 1897, amongst others.

74 F. Coarelli, Guida archologica di Roma, Mondadori, Verona, 1974; Il Campo Marzio: dalle origini alla fine della Repubblica, Quasar, 1997, amongst others.

75 A. Rossi, L'architettura della Città, CitàStudio Edizione, Turin, 1995 [1st ed. 1966], amongst others

76 F. Choay, L'Allégorie du patrimoine, Seuil, Paris, 1996, amongst others.

77 As a reference to Piranesi (1720-1789), Volpato (1735-1803), and Canaletto (1697-1768), amongst other authors who contributed to a large number of XVIII referential paintings and engravings which are valuable as testimonies not only of historical buildings and sites but also of the imaginary: cf. Canaletto's Capriccio: A Palladian Design for the Rialto Bridge, with Buildings at Vicenza, c. 1740, in https://hoocher.com/Giovanni_Antonio_Canal/Giovanni_Antonio_Canal.htm acceded 31/08/2022; Giambattista Piranesi, Veduta del Porto di Ripetta, c. 1760, in https://romaierioggi.it/porto-di-ripetta-piranesi-1760-ca/; Giovanni Volpato, Temple of Mercury, large Roman thermal pool, also known as 'truglio' for its circular shape, Baths of Baia Archaeological Park, 1st century, Campania, Italy, engraving by Giovanni Volpato from a drawing by Natali, Naples, 1768, in https://www.gettyimages.be/detail/nieuwsfoto%27s/exterior-of-the-temple-of-mercury-large-roman-thermal-nieuwsfotos/1150946755; See also Barbero, L.M., Bevilacqua, M., De Lucchi, M., Gagliardi, P., Martoni, A., Valtorta, R., Piranesi Roma Basilico [cat.], Contrasto, Milan, 2019, amongst others. Let us not forget that the number of examples is large and the need of a formation of strategies is imperative in the referential speech, as Michel Foucault pointed out in L'archéologie du savoir (Gallimard, Paris, 1969), (N/A).

78 Regarding advanced technologies and sustainable design practices on Mars, we should refer to NASA's 3D Printing Centennial Challenge, which is a design competition for human habitation on Mars, amongst others. The competition sought perspectives from outside the aerospace industry to explore how a human habitat could be designed and delivered on Mars using autonomous 3D printing technologies and sustainable design practices. Cf. Muthumanickam, Naveen Kumar & Duarte, Jose & Nazarian, Shadi & Memari, Ali & Bilén, Sven. (2021). Combining AI and BIM in the design and construction of a Mars habitat. 10.4324/9780367824259-17 in https://www.researchgate.net/publication/350172943_Combining_AI_and_BIM_in_the_design_and_construction_of_a_Mars_habitat, accessed 2/02/2023; Muthumanickam, Naveen Kumar & Park, Keunhyoung & Duarte, Jose & Nazarian, Shadi & Memari, Ali & Bilén, Sven. (2020). BIM for Parametric Problem Formulation, Optioneering, And 4D Simulation of 3D-Printed Martian habitat: A Case Study Of NASA's 3D Printed Habitat Challenge, in https://www.researchgate.net/publication/341451080_BIM_for_Parametric_Problem_Formulation_Optioneering_And_4D_Simulation_Of_3D-Printed_Martian_habitat_A_Case_Study_Of_NASA's_3D_Printed_Habitat_Challenge, accessed 2/02/2023, amongst others. See also https://www.ted.com/talks/jose_pinto_duarte_how_can_3d_printed_homes_for_mars_address_the_housing_crisis_on_earth, accessed 12/12/2022.

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Giovanni Volpato, Temple of Mercury, large Roman thermal pool, also known as 'truglio' for its circular shape, Baths of Baia Archaeological Park, 1st century, Campania, Italy, engraving by Giovanni Volpato from a drawing by Natali, Naples, 1768, in https://www.superstock.com/asset/temple-mercury-large-roman-thermal-pool-also-known-truglio-its/1788-111118994 accessed 8/08/2022.

Bruni, M., Mauti, M., Wild commons in Rome, 2021 [Master's thesis in Architecture - Urban Design]. Supervisors: Prof. Francesco Careri, Prof. Fabrizio Finucci, Prof. Annalisa Metta [E-book https://issuu.com/marcomauti/docs/bruni_mauti_tesi accessed 12/08/2022.

https://issuu.com/matteopolci/docs/port_folio

https://pressbooks.bccampus.ca/spectaclesintheromanworldsourcebook/chapter/naumachiae-and-land-battles/

Plan of the Rome areas flooded by the 1870 flooding (dwg by S. Pascolini; from M. Bencivenga and others - 1995), in https://www.isolatiberina.it/index.php/en/tevere-e/muraglioni-e?showall=1 accessed 22/08/2022.

https://waters.iath.virginia.edu/acqua_vergine.html

https://www.floodmap.net/

www.digitalaugustanrome.org

https://www.reed.edu/ara-pacis/drawings/1897-lanciani/lanciani-1.php

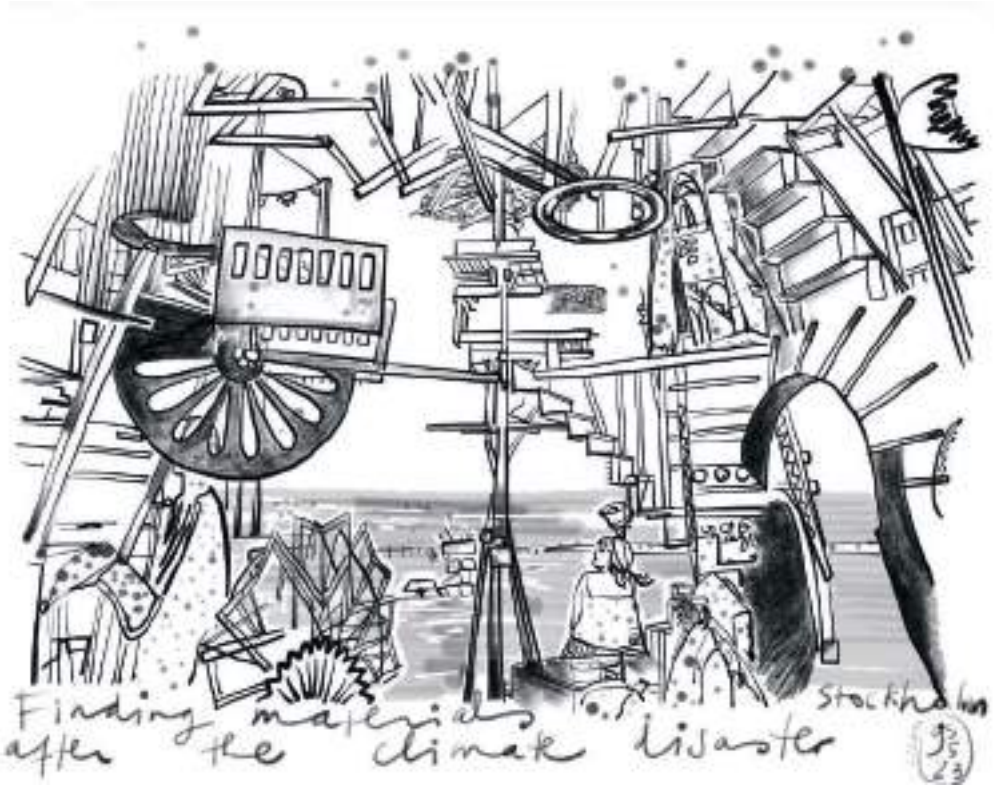
https://en.wikipedia.org/wiki/Naumachia

https://en.wikipedia.org/wiki/Naumachia_Vaticana

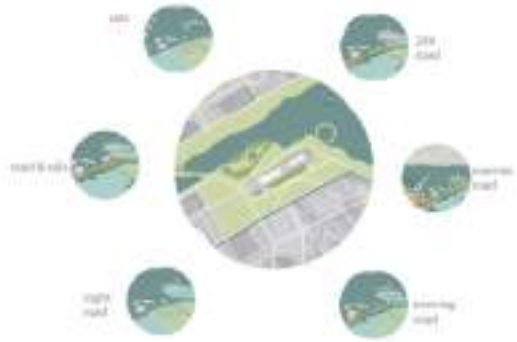
https://pressbooks.bccampus.ca/spectaclesintheromanworldsourcebook/chapter/naumachiae-and-land-battles/

Team Project I

The Arc, Stockholm

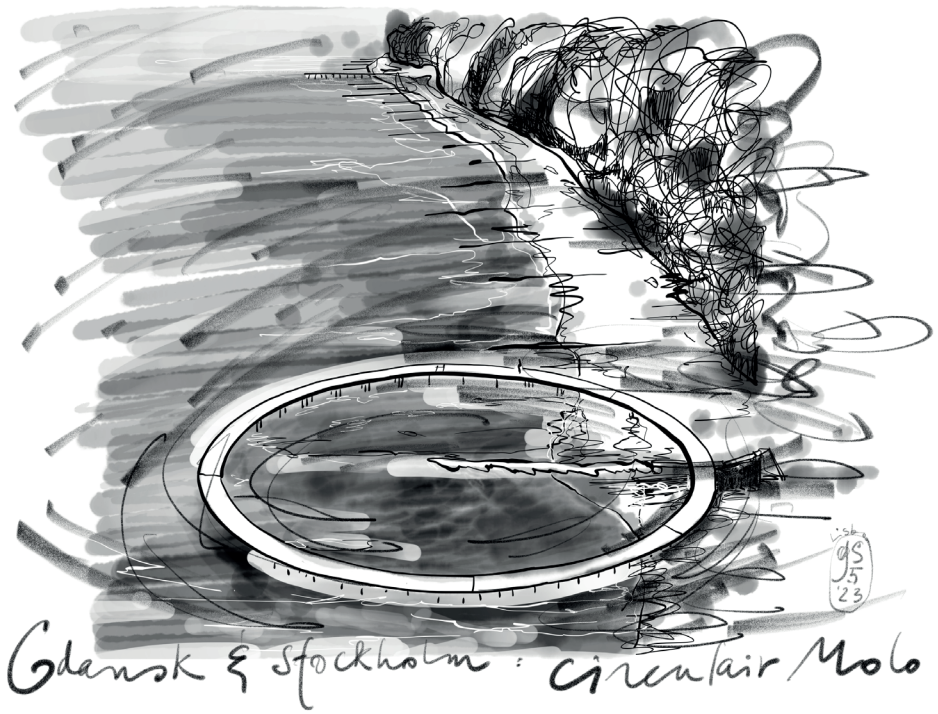


It is proposed to implement green infrastructure along the harbour of Frihamnen waterfront. The new green areas change the existing concrete pavement to permeable surfaces to manage excess rainwater and introduce the sponge effect. Public transport systems will be sustainable, including buses, walking and cycling to reduce greenhouse gas emissions. The current shortage of youth housing requires an increase in supply. The project proposes the reuse of a linner into permanent housing combined with workspace to encourage social collaboration and engage local skateholders in transforming this part of the city. The solution presented is based on three interconnected ideas; Adaptation, Inclusion and Repair... the “AIR”. Adaptation; Adapt to climate change, mitigate and contribute to sustainability by developing the place. Inclusion; Creating a liveable habitat for plants, animals and humans of all kinds that can inhabit the place and be mutually connected. Repair; Making the place sustainable before further development and construction of more tradicional buildings.

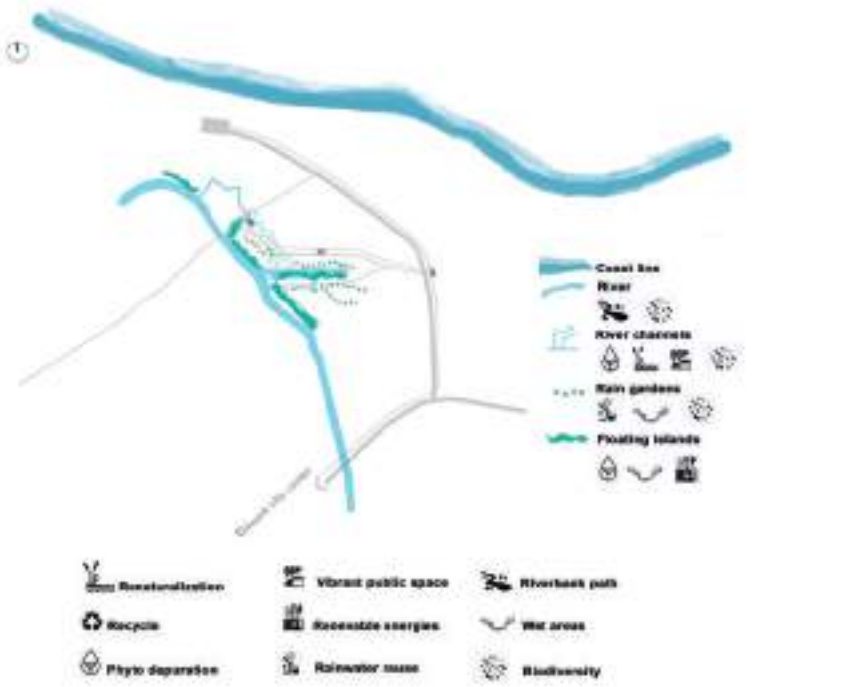


Team Project II

A Leaf on the Water, Gdansk

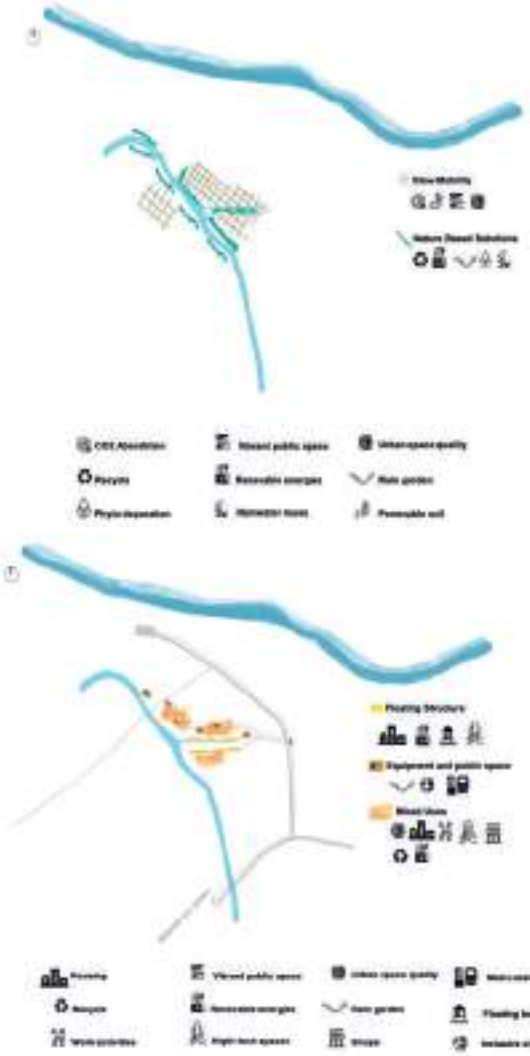


The project focuses on the historic are of Wisłoujście Fortress in Gdańsk, situated in the delta formed by the Vistula River, which undergoes continuous transformations due to sediments and oscillations of the Black Sea. The project aims to preserve the fortress, a Natura 2000 site, and the historical memory of the area. It revitalises the area by creating a network of green public spaces and canals, emphasising the coexistence of the fortress, the river and industrial structures, while proposing a new residential area. To cope with frequent water level changes, floating structures, new river banks and paths are proposes, including a pedestrian bridge and cycle path to connect Gdynia to Wisłoujście and Westerplatte. The project includes the development of the Quay north of the Fortress into a recreational area and the transformations of a new residential neighbourhood into a car-free zone with floating green structures and housing.


Coast line
River
River channels
Rain gardens
Floating islands
Renaturalization
Recycle
Phyto depuration
Vibrant public space
Renewable energies
Rainwater reuse
Riverbank path
Wet areas
Biodiversity


Riverfront renaturalization
Planted promenade pier
Rain gardens
Urban gardens
OSTAR, bio activ green
Protected area Natura 2000
Recreational areas
Renaturalization
Recycle
Riverbank path
Planted promenade
Picnic areas
Playgrounds
Sport facilities
Rain garden
Pedestrian path
area park
Urban agriculture
Biodiversity


Urban roads
Cyclist roads
Bus wings
Bus road
Railway
Metro station
Connections to the center
Vibrant public space
Urban space quality
Bus/coal connections
Inclusive city
Rain garden
Highclash spaces
SPACE
Green mobility


Nature Based Solutions
CO2 Absorption
Vibrant public space
Urban space quality
Recycle
Renewable energies
Rain garden
Phyto depuration
Rainwater reuse
Permeable soil

Floating Structure
Equipment and public space
Mixed Uses
Housing
Recycle
Vibrant public space
Renewable energies
Urban space quality
Rain garden
Shops
Metro station
Floating buildings
Inclusive city

Chapter 2

Urban Waterscapes

Katarina Larsen
Lucyna Nyka
Justyna Borucka

Urban Waterscapes

Introduction

The theme of urban waterscapes, brings attention to the visual qualities of urban waterfronts but also acknowledge the broader interdisciplinary knowledge bases required to fully understand both the waterscapes above ground that may be directly affected by consequences of climate change, but also the underground urban water management of water in dynamic situations with risk of flooding affecting citizens and urban infrastructures.

The texts included in the section, address some key challenges related to how to design solutions to address climate challenges in urban spaces across Europe.

In contemplating the urban configurations of tomorrow, particularly those situated at the intersection of land and water, exemplified in urban waterscapes, it becomes imperative to glean insights from diverse viewpoints. Delving into historical, social, and economic analyses and comprehending the intricacies of this multifaceted environment will aid in discerning the prospective needs that cities must address in light of climate change.

Drawing from past experiences is also essential when considering solutions. Urban waterfronts have historically played a pivotal role in city development (Konvitz 1978, 2019). Examining this history offers valuable insights into how these areas evolved, providing lessons that can shape resilient and sustainable urban waterscapes in the face of climate change (Giovinazzi, Moretti 2010, Nyka et al. 2022). Strategies derived from these experiences honour the traditions and cultures of these places. Certain texts in this chapter strongly relate past ideas to the vision for future urban waterscapes.

Additionally, the social aspect is a crucial consideration in understanding public spaces. This chapter emphasizes creating public awareness and engaging the community in a participatory manner. Incorporating tradition and culture into future urban waterfronts is closely linked to fostering a conscious society adaptable to change and cognizant of cities' transitional needs. Active community engagement through participatory design is pivotal in the transformative processes of cities (UNCED 1992, IPCC 2018, Few et al. 2007, Ayers, Forsyth 2009). Considering the social

aspect when formulating solutions for climate change risks in cities is of utmost importance. Citizens' narratives of urban spaces should be integral when conceptualizing urban spaces in harmony with water and nature.

Examining water spaces across diverse cities and employing analytical frameworks to explore historical practices, social dynamics, and economic circumstances offers profound insights into their evolution. This understanding becomes instrumental in devising strategies to fortify upcoming urban waterfronts against climate change. This involves crafting inventive urban and landscape visions that integrate historical and social perspectives, drawing from lessons derived from the development and comprehension of urban waterscapes.

The research experiences from the European Horizon 2020 project SOS Climate Waterfront shed light on different paths for rethinking cities as laboratories for innovative strategies to address climate change, placing urban waterfronts at the forefront of adaptation schemes. They reveal how concepts and approaches such as sponge city, porous city, or water-sensitive urban design could be translated into specific design solutions and how cross-visions between cities contribute to rethinking urban territories. It also becomes evident that urban transformation has always been based on interdisciplinary approaches, with new ideas emerging from the exchange of expertise integrating various fields of knowledge, such as geography, social sciences, and the environment. For instance, enhanced by Nature-based Solutions (NbS), urban green and blue spaces, like parks, rain gardens, and greenways, go beyond their role in stormwater abatement to address both the restoration of ecosystems and the promotion of human health and well-being. Similarly, rethinking land-water boundaries to manage changing water storage capacity and sustain natural riverine ecosystems calls for inter-sectoral collaboration.

Often, modifications of the land-water interface aim to create innovative waterfront public spaces. These spaces emerge within fluid and expansive transition zones between land and water, often replacing the rigid lines of embankments. Waterfront public spaces can take various forms, including promenades, water squares, floating terraces, artificial islands, buffering parks, or passages through wetlands. To adapt to unpredictable weather events, their outlines are designed to change with different water levels. Intertwined with urban greenery systems, these spaces not only enhance biodiversity but also contribute to the aesthetic

appeal of cities, engraving urban landscapes with natural elements, offering recreational opportunities, and fostering community engagement. Drawing from various disciplines, such as urban planning, environmental science, public health, or psychology, contributes to a comprehensive understanding of the importance of water-related public spaces and their key role in promoting resilient and harmonious urban communities.

Overview of the Thematic Chapter.

Based on experiences from the SOS Climate Waterfront project, this chapter aims to enhance understanding of how different scales of urban and landscape planning, architectural design, heritage perspectives, and environmental engineering technology link together in water-related strategies and how they impact each other in defining preventive action plans. The findings allow for a better understanding of the impacts of climate change on urban territories and indicate paths for further research based on the integration of environmental, technological, and urban design perspectives. By posing new challenges, they also foster the pursuit of innovations in climate-resilient urban and landscape design and planning.

The text about sustainable drainage systems, written by Brattgård, raises relevant questions about how consequences of climate change in terms of risk for flooding in cities and how drainage systems need to be designed to manage transporting large volumes of water. Tracing stormwater management back to the end of the 1900s and learning from different models in US and Europe, the author is stressing the need for strategies for managing situations of flooding, in the urban context. Thereby, extending the discussion of climate change beyond topic of sea level rise to addressing strategies for extreme events of flooding in cities like Stockholm. Although Scandinavia has historically experienced land-rise (due to pressures from thick cover of ice) modern cities will nevertheless need to prepare for flooding appearing as a consequence of climate change. One strategy is to continue learning from different models of water management for a resilient system of underground solutions are also a part of the urban waterscape, even if is hidden below the city.

The analysis of River Contracts in Abruzzo draws, written by Angrilli and Ciuffreda, on experiences from Italy and discusses possibilities of the model of river contracts to for strategies that could potentially integrate water policies with land-use planning.

However, experiences from the 17 river contracts also points to the complex nature of stakeholder interaction of blue spaces in cities. One important component is raising awareness of citizens of the neighbouring villages near the river basins and particular challenges with upgrading blue-green spaces including river banks.

The examination of a Hybrid Urban culture in Stockholm, written by André Augusto Prevedello, takes departure in hybridization between natural and cultural landscapes. Applied to the area of Hornsbergs strand and area of Frihamnen in Stockholm, the authors are discussing Nestor Canclini's concepts of detorritorialization and retorritorialization. The waterfront area is designed and constructed as a revitalization project with a waterfront area enjoyed by citizens for swimming, picnics and kayaking. Solutions that can mitigate effects of floods are discussed, with the ambition of allowing for movement of both people and cars, but also the growth of fungi and grass. These types of suggestions with a blue-green hybrid zone requires extensive citizen dialogues, involving construction companies, municipality planning department, park management authorities to be a practical reality of the future. Waterfronts have a strong visual character, and frequently, the analysis urban waterscapes evokes strong opinions of different interest groups.

Documents such as the 2030 Agenda for Sustainable Development, adopted in 2015, the Paris Agreement, and the impactful report "The Future of our Past," explicitly acknowledge that culture and heritage can guide choices towards building the resilience of cities by revealing "climate-resilient development pathways" (TFOUP Report, p. 7). Following this trajectory, Giulia Luciani explores Beyond Green and Blue: Ecohistorical Infrastructures for Water Landscapes and demonstrates that water landscapes are exceptionally rich in natural and cultural layers where biological landscape systems and the history of the place intertwine. From this perspective, heritage in waterfront territories should not only be perceived as a subject of protection but also as an active tool for strengthening the resilience and identity of urban spaces. This infrastructural approach becomes a tool to transcend the boundaries of various disciplines that often treat water, ecological processes, and heritage as separate entities, leaving their interconnections and potential synergies largely unexplored. Luciani proposes ecohistorical infrastructures as devices to deepen the relationship between the natural and cultural aspects of water landscapes, highlighting their synergistic potential.

Examining the territory from a socio-ecological perspective, Anahita Azadgar presents design proposals aimed at the revitalisation of the neglected spaces surrounding Goharrud River in Rasht, Iran. The socio-ecological approach integrates diverse elements such as native vegetation, wildlife habitats, riverfronts, ecosystem services, resilience, and social considerations. Despite the advantages of socio-ecological urbanism in revitalizing riverfronts, there remains a noticeable scarcity of research that explores this approach through diverse case studies and design projects. The study places significant emphasis on benefits of integrating ecological and social considerations into urban planning and design.

The urban waterfront areas and cities waterscapes will be affected by consequences of climate change – today and tomorrow. With new solutions emerging with inspiration from nature-based solutions (UN 2020) and arguing that design-solutions need to embrace the expected flooding with buildings that can change and adapt with the landscape around them and also engage in dialogues with citizens in new ways with different senses (Dethlefsen 2023). Other studies are focusing on the visual character of urban waterfronts in cities across the world (Luo et al. 2022), we see a highly interdisciplinary scholarship emerging drawing on empirical cases. The empirical knowledge, combining understandings of water systems in cities and willingness to share experiences from different types of urban waterfronts, is required to face consequences of climate change we see today including flooding, extreme weather events, sea level rise, and heatwaves accelerating in urban spaces. Furthermore, by acknowledging the wide range of future expected (and unexpected) severe consequences from climate change on the horizon, the development and reshaping of urban waterscapes can contribute to more resilient future urban spaces.

In conclusion, this comprehensive exploration of urban waterscapes presents a multifaceted understanding of their significance, offering insights from historical, social, and environmental perspectives. It emphasizes the critical role of traditions, citizen engagement, and interdisciplinary collaborations in crafting resilient urban landscapes in response to climate change. By delving into various case studies and approaches, the essays in the chapter underscores the imperative for inclusive dialogue, adaptive designs, and innovative strategies in shaping sustainable and adaptable urban waterscapes for the future.

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Nils Brattgård

Local Handling of Stormwater in Stockholm

Lessons from Sustainable Drainage Systems

Stormwater management (SWM), or urban drainage as it is also called, has been a concern since at least 3000 B.C. (Fletcher et al., 2015; Kirby, 2005). The way the topic has been framed has varied over time, however. In the beginning, drainage was concerned with the transporting of large volumes of rainwater out of the city to reduce the risk of flooding (Fletcher et al., 2015) and protect public health (Vollaers et al., 2021). This meant a focus on the shape of the urban environment, and in more recent times, the use of technical infrastructure to convey the water, primarily through cities sewer systems (Vollaers et al., 2021). As the global temperature rises due to climate change, cities expect changes in yearly rain volumes and rainfall intensities (Ballard et al., 2015; Stockholms stad, 2013). The challenges posed by these increasing volumes are further elevated through increasing densification and hardening of urban areas, allowing more water to run off the cities surfaces (Kirby, 2005).

The Nordics have already experienced what a lack of preparedness means. In 2021, Gävle, a city in the northern part of Sweden, experienced 161.6 mm of rainfall in 24 hours which resulted in major damage to infrastructure, and costs in the millions (Gävle kommun, 2023). Copenhagen, meanwhile, has experienced multiple large rainfall events. The largest one in 2011 caused 5-6 billion DKK in damages (City of Copenhagen, 2012). But improper SWM also affects the environment. Fast water flowing into lakes from pipes can harm coastlines, and contaminated stormwater or combined sewer overflows can impact the water quality in the receiving water bodies (Ballard et al., 2015).

These new circumstances, led to the realization that existing drainage systems cannot handle the flows at a reasonable cost, if at all (Stockholms stad, 2013). Many places started using various types of natural structures (often called (Blue-)Green Infrastructure (GI) (e.g. Suleiman, 2021; Fletcher et al., 2015)) to improve SWM, whether that be the quality of stormwater, the quantity conveyed or both (Fletcher et al., 2015).

1.1 The Creation of New Terms and Concepts

New terms used to indicate the changes in SWM practice thus started appearing towards the end of the 1900s (Fletcher et al., 2015). In the US, Best Management Practices and Low Impact Development took a foothold and later spread throughout the world (Fletcher et al. 2015), while Water Sensitive Urban Design (WSUD), Sponge Cities and other similar terms developed in various countries across the world (Deletic et al., 2020). Some countries in the European Union (EU) have adopted these terms, either outright or by translating them into the native language, while others developed their own terms and concepts (Fletcher et al., 2015). Two of these are Sustainable Drainage Systems (also known as Sustainable Urban Drainage Systems) originating in the United Kingdom (UK) (Ballard et al., 2015; Fletcher et al., 2015) and Lokalt Omhändertagande av Dagvatten (LOD, local handling of stormwater in English) in Sweden (Fletcher et al., 2015). The terms and concepts are in large part interchangeable, but each term may provide its own set of guidance and tools (e.g. The BMP Database and The SuDS Manual (Fletcher et al., 2015)).

1.2 The Role of Comparison

Comparisons can play an important role in the development of knowledge (Boroditsky, 2007), and are used in a variety of fields of study. In SWM, comparisons are frequently made between different types of GI (e.g. Bastien et al., 2010), and different management approaches (e.g. Zhang et al., 2017; Bastien et al., 2010). Similarly, comparisons can be made between different countries' policy and the resulting practice.

The act of comparing two things against each other can emphasize similarities, but crucially, also bring differences into light. Boroditsky (2007) found that two similar items will often appear more similar to each other when compared, while two differing items will often appear more dissimilar. At the same time, they also conclude that searching for differences may uncover similarities because the most meaningful differences are found in structural similarities (ibid.).

1.3 Establishing a Basis for Comparison

LOD appears in a lot of research in Swedish, but most importantly in local policy and planning documents, including Stockholm (Fletcher et al., 2015, Stockholms stad, 2013). In broad strokes, LOD refers to source or site control (Berggren et al., 1991; Fletcher et al., 2015; Stockholms stad, 2013). The term first took shape during the 1970s (Berggren et al., 1991). At first it meant using gravel-filled soakaways to infiltrate water, but it has since come to include several GI building blocks that can be combined with each other and more conventional technical solutions (Svenska vatten- och avloppsverksföreningen, 1983). Since the beginning of the 1990s, there has seemingly been relatively little development. Today, Swedish municipalities describe LOD as management of runoff on each individual plot of land (Täby kommun, 2022) to allow for attenuation, infiltration (Lidingö stad, 2020), and treatment (Värmdö kommun, n.d.). While there is – to the author's best knowledge – no national policy document for LOD, there are advisory documents published by Svenskt Vatten (en: Swedish Water) – the trade organization for the public waterworks companies – on specific solutions and more general guidelines on various SWM topics (Svenskt Vatten, 2022).

Figure 38 Collage of tree planting methods in urban areas. (credits: author)

SuDS shares many similarities to LOD. SuDS was developed during the 1990s in Scotland (Fletcher et al., 2015; Kirby, 2005), where it has been used since. Guidance for the concept has developed over time, from 'similar, but separate' guides for different parts of the UK (Fletcher et al., 2015, p. 5), to the general guidelines for SuDS provided by The SuDS Manual (Ballard et al., 2015). SuDS guiding principle is the maximization of the benefits and minimization of negative impacts of runoff by mimicking the natural state of the ground (Ballard et al., 2015). Further, SuDS should — much like LOD solutions — not be seen as a single component but as an 'interconnected system, designed to manage, treat and make the best use of water' (Ballard et al., 2015, p. 27). The wide range of components, and flexible nature of SuDS, means that the concept can be applied anywhere (Ballard et al., 2015).

2 Stormwater Management using Sustainable Drainage Systems

SuDS are used in all parts of the UK, though it was created in Scotland, where it has been used to a much greater extent than in England and Wales (Kirby, 2005). The SuDS methodology has been used in both new developments and in refurbishment of existing environments (Ballard et al., 2015; Vollaers et al., 2021).

2.1 SuDS Guiding Principles

The guiding principle of SuDS is to mimic the natural drainage processes an area exhibits before development (Kirby, 2005). It makes sense, then, that SuDS performance is evaluated against a baseline set by the natural hydrology of the site (Ballard et al., 2015). The performance is proposed to be evaluated based on four design criteria (Ballard et al., 2015), extending the commonly cited urban drainage triangle (quantity, quality, amenity) (Fletcher et al., 2015, Kirby, 2005) with biodiversity.

It should come as no surprise that water quantity and quality are likely to be the driving factors behind the design of a SuDS (Ballard et al., 2015). EU legislation has focused and clarified the requirements for water quality through the Water Framework Directive (WFD) (Directive 2000/60/EC) and flood risk (Directive 2007/60/EC), guaranteeing at least two topics to be covered. The following analysis of SuDS practice will be focused primarily on these factors, as well as the institutional framework around SuDS usage.

2.2 The SuDS Management Train

The SuDS Management train is argued to be a leading factor behind the success of a SuDS system (Ballard et al., 2015; Kirby, 2005). At its core, the Management train only implies the usage of multiple different types of SuDS devices / measures (Ballard et al., 2015). The chaining of multiple measures has shown to improve, above all, the treatment performance of the SuDS system (Bastien et al., 2010). Following SuDS principles, these measures are meant to be dispersed throughout the development, but many SuDS systems nonetheless choose to use a single end-of-pipe solution (Bastien et al., 2010). The management train concept can be extended further by adding spatial boundaries within system design (Kirby, 2005):

- Source control, where water is dealt with on each landowners' lot.
- Site control, where multiple buildings may share a larger SuDS installation.
- Regional control, involving a few large-scale treatment steps.

The idea is that runoff should be utilized, infiltrated, or stored as locally as possible, with the increasing spatial scale indicating the ability to handle larger rain events (Bastien et al., 2010; Kirby, 2005). The SuDS Manual (Ballard et al., 2015) recommends complete interception for relatively small rain volumes (5 mm), covering commonly occurring small rain events, or the first flush of larger rainfalls. The recommendations for flood prevention, cover larger rainfalls. Rain up to at least a 30-year return period should not lead to any flooding on site, and the built environment should withstand rainfalls up to a 100-year return period (or 200 years in Scotland) (Ballard et al., 2015).

2.3 Regional Differences in SuDS Implementation

Implementation of SuDS is not equal. The success of projects varies greatly due to different approaches (Bastien et al., 2010, Vollaers et al., 2021), but also varying levels of knowledge, potentially leading to failures in the SuDS scheme (Vollaers et al., 2021). There are, however, also differences between implementation within the UK, in large part due to differing planning systems and institutional arrangements (Kirby, 2005; Potter & Vilcan, 2020).

Implementation of SuDS in England and Wales has been hamstrung by the legislation phrased around the older way of working with technical infrastructure (Kirby, 2005). Interest in SuDS implementation exists among planners in England, but they are limited by a lack of legislative backing, the neoliberal planning sys-

tem giving power to developers, and a lack of resources (Potter & Vilcan, 2020). Additionally, the responsibility of planning drainage systems falling on local government while the agenda can be set by the national government does not provide the best opportunities for creating good SuDS (ibid.). The result is the utilization of 'bog standard' SuDS solutions (ibid., p. 15) and at least one planner in England looking enviously at Swedish SWM (ibid., p. 15, 16).

Up to the end of the 1990s, Scotland had many of the same issues as England and Wales, though the formation of the SuDS Scottish Working Party (SuDSWP) allowed these issues to be overcome to a large extent (Kirby, 2005). The creation of a common design manual, agreements concerning the responsibilities of SuDS, and clear guidelines for SuDS requirements in planning were particularly important accomplishments (ibid.). Since then, research has been conducted on a broad scale, gathering qualitative data for SuDS implementations to further SuDS development in Scotland (ibid.). Today, SuDS are required for all new developments and are commonplace in Scotland (ibid.), though large and visionary projects can still have problems finding funding (McLean, 2016).

2.4 Causes of Failures

Vollaers et al., 2021 found that SuDS systems may fail at any stage in their life-cycle. Further, they found that many failures occurred due to lack of experience and knowledge of the planners. The use of SuDS sets new demands on the people in charge, requiring new sets of knowledge (ibid.). There is also a need for policies, guidelines, and standards supporting these new planning

Figure 39 Rain garden on a street in Amsterdam, showing different outcomes using the same stormwater management measure.
(credits: author)

paradigms (Vollaers et al., 2021, Kirby, 2005).

It's easy to see that the conclusions of Kirby (2005) are true even today. The role the SuDSWP had in elevating Scottish SuDS practice can't be understated. Their work in creating comprehensive manuals and studying SuDS performance was especially important in bridging the knowledge gap leading to system failure. In the time since 2005, the SuDS Manual was written to provide comprehensive guidance for England and Wales as well.

3 Stormwater Management in Stockholm

Stockholm started working with stormwater using LOD concepts in 1994 to reduce pollution in the cities waters caused by the duplicate drainage system (Stockholms stad, 2013). The first stormwater strategy was created following this line of thinking, to later be replaced by the current version (ibid.). SWM practice has since expanded to also include challenges related to flooding, amenity and biodiversity. Water quality is still a focus, likely fuelled by the need to reach good water status as defined by the WFD (Directive 2000/60/EC), a goal which is seemingly still far away (VISS, n.d.).

GI solutions are meant to be simple and small in scale, located both on individual lots and on public land. The strategy highlights a priority system—starting by reducing the amount of pollution runoff picks up, secondly reducing the amount of runoff on site, and only if this isn't enough, including larger scale tools within the catchment area. Supporting these goals, an action level (Stockholms stad, 2016a) has been created as a standard, requiring attenuation and treatment of at minimum 20 mm of rainwater to allow for a 70% reduction of pollutants. Though there has been criticism that this standard is too rigid, and possibly sets too high a requirement (Eliasson & Gidlöf, 2020).

Meanwhile, the requirements on flooding are relatively vague, with the stormwater strategy highlighting the need for setting a reasonable level of protection (Stockholms stad, 2013). The strategy highlights the need for reduction of volume through infiltration, decreasing peak flows through attenuation, as well as protecting infrastructure against damages caused by flooding.

3.1 Sustainable Stormwater Management Practice

Since the stormwater strategy and action level are implemented only for new development and significant redevelopments (Stockholms stad, 2013, 2016a) allowing for existing environments to remain as is. Gaining insights into current drainage prac-

tice thus involves analysing these newly developed areas.

Norra Djurgårdsstaden is one of the latest projects in Stockholm where sustainability is highlighted as a key development criteria (Stockholms stad, 2022). A comprehensive stormwater strategy has been developed specifically for the area (Olsson et al., 2011), setting a mandatory minimum level for all development in the area. GI are to be utilized and should be able to intercept a 2-year rain event, while the whole system should be able to handle at least a 10-year event without surface water pooling (ibid.).

Suleiman (2021) analysed three areas, with a focus on the planning process behind their creation.

- Hammarby Sjöstad acted as a test bed for new and innovative management methods (Suleiman, 2021). The area utilizes a large central canal to which rainwater is led from buildings and roads, a staircase shaped wetland combined with sedimentation basins, and a more standard wetland paired with three sedimentation basins (ibid.).
- Årstafältet is now on its second design after development plans were redrawn, consisting of a large-scale pond system towards the areas centre merged into a single water course (Suleiman, 2021) with local measures for rainwater reuse, treatment, and attenuation (Rydberg, 2009).
- In the Hornsgatan project, a new tree planting method was developed (Suleiman et al, 2020), which later came to be known as the Stockholm Model. Following this, a comprehensive guide was written concerning plant beds using trees (Stockholms stad, 2017), and the usage of trees has been added into legislation (Suleiman, 2021).

3.2 Open Issues

Suleiman (2021) found that the result of the recent developments in Hammarby sjöstad, Årstafältet and Hornsgatan are promising – and in large part successful – but are still inadequate in creating a suitable framework for sustainable SWM implementations (ibid.). Planners seemingly understand what sustainable SWM entails. However, they do not have the tools and adequate planning legislation framework to support their work (ibid.).

A large problem exists in communication and role distribution, both in planning and maintenance (Suleiman, 2021). While Stockholm municipality had interest in funding and creating successful schemes, the different actors in the city had different visions for the drainage systems (ibid.). In later stages, maintenance responsibilities were divided based on the type of infrastructure, which is problematic, since many GI have multiple uses and thus multiple maintenance needs ibid.).

Finally, learning experiences from implementations have been limited in part due to maintenance being outsourced to external companies with lacking interest in tracking performance over time (Suleiman, 2021).

4 Analysis and Conclusion

The challenges faced by stormwater management aren't unique to any one city, as is evidenced by shared international legislation in the EU. But each location will have a specific set of circumstances. In the coming years, Stockholm will have to deal with its dense inner city, continue to manage the water levels of lake Mälaren to avoid flooding, improve the water quality of water bodies to meet EU guidelines, manage the flood risk in built environments, and many other issues. Looking past the Swedish border to see how others have solved similar issues can help in forging a path forwards.

4.1 Institutional Framework

As Suleiman (2021) highlights, there is a need for reorganization of the institutional framework for stormwater management in Stockholm. Much like in England and Wales, planners are not opposed to sustainable drainage practice, and might even be keen to work with it more, but are limited by unclear legislation and complicated frameworks in the municipality.

The work in Scotland during the 1990s could be seen as a model to follow. Working with a group similar to the SuDS Working Party would be a first important step in the development of a framework for the distribution of responsibilities, both in maintenance and planning, as well as work towards the other challenges remaining for Stockholm's drainage practice. But pressure also needs to be put on the national government to adapt relevant legislation to new drainage practices. A Swedish Government Official Report concerning water in planning processes, to be completed in 2023, may be one step in this direction (Regeringskansliet, 2021).

4.2 Drainage Policy

The largest criticism that can be levelled at Stockholm's drainage policy is the apparent lack of any direct guidance on flood protection. There are only vague requirements to prevent damage caused by the water. Exact implementations are decided during

planning stages for developments, but even then, exact numbers may be unclear. In comparison, SuDS in the UK has a standard up to which damage to buildings has to be prevented—a 100-year return period in general, and 200-year in Scotland. To highlight the importance of water quantity next to quality, Stockholm could set a similar standard.

One of the large challenges in Stockholm is the ability to implement sustainable stormwater management in existing environments. A large portion of the dense urban centre utilizes a combined sewer (Stockholms stad, 2013), leading to risks of combined sewage overflows in the case of large rainfalls. At the same time, this environment creates the largest challenges when constructing stormwater management solutions due to a lack of space, and the need to demolish and reconstruct infrastructure.

Meanwhile, it's also possible that the action level might be set prohibitively high. Intercepting 20 mm of rainwater requires a large amount of space that may not be available. While it may not be a legally binding document, there is a risk that not achieving this goal leads to a lack of investment, even though small improvements may still be worthwhile. In such circumstances the 5 mm interception recommended by The SuDS Manual may be more reasonable. Having a split requirement could be one path towards faster implementation of stormwater management in existing environments by allowing the city to work in steps instead of all at once.

4.3 Learning From Past Experience

Another key factor in successful stormwater management implementation is experience (e.g. Kirby, 2005; Suleiman, 2021; Vollaers et al., 2021), which can be gathered by a sequence of practice / research, evaluation, and documentation.

Stormwater management occurs hands-on through practice, but also through more theoretical research and tests. The number of projects implementing stormwater management concepts is growing rapidly, as are the research projects Stockholm has participated in or conducted. Stockholm municipality has highlighted a number of water-related research projects it is participating in, many of which concern stormwater management (Stockholms stad, 2023a).

Not only the final result, but also the process leading up to it is important, as has been shown by Suleiman (2021). When evaluating a project, method, or tool, it's also important to note down institutional arrangements facilitating its success, or more importantly, failure (Navidi et al., 2017). Evaluating existing developments or ongoing developments is one possibility. Since many large-scale developments in Stockholm are ongoing, there are still enough opportunities for gathering data. Though that requires Stockholm municipality to take over maintenance. This may be one reason why the International BMP Database relies on volunteers providing data (Submit Data, n.d.). Similarly, the guides published by Svenskt vatten are created by a large variety of institutions.

Finally, documentation is essential to organizational learning, improving the quality of work and preventing the repetition of past mistakes (Navidi et al., 2017). The SuDS Manual is the prime example of documentation within SuDS. The Stockholm Water company, meanwhile, has created concise technical documents for a number of different drainage measures (e.g. rain gardens, Stockholm Vatten och Avfall, n.d.), highlighting key aspects, but not going as in depth as the document created for structural soil (Stockholms stad, 2017) or The SuDS Manual. Further, there is a broad technical handbook (Stockholms stad, 2023b) for all manner of constructions on public land, as well as stormwater management guidelines for three common typologies (Stockholms stad, 2016b, 2016c, 2021). Creating guidance for a large variety of measures could help particularly in the early conceptual design of projects (Navidi et al., 2017), potentially leading to a wider range of measures used.

4.4 The Future

Stormwater management in Stockholm has taken great leaps forward since the adoption of the Stormwater strategy. Nonetheless, a comparison with SuDS implementation in other countries, and Scotland in particular, shows room for improvement. The knowledge collected by Svenskt vatten mimics work done for SuDS and could possibly be expanded further to discuss a large variety of SWM issues similar to the SuDS Working Party, possibly improving institutional arrangements around stormwater management. The work on the national level should directly help in improving SWM locally as well. The most immediate need for improvement in Stockholm is the management of flood risk, where a concrete interception volume is currently missing in adopted policy. This issue, as well as the need for continued improvement of water quality in the city's water bodies, could be helped through a wider range of measures, possibly fuelled by improved documentation.

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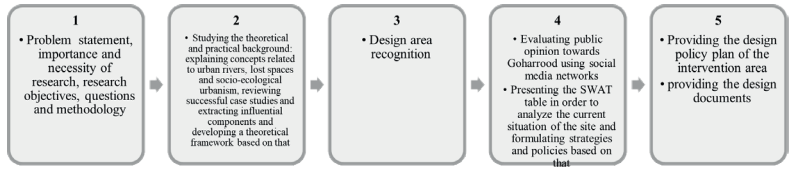
Revitalizing the lost spaces around Goharrud river in Rasht with a socio-ecological approach

Introduction

Rivers play a vital role in the natural landscape, providing several ecosystem services (Böck, Kerstin & Polt, 2018; Acuña, 2013). Despite this though, currently, they are often trapped within concrete walls, rendering them invisible from human sight (Blau, Marie-Luise & Luz, 2018; Clivaz & Reynard, 2018; Pareira et al., 2014). This situation has led to the creation of neglected spaces that serve as hotspots for social issues while accelerating their environmental degradation (Mandal & Das, 2018). But restoring and transforming urban river corridors into vibrant public spaces can help preserve urban ecosystems to a certain degree and create opportunities for recreational activities in urban areas, all while producing an appealing landscape (Everard & Moggridge, 2012; Guimarães et al., 2021). In recent years, adopting a sustainable approach has become the prevailing and customary practice for designing and revitalizing urban spaces. Despite its great value though, this approach is unable to provide comprehensive solutions for riverfronts due to the fact that it mainly focuses on the category of green design and pays little attention to social components (Graves, 2019). Hence, it is evident that the socio-ecological approach holds considerable appeal for the revitalization of riverbanks, given its emphasis on vital factors such as native vegetation, wildlife habitats, riverfronts, ecosystem services, resilience, and social considerations (Heymans, 2016; Dyson & Yocom, 2015; Sameeh, Gabr & Aly, 2019; Aalto, Marcus & Torsvall, 2018). However, despite the clear advantages of socio-ecological urbanism in riverfront revitalization, there is a scarcity of research exploring this approach through case studies and diverse projects (Barthel et al., 2013). This research gap underscores the need for further examination of the socio-ecological approach and its practical implementation in revitalizing riverfronts, thereby transforming neglected spaces into vibrant urban environments.

Goharrood River, once a key factor in the establishment of Rasht City, is plagued by the mentioned issues, including the dumping of waste, industrial and domestic sewage, and construction in its immediate vicinity. These problems starkly contrast with the recreational activities that used to thrive in the past, as today, people rarely engage in such initiatives in or around this river (Rezaei, Tajdari & Fatehi, 2017). Recognizing the urgency

of revitalizing these lost spaces along rivers and the dearth of urban planning studies with a socio-ecological approach, this paper presents Goharrud river (the area between Kargar St. and Azade St. in Rasht) as a model case study, aiming at improving its socio-ecological status through developing design strategies for its revitalization and transforming it into a vibrant collection of public spaces.



Methods

The research methods vary according to the nature of the subject and research objectives. This research can be considered of the applied type based on its goal and, in terms of time, it is cross-sectional, aiming to provide solutions to present issues. Applied research utilizes the knowledge and information obtained through foundational research to address human needs and enhance and optimize tools, methods, and models. Its focus lies in the development of well-being, comfort, and the advancement of human living standards (Hafeznia, 2016). According to the objectives of this research, the appropriate research method is descriptive-analytical. Exploring social networks was also utilized to gather public opinions about the river. Based on the site evaluation and public sentiment, a SWOT matrix was developed, leading

Figure 40 Research Structure (credits: author)
Figure 41 Aerial photos obtained from Google Erath on 9.10.2022 demonstrating city of Rasht (top, left), the vicinity area (bottom, left) and the study area (right) (credits: author)

to the formulation of strategies and policies. The study concludes with the creation of a 3D model using SketchUp software, providing different design views for better understanding the solutions.

Theoretical Framework:

Urban river revitalization refers to the restoration of waterways that have lost their ecological and social functions (Palmer & Allan, 2006; Nissen et al., 2012; Heikkila, 2011; Neruda, Tichonova & Kramer, 2012; Lee, Ma & Cheung, 20121). These revitalization efforts often target urban lost spaces, which are undefined areas lacking specific boundaries and functions (Trancik, 1986; Memarian, 2014; Hamelin, 2016; Khalid, Hilal & Marzukhi, 2018). In the context of cities as socio-ecological systems, the integration of humans and nature is a fundamental aspect (Plessis, 2008; Escalera-Reyes, 2020; Frank, Delano & Caniglia, 2017). The concept of socio-ecological systems recognizes the intricate and interconnected nature of urban environments, where humans are an integral part of the larger ecological framework (Resilience Alliance Organization, 2006). The application of this approach in urban planning gained momentum with the publication of "Social Ecological Urban Development," which showcased the implementation of the model in a real case study in 2013 (Barthel et al., 2013). This integration of socio-ecological principles in urban design and planning serves as a practical entry point for fostering sustainable and resilient urban environments.

After conducting a review of the relevant literature, the present study identified several critical elements that should be considered when undertaking a design based on a socio-ecological approach. These key elements are organized into five main aspects, as outlined below:

Ecological:	Physical:	Functional:	Landscape
o Maintaining the quality of water and environment surrounding	o resilience and flexibility	o pedestrian friendly	o Inviting
o Energy efficiency	o Safeness	o Providing public access	o Vitality
o Smart water consumption	o Active ground	o Multi-performance	o Identity
	o Green arteries	o Recreational	o Direct contact with

Figure 42 Criteria for revitalizing the lost riverside spaces with a socio-ecological approach (credits: author)

Exploring Social Medias:

Based on the review of people's opinions about Goharrood on social networks, several important tips emerge. These include people's distrust towards city officials, the collective memory of Goharrood's past, the improper state of landfill and sewage, the

presence of popular campaigns for revival, people's positive sentiments towards the designed riverfront areas, the role of citizens in waste production and pollution, suggestions for improving the waterfront's current state, occurrences of anomalies such as crimes and vandalism on the river's edge, and the recognition of the river's tourism potential, with a comparison to tourism management in Western countries.

SWOT Analysis:

The main goals of this research in accordance with its theoretical framework are providing a sustainable, balanced, law-abiding, complete and competitive physical environment, organizing the river's landscape and consideration of human needs throughout the design process.

<table>
<tr><th>Strength</th><th>Opportunity</th><th>Weakness</th><th>Threat</th></tr>
<tr><td>Presence of river's natural landscape</td><td>Possibility of creating active grounds due to physical differences</td><td>Lack of recreational, cultural and sports spaces on the riverside</td><td>Possibility of underground water contamination in the region due to the infiltration of part of the sewage in the ground and also the release of waste in the water flow path</td></tr>
<tr><td rowspan="3">The existence of a highway network around the area which provides suitable access for all citizens</td><td rowspan="2">The possibility of strengthening the perception of the area through strengthening the visual and auditory senses, the element of the river, greenness and increasing the sensory richness</td><td>Lack of tangible economic activities and public attractions in the surrounding area</td><td rowspan="3">Possibility of vitality and legibility reduction in the area due to physical problems and the lack of collective spaces</td></tr>
<tr><td>Turning the river into a channel and destroying its natural landscape</td></tr>
<tr><td>Possibility of strengthening behavioral settings to increase the social relations of residents</td><td>Lack of safety and safeness</td></tr>
</table>

Figure 43 Criteria for revitalizing the lost riverside spaces with a socio-ecological approach (credits: author)

Strategies:

After establishing the main goals and conducting a SWOT analysis, several strategies have been identified to guide the revitalization efforts. The most prominent strategies include removing visual obstacles to the river, establishing dedicated and suitable paths for active modes of transportation while ensuring proper access to both sides of the river corridor. Additionally, there is a focus on developing green spaces, promoting tourism and leisure activities along the riverbanks, and creating a cohesive network while eliminating incompatible uses. To protect the environment, measures will be implemented to control water and soil pollutants, preventing further degradation. Enhancing the urban space's vitality and attractiveness is another key aspect of the strategy, along with eliminating secluded areas and promoting inclusive public spaces. Finally, the creation of employment-generating land use is considered a crucial element in the revitalization plan.

Results:

In the last part of this study, after laying over all the information provided by recognition and analysis of the site, major policies for different points in hopes of turning this lost apace into an efficient and functioning public space as a whole were proposed and located. In order to reach a detailed design, firstly we need to categorize the spaces on macro scale. Due to the adoption of a socio-ecological approach in this research, some of the proposed activities will align with the cultural system of the area while also considering recreational and service land use. To achieve this, a spacious central zone dedicated to cultural activities forms the focal point of the site. Additionally, strategically placed fishing platforms serve a dual purpose as observation points, contributing to the revival of collective memory and cultural engagement. Complementing the cultural zone, the site features additional spaces such as a library and an open amphitheater.

The site features dispersed wooden booths and a local products market as micro-spaces within the commercial-service zone. Leisure-sports activities are defined by a children's playground, bicycle path, and fishing platforms. Adjacent to the playground is an urban agricultural spot that supports cultural and recreational activities, ensuring proper supervision and safety for children's activities near the community gardens.

Organic lines were chosen to connect design elements, as they complement the site better than broken lines. Particularly in the western part, curved lines align harmoniously with the site's form.

These meandering lines, resembling springs and rivers, feature deep curves that create a soft and undulating effect. They are well-suited for paths, plant bed lines, and river beds. By guiding viewers around corners and revealing new views and spaces, these winding lines add a sense of freshness and mystery, stimulating viewers' curiosity and enhancing the garden and green space's overall atmosphere (Hansen, 2016).

Conclusion:

Overall, the socio-ecological regeneration of the Goharrood River presents an opportunity for reviving neglected urban river corridors into active public areas. The emphasis of this study is on the incorporation of ecological and social considerations into urban planning and design. The removal of visual obstructions, creation of active transportation modes, formation of green spaces, promotion of tourism and leisure activities, environmental protection, improvement of urban vitality, and creation of job possibilities are only a few of the suggested strategies. The design's incorporation of organic lines improves the site's aesthetics and connection to the river's natural form. Cities may revitalize their rivers, design inviting public areas, and add to the overall resilience and sustainability of the urban landscape by embracing the socio-ecological urbanism framework.

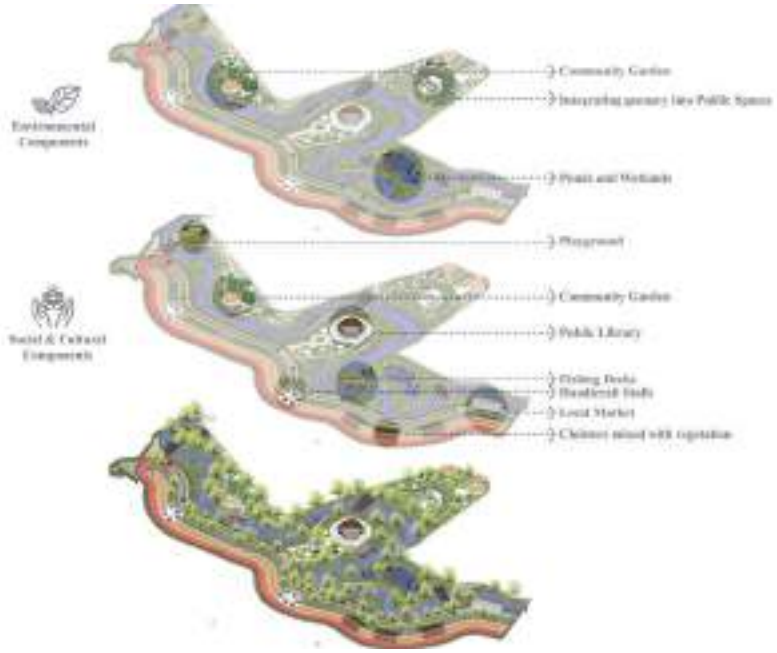


Figure 44 Diagram depicting Environmental, Social & Cultural Components of the Design (credits: author)v

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River Contracts Atlas in Abruzzo

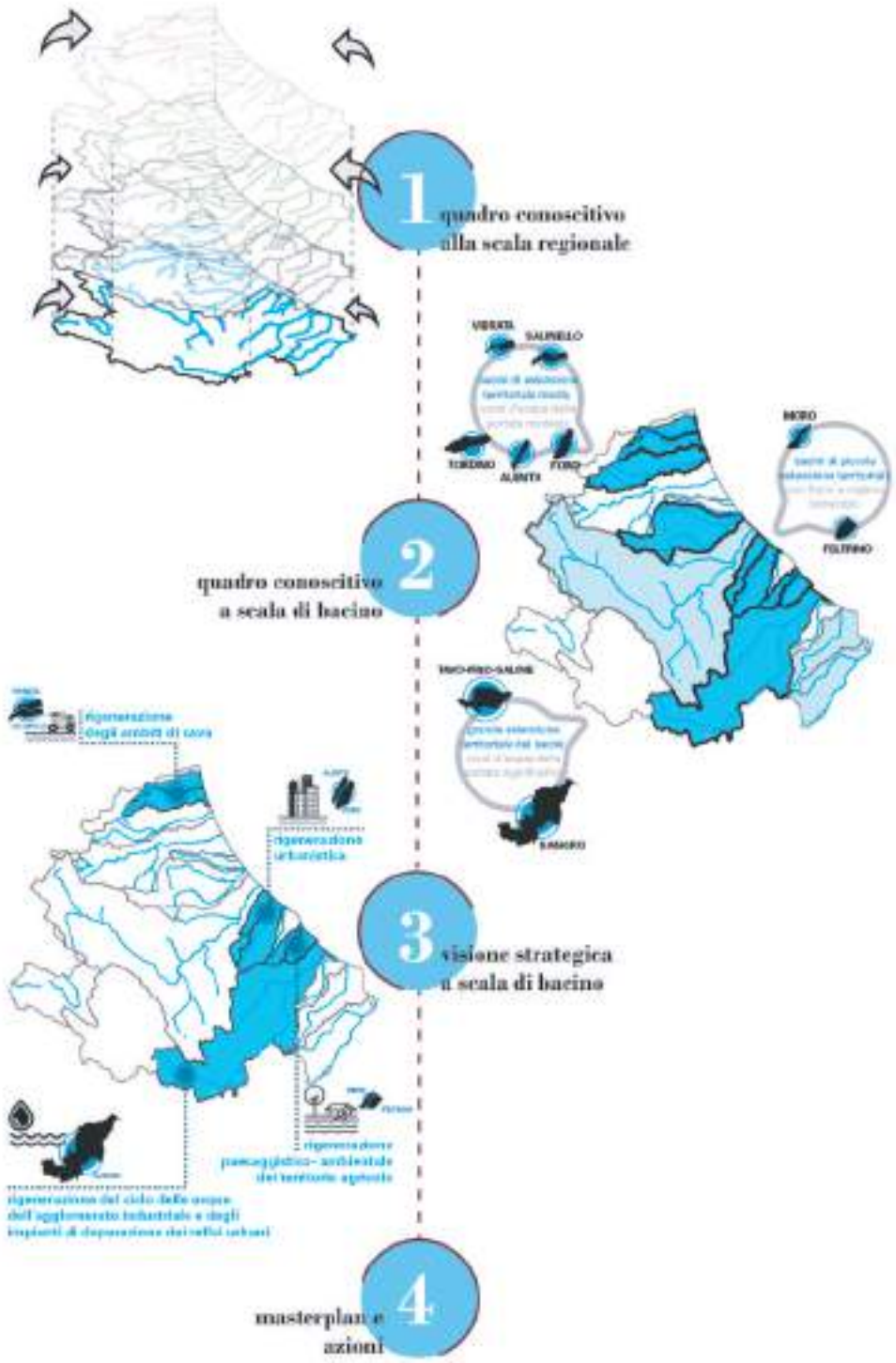

Figure 45 Outline of the atlas methodology through the stages of:
1) cognitive framework at regional scale;
2) cognitive framework at basin scale;
3) strategic vision at basin scale;
4) master plan and actions.
(credits: authors)

Premise

This contribution aims to provide an updated overview of the Abruzzo region's experience with River Contracts, referring to the outcomes of the research 'River Contracts Atlas in Abruzzo' carried out with the aim of defining a document of an organic collection of maps and regional guidelines.

In the last years the context has changed, first as a result of new national acts, in particular with the recognition of river contracts at the legislative level, which took place with the *Collegato Ambientale*[1], and with the National Strategy for Adaptation to Climate Change, and then following the publication of the National Recovery and Resilience Plan (NRRP) calls, with the planning excitement that resulted from it.

At the time of the signing of the protocol between the Abruzzo Region and our Department of Architecture[2], the regional context in Abruzzo was characterized by the sudden proliferation of initiatives aimed at establishing river contracts, often in the absence of previous negotiated planning (important for sedimenting on the territory a habit of cooperation) and in which the delay in the establishment of a regional steering committee contributed to the confusion and extemporaneity of the attempts at self-organization of the different local contexts.

The research attempted to define a methodology useful for setting up a river contract process and recognizing the degree of criticality for each river basin with respect to the various indicators that characterized its state of health (Figure 45). This was with the aim of comparing the quality of river basins with each other with respect to the different forms of pressure they experience.

To arrive at this result, the research work had been organized in several stages: from the critical reconstruction of ongoing actions at the regional level to the reconstruction of the system of knowledge available at the regional scale (Figure 46). From the identification of pilot cases representative of the different regional watersheds (and construction of the relevant knowledge

frameworks) to the construction of strategic visions and action plans on the pilot contexts (Figure 47). It finally led to the methodological definition of a priority matrix and the construction of methodological guidelines.

The research methodology

The research team proposed a vision of river contracts as processes capable of interpreting a twofold innovation, the first pertaining to the opportunity to proactively integrate water policies with land use planning, especially in view of a land use government capable of averting the further depletion of water resources; the second concerning the active role of citizens, involved in inclusive processes aimed at participation in choices inherent to river basins. All this was by no means a foregone conclusion; it was first necessary to unhinge the sectoral and technocratic vision that connoted (and perhaps still connotes) public action on water in Abruzzo, as moreover in many other Italian regions. There was also a need to overcome the strongly hierarchical approach with which action is taken on common goods of primary importance such as water bodies; there was also a need to rebuild citizens' attention to public water, an attention that at the moment is still represented by a form of utilitarian interest, which leads citizens to conceive the common good river as a resource to be appropriated indiscriminately, especially when there is a persistent difficulty in the attribution of the status of ownership of the areas, as well as of the competencies over the management of its waters.

These starting conditions still hinder the effectiveness of the actions put in place by regional governance, on the other hand, even at the national level it should be noted that the results achieved by the Water Framework Directive (WFD), with regard to the objectives of improving the quality status of rivers, are not satisfactory, and there are many regions that have asked for an extension to 2027 of the deadline for achieving the environmental class good for their rivers.

It was also stated that the solution to the critical issues of rivers and basins requires a strong degree of integration between urban planning policies, management of water uses, land maintenance, development of integrated water service and cognitive systems. An integration that in many regions, and among them Abruzzo, would have required a new culture of collaboration between institutional actors and, above all, the activation of participatory processes from below, linking the explicit and technical knowledge, proper to expert knowledge, with the 'tacit knowing'

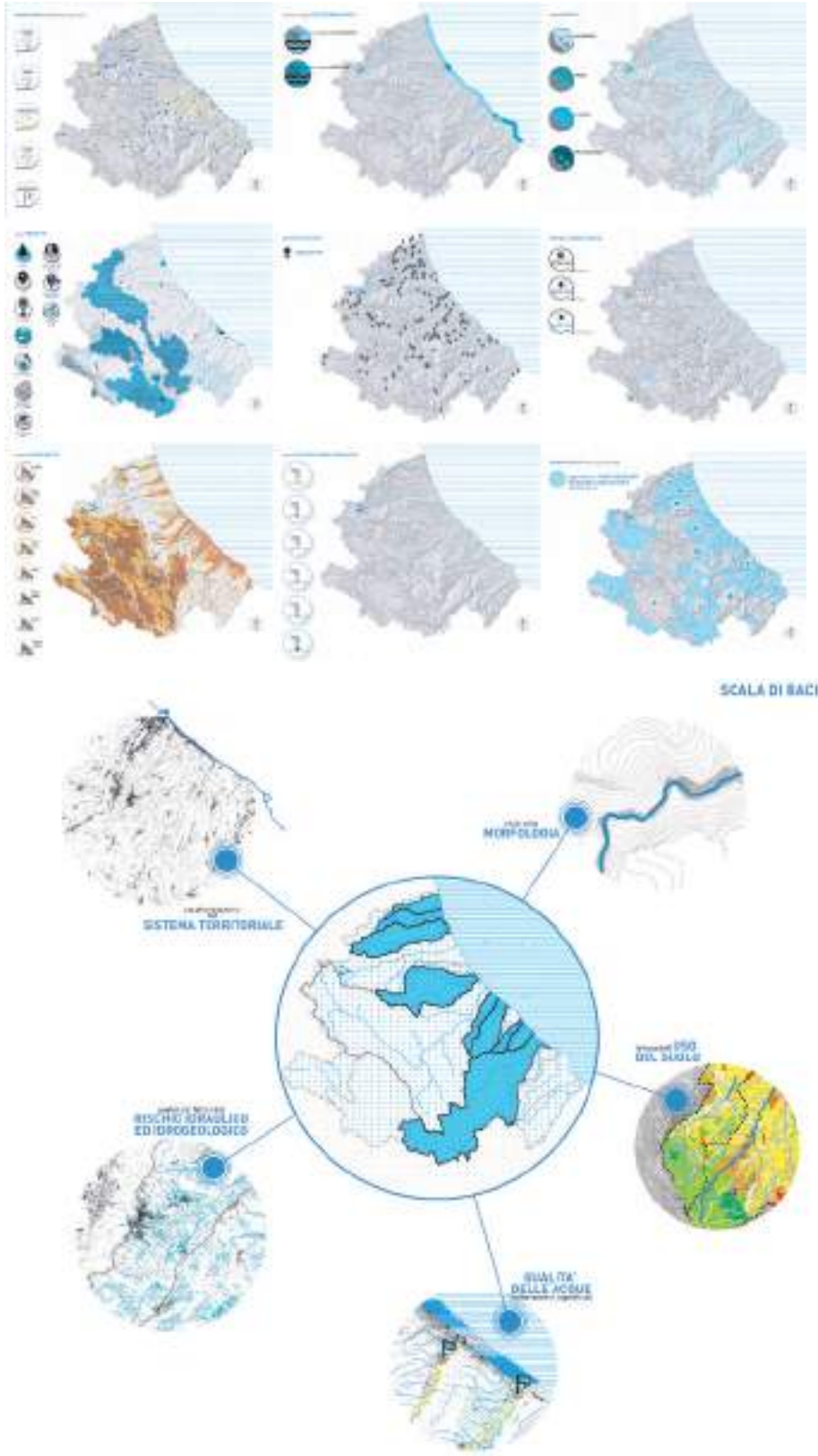

Figure 46 Cognitive framework at the regional scale: mosaic of regional analysis maps. (credits: authors)
Figure 47 Stages of the cognitive framework at the basin scale: land system characterization, morphology studies, land use studies, groundwater and surface water quality, hydraulic and hydrogeological risk factor analysis. (credits: authors)

(Polanyi, 1979), represented by that implicit knowledge, elaborated by the community of local actors on the basis of cognitive and experiential knowledge, valuable in the activation of development processes.

On the basis of these premises, the picture emerging from the initial analyses was not encouraging: despite the large number of initiatives still no contract had reached the launch phase of the strategic plan and most were still quite far from that result. Not only that, often the river contracts insisted on the same basin involving it in different parts and in the absence of an overview; this fragmentation reflected the tendency of municipalities to form aggregations on the basis of administrative management opportunities (and political homogeneity), which have little to do with the scale of the problems of river ecosystems. The same fragmentation of the basins was also the cause of a lack of systemic capacity to resolve the deterioration phenomena, which, as we known, act on the scale of the entire basin.

The research highlighted the crucial importance of horizontal and vertical coordination between institutional and non-institutional actors, in a context of fragmented institutional and territorial competences like a water basin involving several municipalities, and possibly superior institutions such as parks and provinces. In many regions, including Abruzzo, these skills are absent, and collaboration between different administrations and civil society is still in its infancy. Moreover, there is a need to promote the principle of subsidiarity between institutions of different levels.

River contracts are regulated by the principle that a synergic and strong action of all stakeholders, public and private, is necessary for the regeneration of river basins and the pursuit of environmental, landscape, social, and economic objectives. To achieve success, a strong political intentionality and identification of the territory with an institutional subject of a supra-local nature are also required. This subject should hold the most important administrative functions in water governance, and the recognition of its coordinating role is more probable if it is close to the territorial realities.

The research on river contracts conducted an experimental phase for drafting the Atlas, which involved selecting different pilot contexts from Abruzzo's various basins. This allowed for the identification of scenarios that highlighted environmental and urban planning issues representative of the basins. The Alento and Foro water basins were a distinctive example of a case study that combined two different basins with similar and correlated identity characteristics. The analysis was conducted considering the two rivers as a single entity, both during the analysis phase and the definition of the river contract program.

The pilot application

The first part of the pilot application is entirely focused on the critical reading of the territorial, morphological, land use, hydraulic and hydrogeological risk characters (Figure 48), which is crucial for the implementation of the second part, in which the river contract is outlined both through the setting up of a site specific form of governance as well as through the indication of good practices and the formulation of a proposal for the urban and environmental regeneration of the Alento river mouth, the latter exemplified by a project with defined and replicable aspects, aimed at mitigating the hydrogeological risk caused by the channelization of the riverbed.

The two rivers flow through diverse territorial and landscape contexts, including the natural environment of the Maiella National Park, industrial settlements, rural areas, and small to medium-sized urban agglomerations. An analysis of land use over time, based on data from the Corine Land Cover project spanning from 1990 to 2012, reveals a significant increase in industrial and commercial settlements near watercourses and a corresponding loss of wooded areas. While soils in close proximity to watercourses are predominantly agricultural, anthropogenic loads associated with civil and industrial uses have had the greatest impact on water quality. Furthermore, the continuity of the river course is disrupted in some places by small commercial settlements and a few sporadic urban agglomerations.

The difference between the environmental conditions of the springs and mouths is evident. The high degree of naturalness of the springs, sublimated by the presence of the Maiella National Park, contrasts with the chaotic condition of the mouths, typical of the coastal conurbation of the middle Adriatic. There are also built-up areas that fall within hydraulic risk restriction zones, with two types of urban agglomerations: sprawled houses mixed with agricultural land and urban settlements. The history of flooding events and the risk map show a clear correlation between flooding phenomena and the characteristics of the built fabric. Channeliza-

tion of the watercourse causes considerable damage when rainfall is intense. The area most exposed to hydraulic risk in the case of the Alento river is the heavily urbanized mouth, while the inland area characterized by predominantly agricultural land use is the concentration of areas vulnerable to hydraulic risk in the case of the Foro river.

Scenarios and project

We moved from territorial analysis to constructing strategic scenarios, with the Province of Chieti as the hypothetical lead partner, assisted by a steering committee made up of representatives from participating municipalities and decision-making bodies within the basins. The governance proposal's innovative character lies in the organizational structure of the technical support secretariat of the steering committee, divided into three contexts: the Maiella National Park and its surrounding territory, a rural area with agricultural cultivation and small urban settlements, and an urban context with a high density of built-up areas and numerous productive activities.

The three contexts were identified based on spatial characteristics, water quality, and criticalities. For each context, priority lines of action were identified to address specific needs. The strategic vision includes qualitative protection interventions, rebalancing the hydrological regime of the watercourse, safeguarding the river corridor and ecosystem, rehabilitating the geomorphologic structure, preventing further artificialisation, and removing environmental and landscape deterioration. Other proposals include regenerating connections between villages and the river course, creating an agricultural park, upgrading the path network, recovering and protecting sheep-tracks, protecting parks and SCI, and enhancing tourist-recreational activities. From the general objectives of the river contract, we moved on to the definition of the specific objectives, also determining the actors to be involved in the planning phase, as well as in the management and control phases and the expected timetable for activation and implementation. The strategic vision gives rise to the Masterplan and the Action plan, the latter articulated according to three priority policies: mobility; green system; routes and connections (Figure 49). The planned actions cover a time span of between two and five years, with activation times set at three years by the river contract, taking into account the time required to carry out the works and the degree of priority assigned to each action with respect to the context in which it falls.

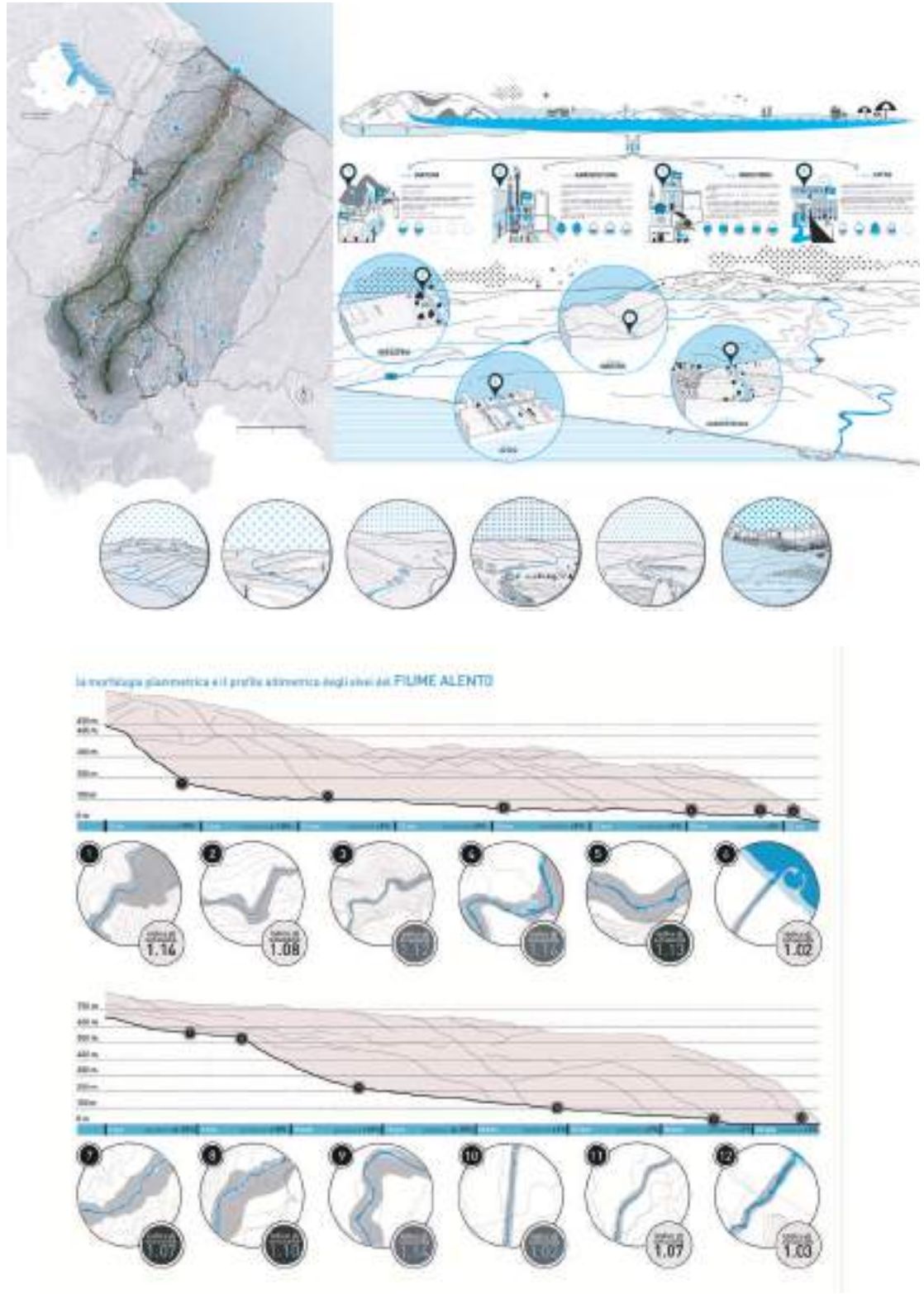

Figure 48 Basin-scale studies. The case of the Alento and Foro rivers (credits: authors)

In consideration of the analyses carried out on critical issues and of the actions contained in the action plan, it is evident that the weakest context is the urban one, in need of particular attention in the planning of interventions: the most relevant issue is that of hydraulic risk, due to the proximity of the riverbed to built-up areas .It was therefore chosen to refer to Directive 2007/60/EC[3], which stipulates that member states shall, on the basis of a preliminary risk assessment, identify, for each river basin district or management unit, the areas in which there is a potential significant flood risk.

For the areas thus identified, Article 7 of the directive provides for the drawing up of a specific Flood Risk Management Plan coordinated at the level of the river basin district or management unit. The general objectives of the plan are to reduce the negative consequences of floods with respect to: human health, territory, environmental assets, cultural heritage and economic and social activities.

Starting from this very article of the directive, which states that 'Flood risk management plans may also include the promotion of sustainable land use practices, the improvement of water retention as well as the controlled flooding of certain areas in the event of a flooding phenomenon', the pilot project involving the mouth of the Alento river was established.

The project is articulated in four progressive steps, in accordance with the objectives of the river contract: the removal of the concrete banks; the restoration of the original geomorphologic structure; the re-naturalisation of the river banks and the creation of a river park open for the community.

The new river park therefore links the existing agricultural landscape and riparian vegetation with the new corridor, shaped in steps starting from the natural slope of the site, while respecting the existing flood areas. The morphology of the new river corridor also allows for an increase in the sinuosity index and the restitution of a totally permeable riparian area which, together with the enlargement of the section of the wetland area that can be flooded inside the riverbed, partially solves the problem of the hydraulic risk to which the area is subject.

Recent developments

A few years after the conclusion of the research, the advent of a new regional government seems to have given, in the framework

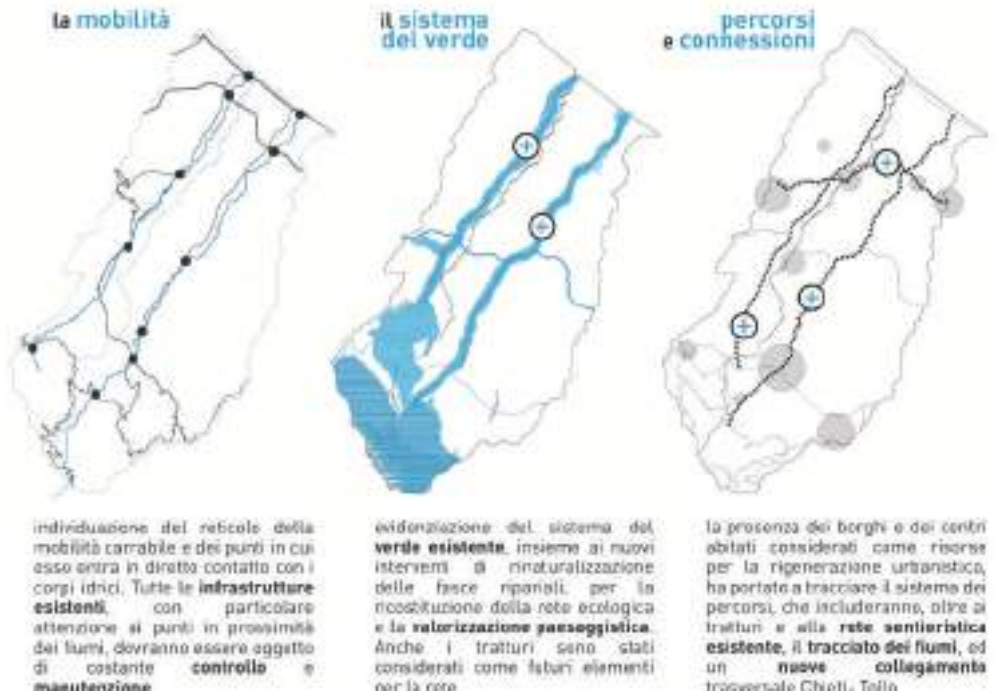

Figure 49 Basin-scale studies. The case of the Alento and Foro rivers (credits: authors)

of the green and digital transition program, a renewed impetus to water policies, perhaps also propitiated by the organization of the 2020 assembly of the Italian National Board of River Contracts (Tavolo Nazionale dei Contratti di Fiume) in Pescara, which was attended by a qualified representation of the regional authority, with the presidents of the Regional Council, the Councilor for Town and Territory Planning and the head of the Territorial Government and Environmental Policies Department.

The main actions implemented so far by the new regional government have been the reorganization of the offices and, above all, the provision of a resolution by the regional council that, in addition to make the point of the situation of ongoing contracts, sets the objectives to be achieved, the reference methodology and the operational steps to be observed.

In detail, the establishment of a task force within the regional service is foreseen to assist local authorities in the implementation of the processes, verifying their correspondence with the regional guidelines. The task force will provide support for the organisation of consultation activities as well as participation in regional and national thematic sessions and meetings of the National Observatory of river contracts.

The draft resolution is then accompanied by the Strategic Document and Action Plan models that the local authorities, each in its own specific executive and management needs, may use as reference. The Region also provides a list of eligibility criteria together with a synoptic table setting out the model actions to be contained in the action plan.

Finally, it is worth mentioning the programming within the 'Proposta d'Abruzzo', drawn up for the use of NRRP resources, of 80 million euro for financing river contracts, together with other substantial resources for upgrading purification plants and sewerage networks and the renewal of the aqueduct network.

Conclusions

The picture that is emerging in Abruzzo seems to be encouraging for those who see the river contract as a strategic tool to restore focus on policies that prioritize water resources in the region. River contracts are instruments that aim to prioritize the health and management of river systems and it appears that this approach is gaining momentum in Abruzzo. The river contracts are at this stage of the process bringing hope for different local decision makers by providing targeted lines of action to mitigate the impact of climate change on rivers and flooding, as well as by establishing a site-specific governance structure that includes representatives from participating municipalities and bodies with decision-making powers.

In order to give a further impulse to this process the region should start planning on pilot cases with the aim of giving concrete spatial arrangements to the objectives of improving water quality, which very often take vague and technicist forms, far from the common feeling of citizens. This research envisaged the formulation of strategic visions for each basin identified as a case study, to be understood as 'delegated and deferred' projects, to be implemented progressively through the convergence of the actions of several actors, guided by the guidelines associated with the strategic vision. Projects that did not, however, give up on the possibility of arriving at a final formal configuration, considered as a sort of anticipation of a future that is not univocally established, capable of acting as a figure on which the individual actions of the various parties involved in the river contract could continually collide, possibly correcting them. For this reason, the vision played an important role, aimed at bringing together everyone's commitments and responsibilities in achieving the objectives of recovery of the watershed, a recovery to be considered as preparatory to the relaunch of territorial economies, of which the restored river landscape could be a strategic factor.

It is a hypothesis that wanted to flank the current model of watershed management, which favors top-down action, typical of the model of protection exercised through regulation, with the opposite and complementary model, which appeals to everyone's sense of responsibility, that of participatory governance.

The research's empirical major contribution is the production of an "Atlas". As defined, the Atlas has primarily a documentary value, offering a comprehensive overview of Abruzzo's watersheds at the analysis phase. It systematizes data that is currently fragmented across various sources and generates original images and maps that will become useful over time for comparative assessments. The transformation of data into a schematic and organic collection constitutes a methodology that can be applied and repeated in any river context, nationally and internationally. At the same time, the design and experimental phase, applied on the selected pilot basins, is useful for the definition of best practices and methodologies useful for the development of strategies

on the territory and the evaluation of the advances and transformations that have occurred.

Furthermore, by outlining the methodological guidelines in the research, the aim was to have a practical impact on those responsible for managing the river system in Abruzzo. It is noteworthy that two prominent regional officials, who currently oversee the river contract processes, are acquainted with this research and have played a role in its development/publication.

The research has had another impact on a national scale, particularly within the scientific community. This is due to the publication of the research as a book, which has made the findings accessible to a wider audience and has contributed to the advancement of research on river management and land governance. The book has also been recognized with an award from the National Table of River Contracts and the National Institute of Urban Planning (INU) .

Notes

This paper is the result of a shared elaboration of the author. The drafting of the various paragraphs can be attributed as follows: Massimo Angrilli (Premise; The research methodology; Recent developments; Conclusions); Valentina Ciuffreda (The pilot application; Scenarios and projects; Conclusions

1 Law No 221 of 28 December 2015 'Provisions on environmental matters to promote green economy measures and to curb the excessive use of natural resources'

2 Department of Architecture, University G. d'Annunzio Chieti-Pescara (It).

3 The directive 2007/60/EC, know as "Flood Directive", entered into force on 26 November 2007. This Directive established a framework on the assessment and management of flood risk, aiming at the reduction of the adverse consequences of floods for human health, environment, cultural heritage and economic activities.

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Giulia Luciani

Beyond Green and Blue: Ecohistorical Infrastructures for Water Landscapes

Urban waterscapes and their life histories

Imagining the future of contemporary water landscapes often turns out to be a hard task. Threats of the most diverse kinds contribute to making their path uncertain, ranging from changes in the climate and environmental degradation to urban transformation and geopolitical shifts and unbalances. The intrinsic instability of water-land systems is thus increased by the combined effects of often unpredictable forces and processes, while rapid population growth, soil consumption, polluting activities, and large infrastructures add to their risk conditions.

On the other hand, the formative and destructive power of waters and the many uses water has had in time have made these landscapes exceptionally rich in natural and cultural heritage. Port structures, historical transport roads, defence systems, industrial heritage, agricultural structures, or historical canalizations are only some of the many examples of water-related heritage that can be found in cities on water and their surroundings (Figure 50 and Figure 53). In fact, the strategic presence of water and the richness of the natural environment themselves have made these places particularly favourable for human settlements, so that layers of sediments have accumulated in time. The contemporary urban waterscapes are thus permeated and infra-structured by ecological processes and sedimented heritage webs we are barely aware of. They have life histories in which the evolution of the biological landscape systems and the history of the place inscribed in its heritage are inextricably tied in a way that is too often unrecognized.

While growing attention is being given to the ecology of urban water landscapes as a source of wellbeing for the urban population, the approach to heritage, especially in coastal areas, mostly envisions it as an endangered object, focusing on protection. However paramount the issue of protection can be, heritage can be at the same time an active tool for strengthening the resilience of these territories. In fact, it has been stressed that an engagement of cultural heritage into adaptation strategies is needed to raise awareness, provide local knowledge and tools, increase social resilience by binding people to places, conveying identity values, stimulating participation (ICOMOS, 2019). There is limited understanding, however, both of water's value as heritage and of heritage as an active player in the future-making of the urban waterscapes (Hein et al., 2020). Different disciplines tend to approach water, the ecological processes, and heritage separately, so that their interrelationships and potential synergies remain underexplored.

An infrastructural mindset

The approach to contemporary urban waterscapes has to deal with managing urbanization beyond the city. It is not only a difference in scale that I am pointing out, but one of kind. The regionalization of the urban systems, rather than corresponding to a bare expansion of the city, springs from a suppression of the traditional urban features and leads to the dissolution of both the urban and its opposite the rural, fostered by a planning and design approach which considers only one scale – the broad scale of the infrastructural networks (Choay, 2008). These networks are the driver, support, and even purpose of the urban regions that are growing especially in the globally connected coastal areas.

If a structural difference exists between the traditional and the contemporary urban form, a different method is needed to work within the urban environment today. And if infrastructures are the core of these new landscapes, it comes to no surprise that among the most promising propositions is an infrastructural approach. Infrastructures have become a method to interpret and transform the (post)urban landscapes, a way to work at a large scale for which traditional methods such as land use planning turn out obsolete, and within overbuilt environments where the only possible strategy is to work with what is already there. The shift is double-sided: on one side, it affects the way infrastructures are conceived, not anymore as the realm of one single discipline but as a multifunctional and participative field – stressing the migration of infrastructures from sectoral engineering disciplines to the holistic framework of landscape (Bélanger, 2009); on the other side, the change deals with how landscape is conceived, "as an operative field that defines and sustains the urban development" (Nijhuis and Jauslin 2015, p. 18) – defining landscape itself as infrastructure. Such an approach aims to address the contemporary conditions arising from complexity, uncertainty, and multiplicity, and to manage an environment of fluxes rather than static components.

Two decades ago, Stan Allen described with seven propositions the characters of the emergent mindset he named "infrastructural urbanism".

1. Infrastructure works not so much to propose specific buildings or given sites, but to construct the site itself".

2. "Infrastructures are flexible and anticipatory".

3. "Infrastructural work recognizes the collective nature of the city and allows for the participation of multiple actors".

4. “Infrastructures accommodate contingency while maintaining overall continuity”.

5. “Infrastructures organize and manage complex systems of flow, movement, and exchange”.

6. “Infrastructural systems work like artificial ecologies”.

7. “Infrastructures allow detailed design of typical elements or repetitive structures, facilitating an architectural approach to urbanism” (Allen 1999, pp. 54-57).

The fields in which such landscape infrastructures[1] find increasing application include transport systems, green networks, and water management (Nijhuis and Jauslin, 2015). Green and blue infrastructures, in particular, have gained momentum since their introduction in the Nineties as a development of the concept of ecological corridors and networks. Still conceived as linear structures, while the corridors mainly focused on continuity for the conservation of the biodiversity, the stress on multifunctionality within the green infrastructure concept aimed at broadening the goals these structures could achieve. The idea was to integrate different natural and anthropic systems in networks – the ecological network, the hydraulic protection network, that of the green spaces for recreation, the soft mobility network, and so on - with the aim of bestowing positive environmental, social, and economic effects on landscapes and communities, enhancing the wellbeing of both people and ecosystems (Acierno, 2018). With a shift in the conceptual framing, I propose to develop the concept into that of ecohistorical infrastructures.

Life histories made infrastructures

Reconceptualizing green and blue infrastructures in the frame of ecohistorical infrastructures aims, at first instance, at stressing the tight relationship between natural and cultural heritage in water landscapes and emphasize their synergic potential in providing benefits to the urbanized landscape. It also encompasses, however, a different understanding of human beings and how they relate to the environment. Anthropologist Tim Ingold marks a distinction between, on one side, a dominant view of human beings as substantially detached from the rest of the world, which is at the basis of both the anthropocentric and ecocentric attitudes, and, on the other side, a view of human beings as constitutively immersed in the world no less than its other non-human components (Ingold, 2000). This dwelling perspective, rooted in Heidegger’s and von Uexküll’s reflections, is close to the perspective of geographer Augustin Berque who proposes the notion of “ecumene” (Berque, 2016) to indicate the human environment and home (recovering the original domestic meaning of the Greek word oikos). While it overcomes the false distinction between the human and the non-human, it also overcomes the conventional distinction between the “natural” and the “built” environment[2]: both are constructed during time to be dwelt-in, have ongoing and never completed life histories of unfolding relations to one another.

The “ecohistorical” concept embraces the dwelling perspective, acknowledging a circular relationship between action, perception, and memory. To perceive the environment means to engage perceptually with it through the body and its movement, so that action and perception overlap. Moreover, since the environment, or better landscape[3], continuously incorporates action collapsing into a form, to perceive it also means to engage with an ongoing past. Temporality belongs to the landscape and at the same time to its perception, as it takes place in the act of moving along certain paths. In fact, time, body, and movement are interwoven in this process. As Ingold puts it, “the same movement is embodied, on the side of the people, in their ‘muscular consciousness’, and on the side of the landscape, in its network of paths and tracks. In this network is sedimented the activity of an entire community, over many generations” (ibidem, p. 204). The heritage infrastructuring this landscape, being part of both the conventional realms of the human and the non-human, can be the mediator, the enabler of an attunement to the environment through the narration of its life histories.

Ecohistorical infrastructures, then, can be conceived as devices through which the urban landscape is crossed, perceived, and constructed, and through which people are “experienced” in turn - in the double sense that they gain experience while the environment “senses” them. These infrastructures have nodes and connections. The nodes will be parts of the landscape (places) with higher significance or capacity to enable an attunement, because meanings coagulate there, while the web of relations gets thicker. They allow new relations to be established, creating the conditions for them to unroll. They are naturally multifunctional because the human–environment relationship unfolds through them, so they develop along slow paths and tracks, the ones where the body is involved, and accommodate material as well as symbolical interaction with the environment. In the case of waterscapes, movement through and along water, experience of the historic waterscape and its participation or latency in the present, water management, et cetera, will be sustained by such an infrastructural network.

Ecohistorical infrastructures as an approach to urban waterscapes

As Allen underlined, infrastructures rather than design a specific site create the conditions for it to develop. This way, ecohistorical infrastructures make new synergies possible, by bringing together on the same ground the human being and his own environment – which is to be distinguished from the environment. The environment as a single entity is in fact a product of that same detached, global perspective which is at the root of the dominant dysfunctional approach (Olwig 2011, Barca 2020), featuring a view from outside as opposed to the view from within, which we are pursuing in order to recover a nonconflictual approach to the environment.

As an approach to urban water landscapes, ecohistorical infrastructures display, enhance, and manage the continuous exchanges which shape the natural and cultural ecology of the territory. In this respect, they mix in innovative unexpected ways valorisation, nature-based intervention, common goods re-appropriation, heritage reactivation, etc. Recovering the function of old canals and structures, creating new ecosystems inspired by previous landscape patterns, reusing abandoned structures for the storage of water, or allowing the formation of temporary water landscapes changing with tides or heavy rainfalls, can at the same time build resilience to climate change and weather events and enhance the perception of the structures and traces of the past. Vice versa, the dialogue with heritage can stress the meanings and increase the engagement and identification with the newly created water landscapes. Thus, ecohistorical infrastructures allow water-related heritage to recover, and often reinterpret or actualise its function, reconnecting the built environment and the ecology of the landscape.

As an approach to heritage, the strategy is coherent with a shift from an object-based approach to a landscape-based, systemic view. While the concept of heritage is getting close to that of landscape, as both are understood more as processes and complex sets of elements rather than single static objects (Fairclough, 2016), the urban space itself has been re-conceptualized as a landscape, as the understanding of the urban environment has moved its focus from a static view of structures to an ever-changing experience gained through walking and wandering (Nyka, 2017). Through the practice of wandering, nature and the built environment are perceived as inseparable parts of the same urban experience, and the open space reclaims an equal, if not preeminent role, to the built space. Connecting, mending, sewing emerge as key actions for intervening in the urban landscape. Routes, itineraries, and corridors become key figures for assuring continuity of movement and experience in the urban planning as well as the heritage or cultural landscape management fields. In coastal areas and urban waterscapes in general, often characterised by ecological and perceptual fragmentation, ecohistorical infrastructures will easily grow on waterlines, stressing their reciprocally enhancing roles as paths, ecological structures, and heritage agglutinators (Figure 50).

Moreover, acknowledging the collective nature of the urban landscape and the intrinsic multiplicity of water as its structuring element, ecohistorical infrastructures require more than any other kind of infrastructure new collaborations between many artificially separated fields and disciplines, fostering synergic rather than conflicting strategies, and leading to dismantle long-running conflicts such as that between preservation and development. At the same time, they enable real participation by assuming the attunement and reconnection of people with their own environment as their primary aim. Compared to green infrastructures, indeed, they are aimed not just at bestowing services but rather at creating new ecologies of dwelling.

For an attunement to the environment to be reached, links and connections are displayed and explained through multiple stories and narratives. Narratives relate at the same time to history and imagination, for the infrastructure allows a variety of narrative paths to arise from the interpretation of the past and branch out into the figuration of future itineraries, through which coherent and "attuned" interventions can be designed and implemented. The idea of a narrative path is somehow present in figures related to heritage management such as cultural routes or heritage corridors. However, sticking to a past-looking, preservation-focused, and tourism-oriented conception, they lack an infrastructural grasp to make them active participants in the transformation of the territory.

Telling a hi-story for the future

Ecohistorical infrastructures, in conclusion, are devices which integrate constructed, natural, and historical (in one word: environmental) features and facilities in a web of nodes and connections, where nodes correspond to "deep places" which, because of their special ecohistorical significance, are able to trigger

and represent people's identification and connection with their environment. Using a traditional sectoral language, they feature high ecological and/or cultural values. Participation will be crucial in the identification and reactivation of these places. Connections between the nodes, on the other side, correspond to paths where people, through movement, engage mentally and physically with an environment that is pregnant with the past. However, it is not only about tracing an itinerary through significant places: it is about putting them into value as nodes of a system of interactions and exchanges, points of contact and action with and within the environment. Thus, they are not meant as museum itineraries but as living infrastructures connecting horizontally – through space – and vertically – through time – people, places, stories. They are future-oriented as they catalyse projectuality towards the creative renewal of the ecologies of dwelling. Operationally close to green infrastructures, they differ in their conceptual foundation as well as in the equal and synergic importance of the ecosystemic and cultural dimensions. Ecohistorical infrastructures, in fact, assume that cultural heritage, beyond simply adding cultural values to green networks, is part and parcel of a continuously transforming environment where "nature" and "culture" cannot be considered separately, and therefore plays a key role in mediating perception and action when engaging with the landscape. Rather than working with stratifications of ultimately independent networks, they approach the oikos holistically, in such a way that elements taking part into the infrastructure are not simply summed but multiplied.

For the concept to be transposed into practice, a framework for heritage management is needed that could allow a reactivation beyond the logic of musealization within rigid constraints, and at the same time prevent improper interventions that may betray or exploit the sense and material value of heritage. Contractual instruments could be envisaged to deal with cultural heritage and the environment as common goods. Technology may help providing collaborative frameworks for the active participation of different stakeholders. Such a framework, however, should be object of future research to gain consistency and be fruitfully applied.

Valorisation and re-activation of cultural and natural heritage in lines and networks, within the concept of ecohistorical infrastructures, will then stand as an operative methodology for the implementation of a soft infrastructure system serving as a backbone for resilient urban development and/or regeneration within complex and rich contemporary water landscapes.

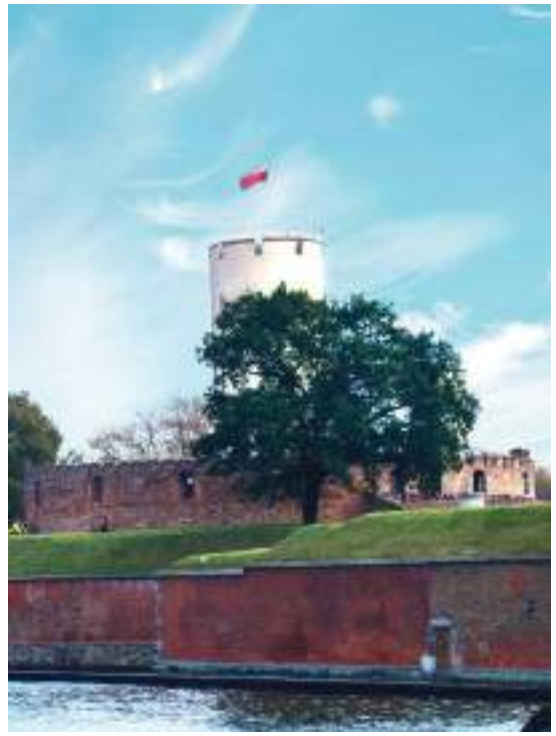

Figure 50 Abul Phoenician trading post in the Sado estuary, Portugal
Figure 51 Bastion Wilk, Gdańsk
Figure 52 Wisłoujście Fortress along river Motława, Gdańsk
Figure 53 Paola tower facing the Tyrrhenian sea, Latina (Italy)

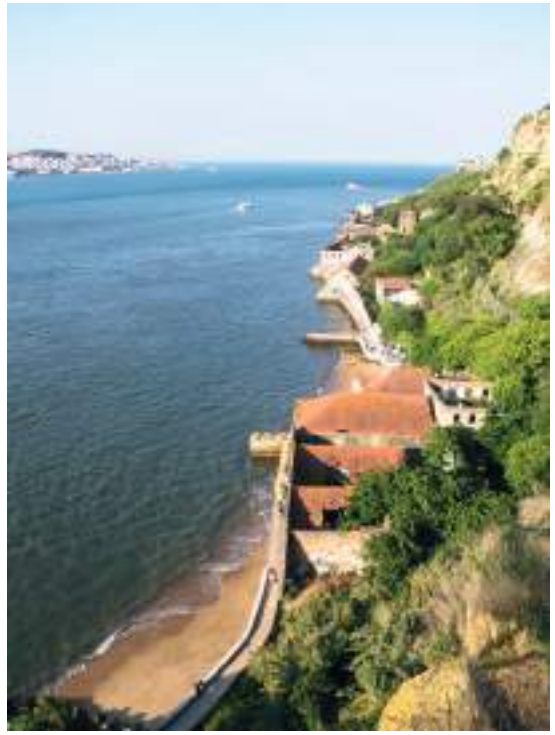

Figure 54 Decommissioned structures along the South bank of river Tagus, Portugal
Figure 55 The Museum of the Second World War, located in a symbolic place of memory facing the Motława river, Gdańsk

Notes

1 With this expression I refer to the wide range of infrastructures framed within the "infrastructural mindset", which aim at supporting urban development from a multisectoral and integrative perspective.
2 The nature/culture dichotomy persists despite the many attempts at integration. For instance, "cultural values" are considered a plus for the multiple uses of green infrastructures, just as an added layer. Similarly, when it comes to other figures more focused on the culture realm, such as the heritage corridors, "ecological values" are integrated as a secondary object of protection. Even when a complementary integration is pursued, one remains stuck to a dualist terminology – "biocultural" is an example – which still presupposes the existence of separated fields which can in some cases be treated together. The term "ecohistorical", conversely, expresses an attempt to approach the environment as a whole, joining the notions of environment, place, history, and evolution. Here, eco is not just a contraction of ecological, but recalls the dwelt-in environment, the concept of home, while the historicity abandons the narrow meaning referred to the human matters only, to incorporate the (biological) notion of evolution.

3 For Ingold, organism and environment relate to one another as body to landscape. While the first pair refers to the process, the second draws attention to the form.

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André Prevedello

For a Hybrid Urban Culture in Stockholm: The Application of Nestor Canclini's Concept in Two Areas of the Waterfront

KEYWORDS:
Stockholm. Hybrid. Waterfront. Climate Change. Society.

Introduction

Stockholm's urbanized seafronts compose a human ecology featured by a landscape normally anthropized and loaded with cultural references. The presence of natural sites is restricted even if the city has a quantity of green area per inhabitant higher than several cities in Europe[1]. Waterfront lines are suffering local major impacts from global climate change. It is in the relationship between urbanized areas on waterfronts and the natural environment that we envision vital actions to mitigate problems arising from climate change, which should take place from a hybrid thinking.

It is possible to perceive another urban form that starts from the hybridization between natural and cultural landscapes. It is suggested here the effort apply the thought of Nestor Canclini, who defends the city as a space in constant deterritorialization and reterritorialization (Canclini, 2006)[2]. When implementing a new urban design in the city that better mitigates the impacts of climate change, a disconnection between culturally established society and the place itself occurs naturally, since the city as a culture is always understood as a constructed artifact.

The intention here is to contribute with another understanding of the waterfront redevelopment phenomena in two sites of Stockholm: Värtahamnen waterfront located northeast of the city and Hornsbergs Strandpark waterfront, west of the city.

The City and The Waterfronts: Relations in Stockholm.

The city of Stockholm, the capital of Sweden, is a hub of people that concentrates more than 20% of the country's entire population[3]. The city is immersed in water with several lakes such as Mälaren, located in the center of Stockholm, Lötsjön, and lake Hjälmaren, among others. An analysis, without scientific commitments of maps and aerial photographs, about the urban evolution of the city, easily reveals this strong relationship between the city and water. The international fair of 1930 revealed, through advertising images, the modernism of a city immersed in a natural environment. This native habitat was then supposedly dominated by geometrized waterfronts that revealed the anthropization of nature. This relationship with water is so strong that it is also

expressed in architecture, being visible in projects such as the Church St. Mark's Church in Bjorkhagen, 1960, by architect Sigurd Lewerentz. In the contemporary city, the Stockholm Sustainable Development Plan (2021) states that the city's bodies of water, Lake Mälaren, and the Baltic Sea are heavily burdened by human activity[4].

Since the end of the 19th century, several areas of the city have had a gradual development of port and industrial activities. The original core of the city, located on the island of Gamla stan[5], reveals the occupation of an island that had in the past, the function of protection against invaders, precisely because it uses the natural environment, mainly the water. This symbology of being protected and at the same time islanded, came to the contemporary city in a very peculiar way, in which the relationship with water went from protection and isolation to contact and resilience.

In the current city, set in the context of climate change, the contact between city and water is essential to create environments not completely artificial nor natural, with ample spaces of vegetation, biodiversity, noise attenuation and other characteristics that promote quality of life. At the same time, the waterfronts can act as belts to promote flood control, soil erosion, soil permeability, and the protection of the cities themselves. These boundaries between water and city, act as a social and political infrastructure, in which 'the resilience and even language of ecological systems, in their multiple forms and manifestations, forms the basis for a new set of flexible, receptive and adaptable design practices' (Reed, 2014)[6], in other words, hybrid. In the case of Stockholm, surrounded by waterfronts, these can behave as a continuous green belt of great size and impact on urban life.

In this proper context, even with abundant green areas[7], the confrontation of climate change passes through the understanding of the relationship between the city and water. Among the 17 objectives and 169 subobjective's for achieve the goals of the UN Agenda 2030, gains prominence the goal 14: 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development'. In the ecological landscape of Stockholm, where the presence of the natural water environment is part of the urban public space, these objective gains great relevance.

Methodology: The Hybrid of Nestor Canclini applied to the Landscape.

The methodology used here is based on the appropriation of Nestor Canclini's hybrid concept and its transposition to the urban environment. Since the author uses the theory in cultural relations, this methodology of action is based on the ontological understanding of the city as a cultural expression, primarily. Moreover, culture is understood without the classic opposition between man and nature. It does so, because it argues here that all nature acts with social and aesthetic meaning for each society, thus creating identities. This happens geographically in the context of Stockholm city, with emphasis on the areas under study (Värtahamnen and Hornsbergs Strandpark).

Debating about the city's environment means not an indeterminacy, but an understanding of specific and merging knowledge. This is because this environment consists of a natural part (water), another undefined part (lawns, planted trees, plant beds) and yet another anthropic part (sidewalks, streets, decks, buildings). As Hagan (2014)[8] defends 'if nature is culture, then the time has come for culture to become nature, it must be reciprocal'. Canclini states that this understanding 'requires hybrid methodologies' (2004)[9].

Applying the concepts of Hagan and Canclini to the landscape design, we characterize the hybrid from three evolutionary stages: First: the use of clearly defined boundaries, which results in a landscape of little hybridization, great archetypal definition, typical of the early western 19th century rationalist. Second: the use of fluid boundaries, characteristic of an organicist design, continuous, of medium hybridization, typical of the late western 19th century romantism. This second design option is present in the 'Program for Sustainable Development, 2021', of Stockholm municipality[10]. Third: complete absence of limits, which results in the 'dematerialization of form'[11], with the non-identification of defining lines, thus generating diffuse and continuous territorialities.

Branzi (2014)[12], by contesting the urbanizing and universal modernism advocated in the Athens Charter[13], recommends that the cultural landscape, especially the city, should 'create thresholds between the city and the countryside through hybrid, half urban and half rural territories... conditions of discontinuous and flexible housing according to the seasons and climates'. Thus, we speak of an undefinition between the built and the free space, the physical and the virtual, the human and the animal, the built and the flora, and the geometric and the biotic. In Movies depicting dystopic futures such as Stalker (1979) by director Andrei Tark-

ovsky (1932-1986), it is common a negative reference to the city taken by vegetation in the midst of constructions. However, this is precisely the image of a hybrid landscape, not in the sense of destruction, but of the natural merging with the anthropic environment, which is exactly Canclini's concept of materialization, when applied to architecture, landscaping, and urban design. It is in this sense that Di Felice (2009)[14] claims: '... the environment and the surrounding territory are recognized, by some minority aspects of thought, no longer as a thing, nor as a lower way of life, but as something of a living, as a complex entity, agent and communicative'.

Värtahamnen Waterfront: The Future.

The Värtahamnen port area is located northeast of the city and was the site of studies of the SOS Waterfront June/July 2022[15]. The operations of the wharf were gradually developed during the early 1900s, with the construction of new piers and the gradual deepening of the channel level for vessels access. The site became a bulk cargo port for handling goods. Ferry traffic to Finland was started in 1966 with a flow that developed until the late 1980s. The Värtahamnen area is currently a strategic urban development site in Stockholm. Thus, several urban studies have been being developed by the municipality since 2011. The plans seek to transform the area into a part connected to the rest of the city. Studies predict that the region will hold around 10,000 new residential units, as well as offices, shopping malls and leisure spaces. Currently, the area is characterized with large parking areas, lack of green spaces, sparse vegetation, and public spaces, being characterized as a port area. The waterfront is geometrized with concrete floors for mooring boats (Figure 56).

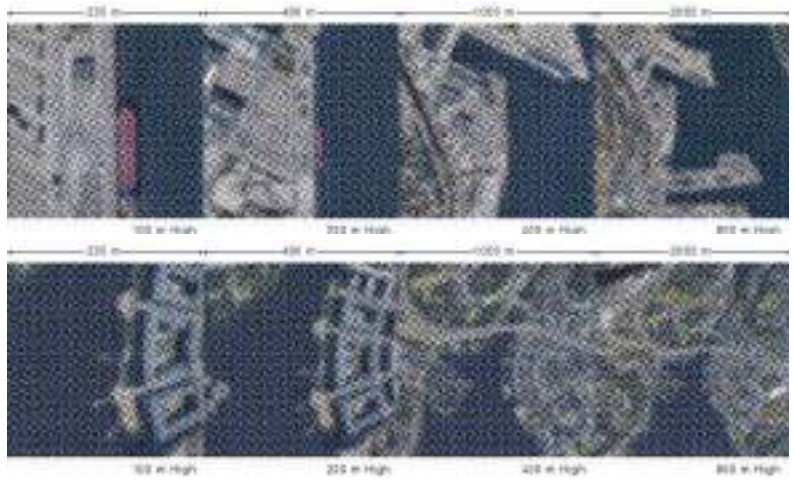

Figure 56 Actual hybridization in Värtahamnen (first) and Hornsbergs Strandpark waterfront (second). Maps. 0,5x0,5 mm pixelation. (Credits: author, 2023).

The area highlighted as well as a future possibility for the insertion of resilient urban experiences, which positively impact the urban fabric, and act head-on against climate change. The city of Stockholm decided in 2009 that the area should have an environmental profile, functionally mixed use, with high architectural quality and public space alive and accessible to all. As stated more than 40 years ago 'the strategy for dealing with the two key problems, development and the environment, should be conceived as being just one' (Meadows, 1972)[16]. Thus, the future potential of the area must respond to urban development, but with a strong emphasis on the ecological development of the city.

Hornsbergs Strandpark Waterfront: The Past.

The Hornsbergs area is located to the west of the city. Much of this area (Stadshagen) has a history of acting as a leisure space for the central area of Stockholm (Norrmalm). The waterfront called Hornsbergs Strandpark connects Kristineberg with Stadshagen, and currently undergoes a process of urban regeneration, transformed it from a former industrial area.

The area underwent extensive urban revitalization in 2012, with redesign of its waterfront of almost 1000 meters and insertion of public space, vegetation, decks, sidewalks, and small squares. The project implemented an organic urban design with well-defined drawing lines, creating green spaces and direct contact with water, with level variations of up to 2.50 m high. Three long floating piers advance into the water creating leisure spaces in the middle of Ulvsundasjön bay. Several direct water accesses characterize this waterfront as a natural swimming pool easily accessible for use during summer.

In the 2012 project, the extensive use of concrete floors, well-defined organic lines and the arrangement of stones and benches in a clearly organized manner, end up strongly delimiting the separation between nature and built landscape. The authors of the project defend the need to clearly express that the waterfront was planned and built as an anthropic beach park, in which nature is not understood as culture. The larger vegetation is also arranged in a rational and organized way, which reaffirm the concept of the architects. Only accesses and small concrete stairs have some direct relationship with the rest of the streets that reach the waterfront. The only green area that starts on the

waterfront and enters the city, takes place on the avenue Lindhagensgatan, with a symmetrical and organized sequence of trees arranged in a central flowerbed. In the rest of the site, the density of buildings acts clearly delimiting the natural landscape (Figure 56).

The waterfront is characterized as an anthropized and organicist landscape, with low hybridization. Much of the area is currently an embankment over the Ulvsundasjön bay, which eliminated the original shoreline, erasing all marks of the original waterfront.

Hybridism Applied to The Areas.

The relevance of the two waterfronts and the local impacts generated by worldwide climate change, empower the acceptance that actions in waterfronts must occur from a hybrid character between nature and city. It is suggested here the effort of application of the cultural thought of Nestor García Canclini applied to the urban space. This thought argues that the city is a space in constant deterritorialization and reterritorialization with a frequent loss of the natural relationship between culture and social territories (Canclini, 2006)[17]. The strategy of hybridizing the natural (water and vegetation) with the anthropized environment (traditional city) is part of the objective to create a progressive transition between these territories, to maintain and increase the social relations of society with waterfronts environments. This ecological urbanism acts in a resilient way, enabling to mitigate the effects of floods, increase soil permeability, increase green areas and vegetation, expand unbuilt limits, among others.

In the Hornsbergs Strandpark waterfront, there is the possibility of physically expanding the 30 m wide waterfront into the city and the Ulvsundasjön bay and eliminate the boundaries between city and vegetation that today are clearly defined. This is possible by mixing floors with vegetation and stones that allow the movement of people and cars, but also the growth of fungi and grasses. Stimulating the dissemination of natural substrates and the passage of microfauna and yet human occupation. Using floors with natural materials that decompose over time and could be recycled and replaced. With this actions, it is possible to create a dynamic landscape, without limits between nature and the city (Figure 57).

In the Värtahamnen waterfront, the possibilities are much greater. With a waterfront ranging from 100 to 700 m wide, there

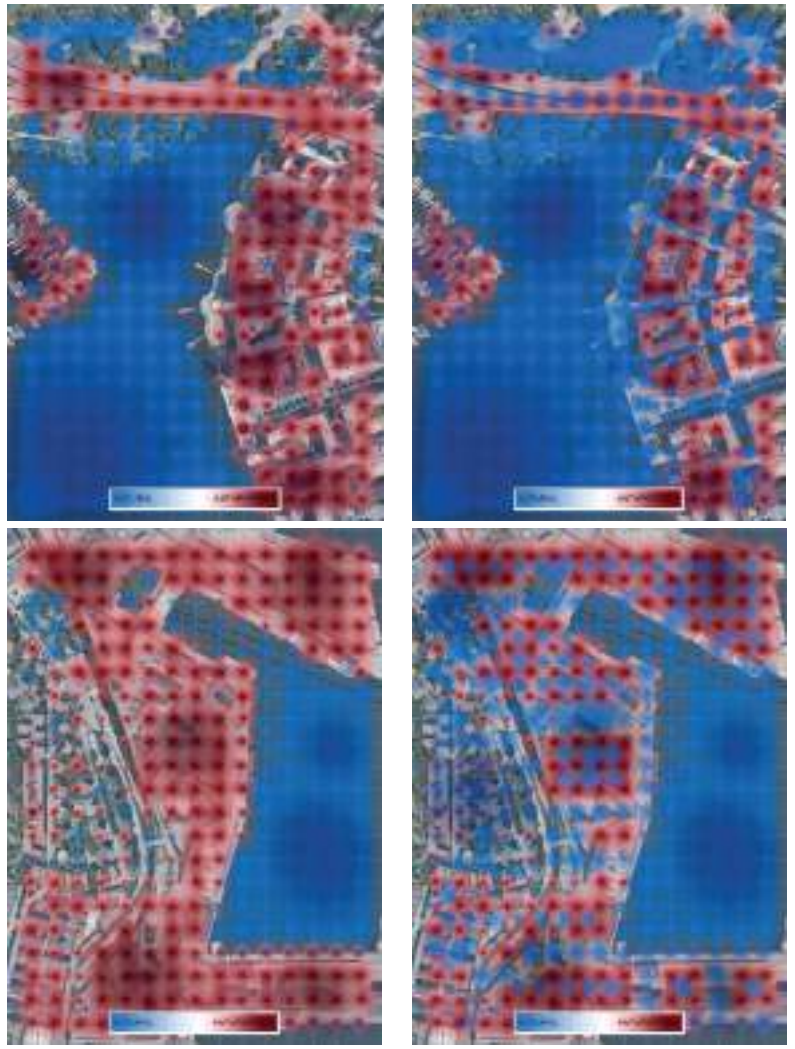

Figure 57 Hybridization map of Hornsbergs Strandpark waterfront. Reality (left) and possibility (right). (credits: author)
Figure 58 Hybridization map of Värtahamnen waterfront. Reality (left) and possibility (right). (credits: author)

is the real possibility (because it is not yet urbanized) of predicting a deeper hybridization, crossing the built environment, and reaching the Gärdet Cricket Ground, located southeast of Värtahamnen. Elevated floors and streets could allow the expansion of the natural flora and fauna. The vegetation can naturally be restored without major landscape interventions. The fauna would also be recovered, not as in the original way, but in line with the medium density occupation (Figure 58).

These boundaries should work as transitional urban ecosystems which can exhibit characteristics of different stages of urban evolution and show increased variability in ecosystem structure, functions, and services, before shifting to a more stable urban

regime. It is a matter of infiltrating the natural environment within the anthropic environment as a strategy against climate change. In this sense, the occupation of this part of the city, could occur within the logic of Di Felice (2009)[18]: 'could be configured as the transient and fluid hybridization of bodies, technologies and landscapes with the advent of a new ecology of ecosystems, neither organic, nor inorganic, nor delimited, but informative and immaterial'.

Discussion.

Canclini states that 'the surveillance of political correctness sometimes asphyxiates linguistic creativity and aesthetic innovation' (2015)[19]. Despite the urban quality of the site, the revitalization of the currently built Hornsbergs Strandpark leaves the natural environment clearly delimited. This territorial demarcation leaves little space for an informal ecology to be established. Although, the project has inserted green areas and contact with water, which is already of great relevance because it acts to alleviating the problems caused by climate change such as the increase in water level. Otherwise, a greater hybridization in Hornsbergs Strandpark would allow the settlement of a new cultural image for the society, in which the boundaries between the natural and the urban environment would no longer be defined.

A hybrid design acts not only horizontally but also vertically, which is very clear in Värtahamnen waterfront. According to the memorandum 'Guidelines on design values for sea levels in development projects', from 2015, new constructions facing waterfronts must have a minimum height of 2.25 meters, according to the RH2000[20]. This recommendation aims to mitigate the impacts of rising sea levels due to climate change for the next 100 years. In Värtahamnen, this height of 2.25 m can be diluted on the large plateau, generating a hybrid design of vegetation penetrating the urban environment that can reduce the vertical distance between the community and water, and maintaining Stockholm's historical cultural landscape and its relationship with aquatic environments.

Since the two areas are represented by the Stockholm City Plan, 2018, as areas of continuous use between land and water, it is possible to conclude that hybridization in these places can behave as a positive cycle that seeks to balance urban growth. The hybridization acts as a 'resilience urbanism which appeals to a certain back to basics attitude' (Adams, 2016)[21], where nature is no longer seen as something to be domesticated, but as an integral

part of society. The concept defended, and culturally conceptualized by Canclini, is nothing more than the updating of part of the values expressed in the early eighteenth century, in the picturesque style.

Both areas are subject to the insertion of some guidelines for further hybridization such as: use of permeable floors that allows the growth of grasses; flexibility for the natural growth of vegetation; insertion of larger amounts of natural green areas in assorted sizes entering urban space; use of natural building materials and furniture that decompose in nature; allow vegetation to grow through the walls and floors of buildings, creating a vertical and horizontal natural connection (Figure 59).

The discussion here intended is part of the cultural acceptance of the landscape as a hybrid environment, simultaneously understood as an ecosystem and a cultural system (McHarg)[22]. As stated Di Felice (2009)[23] 'the natural environment, human and social structures, instead of contrasting, should integrate into a symbiotic dynamism that would have allowed the improvement of living conditions'. Facing the global calamity of climate change, this symbiosis, which is a form of hybridization of the city with the natural, is a powerful tool for protecting human heritage.

Figure 59 Hybridization in Värtahamnen waterfront. (credits: author)

Notes

1 The World Health Organization (WHO) recommends 12 m² of green area per inhabitant

2 N. G. Canclini, 'Hybrid Cultures: Strategies for Entering and Leaving Modernity', University of Minnesota Press, January 5, 2006, p. 288.

3 Population of 2,231,000 in 2015.

4 The main ecological problems reported in the Stockholm Sustainable Development Plan (2021) are eutrophication, toxins in water and land, and impact on the physical environment.

5Gamla stan, until 1980, was officially named as "Staden mellan broarna".

6 Cris. Reed, 'The ecological agency'. In 'Ecological Urbanism', Org. Mohsen Mostafavi and Gareth Doherty (Editors). Lars Muller, 2016, p.329.

7 The available public green in European cities is Stockholm at 41.61 m² per inhabitant, Dublin at 33.99 m², Copenhagen at 25.34 m², Berlin at 22.73 m2, and Prague at 25.71 m². Source: Maes et al., 2019 https://publications.jrc.ec.europa.eu/repository/handle/JRC115375

8 S. Hagan, 'Performalism: environmental measures and urbanism'. In 'Ecological Urbanism'. Org. Mohsen Mostafavi and Gareth Doherty (Editors). Lars Muller, 2016, p. 458.

9 N. G. Canclini. 'Diferentes, desiguales y desconectados: Mapas de la interculturalidad (Spanish Edition)', Gedisa Editorial, 2004, p. 189.

10Program for Sustainable Development, Stockholm city. The Exploitation Office. Production: Blomquist Communication, 2021, p. 25

11 The concept is defined by Prevedello, A. 2021, and presented in https://vitruvius.com.br/revistas/read/arquitextos/22.255/8229

12 A. Branzi, 'For post environmentalism: seven recommendations for a New Athens Charter'. In 'Ecological Urbanism', Org. Mohsen Mostafavi and Gareth Doherty (Editors), Lars Muller, 2016, p. 111.

13 The Charter of Athens was written in 1933. Among the various criticisms appears: "The evil is universal, expressed, in the cities, by a congestion that corners them in disorder and, in the countryside, by the abandonment of numerous lands".

14 M. Di Felice, 'Paisagens Pós-urbanas. O fim da experiencia Urbana e as Formas Comunicativas do Habitar'. São Paulo: Annablume, 2009, p. 38.

15Project SOS Waterfront 2022. http://sosclimatewaterfront.eu/sos/news/urban-design-workshop-stockholm

16 D. L. Meadows, 'The Limits to Growth', Ed. Perspectiva S.A, 1973, p. 188.

17 N. G. Canclini, 'Hybrid Cultures: Strategies for Entering and Leaving Modernity', University of Minnesota Press, January 5, 2006, p. 288.

18M. Di Felice, 'Paisagens Pós-urbanas. O fim da experiencia Urbana e as Formas Comunicativas do Habitar'. São Paulo: Annablume, 2009, p. 229.

19 N. G. Canclini. 'Diferentes, desiguales y desconectados: Mapas de la interculturalidad (Spanish Edition)', Gedisa Editorial, 2004, p. 26.

20 The Swedish national height system RH 2000 is the official national height. Formally adopted in 2005.

21 R. E. Adams, 'Climates: Architecture and the Planetary Imaginary. An Ecology of Bodies'. Columbia Books on Architecture and the City. Lars Müller Publisher, 2016, p. 189.

22 R. E. Adams, 'Climates: Architecture and the Planetary Imaginary. An Ecology of Bodies'. Columbia Books on Architecture and the City. Lars Müller Publisher, 2016, p. 189.

23 M. Di Felice, 'Paisagens Pós-urbanas. O fim da experiencia Urbana e as Formas Comunicativas do Habitar'. São Paulo: Annablume, 2009, p. 39.

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Coastal city learning model

Reflecting Climate Change Adaptation Measures with other Cities.

KEYWORDS:
Climate Change, Coastal Cities, Adaptation Measures, Comparable Model.

Abstract

As the impact of climate change on coastal cities becomes clearer, cities are developing new strategies to deal with the impact of this change, according to recent publications on water-related assessment studies, as well as following the results of the H2020 Marie Curie project SOS Climate Waterfront and its spin-offs (Sanders 2020) (Sanders et al 2021).

This development is reinforced in view of the various reports that have appeared recently; whereby the expectations for global climate change and sea level rise becomes clearer and the need for adaptation measures gains ground compared to mitigation measures as the priority (Deltares 2018a 2018b 2021) (IPCC 2020) (Van de Meulen 2020)

With this increasing threat, its clear that small and large coastal cities will look for measures that will specifically help in their own situation to move along with the climate change effects, so that the lives of their inhabitants and thus their cultural phenomenon can be conserved or will not be drastically changed, but can change with the changes (Deltares 2019) (Murphy 2022) (Roo 2011) (Van Bergen 2021).

In order to encourage cities to support each other in this development, to learn together how choices can be adapted and communicated with their citizens and stakeholders, and how the related changes to these choices can become cost-efficiently, a model has been developed with which cities can compare each other's situation in the light of their worked-out measures; a model that covers both hard built environmental and more fluid cultural measures and what is in-between, large and small-scale, expensive and cheap measures. Existing models have been used for generating this model (WUR 2019) (Deltares 2022) (Hendriksen 2022) (Lin 2020) (Van Bergen 2019), and relevant case-studies as well (Berkens 2014) (Dal 2021) (Hooimeijer 2022) (Mispelblom 2019) (Van Bergen 2019).

To model is tested on the six cities from the H2020 Marie Curie SOS Climate Waterfront programme: Lisbon of Portugal, Rome of Italy, Thessaloniki in Greece, Gdansk in Poland, Stockholm of Sweden and Amsterdam in the Netherlands. Each of these

cities their coastal circumstances and actual adaptation measures taken and those that are in consideration, were given a place in the model and involved parties were asked for reflection, in order to process their recommendations into a first guide to using the model, as a contribution to the European scale for all comparable coastal situations.

Introduction

It is becoming increasingly clear that the impact of climate change on life on our planet is becoming increasingly influenced by climate change. This is illustrated by the shift in topics that have been successively discussed at the climate conference over the past few years. While in Paris in 2015 the focus was still mainly on reducing greenhouse gas emissions, recently in 2022 at the conferences in Montreal Canada (UNFCCC-COP15 2022a) and Cairo Egypt (UNFCCC-COP27 2022b) the focus respectively was on preserving biodiversity and rising resilience: starting a 'loss and damage fund', to react adaptative on the changing living conditions caused by climate change. Reading the accompanying conference statements, a sense of responsibility is also emerging on a global scale, and the trend of continued negative results in reducing greenhouse gas emissions leads to a shift in focus towards adaptive measures (COP15 and COP27). Also, the increasing effects of climate change call for systematic risk management, more adaptation and accelerated decarbonization (Woetzel/McKinsey 2020).

The same trend change could be observed in the Netherlands; Deltares consultant (former governmental research centre for coastal defence) was the first to come up with scenarios for the future coastal defence of the Dutch delta (Deltares 2019) (surfacing approximately 50% of the land area in the entire west of the country in terms of size) in the event of further sea level rise (assuming emissions of greenhouse gases exceed the agreed amount in the UN Paris agreement. which is based on a maximum of 1.5 degrees of global warming). Then the Agricultural University of Wageningen (WUR 2019) and Delft University of Technology (RDM 2022) followed with plans for a completely new and different landscape design respectively concerning the whole country and the most crowded areas in the western part of the country. The Delta Commissioner, the Netherlands' most important government adviser on coastal defence, also stated that long-term coastal defence planning is necessary, as the western part of the country would not be able to be kept dry with the current constructions if the sea level rises by more than 2.0 metres.

These developments show the first steps in the Netherlands to invest extensively in a new coastal defence in addition to the current mitigation program (CO2 neutral in 2050) (Rijksoverheid 2019). These first plans illustrate that such plans will go much further than coastal defence alone. The climate change for the Netherlands shows that (KNMI 2021), in addition to the expected sea level rise, there will be wetter and drier periods in the future, which will also affect the agricultural sector and overheat the cities, partly because the water level in the rivers will fluctuate more strongly. With all the associated problems, such as a threat to the health of the elderly, salinization of the agricultural area with a major negative impact on potato and flower bulb cultivation, lack of cool water for energy plants. as well as an accelerated loss of biodiversity in the nature reserves spread across the country.

What is new is that, in addition to the strategic prospects mentioned above, Deltares consultancy has made a decision model for developing scenarios (Deltares 2022) that could also be used for other deltas. The question that may be critically asked is whether such a model for deltas in general can be made from the Dutch context, because many deltas, unlike the Dutch situation, have not previously worked on comparable structural coastal defences. Shouldn't a comparison of deltas around the world be made first, at least to explore whether situations occur there that are completely different from those in the Netherlands? A critical note that makes the H2020 Marie Curie program 'SOS Climate Waterfront' (Lusofna 2018) interesting to include in this search for robust adaptive scenarios. in particular because this program examines learning points between a number of European deltas, without taking a biased position. The participants visit each other successively to work out sustainable city-designs in conversation at locations. This implicitly creates a shared picture of the differences between the six deltas from which the participants in the program come: Lisbon in Portugal, Rome in Italy, Thessaloniki in Greece, Gdansk in Poland, Stockholm in Sweden and Amsterdam in the Netherlands. Unfortunately, this implicit comparison is not an active part of the program.

That is why additional research has been done for this, a model has been built on the research question: 'What model can be a tool for city management to compare their climate-change situation with that of other cities, for mutual learning and creating adaptation measures for the city for a safe and prosperity future?' to compare the situation of these deltas with their sensitivity to

climate change, and that model has been tested at the six delta locations of this programme. Before presenting the results, the following aspects are discussed: the backgrounds and the result of the model, the test results based on visits to the six deltas and then the possible refinements of the model, with conclusions and evaluation.

The CCLM-model generated

In recent years, a few models have been compiled in the Netherlands to develop adaptive scenarios for cli-mate change (Deltares 2022) (UNDP 2010) (Downing and Patwardhan 2020). The Deltares model show to be the most hand-on and offers a wide range of measures that can be taken to compensate for and defend against the changes caused by climate change. The many other models as the ones from the UNTP and Downing & Patwardhan are more models of processes, being roadmaps to gather and select data for creating strategies. None of these models are in principle location-bound, and none are basic enough to compare the situation between cities.

That is why a new model, the Coastal City Learning Model (CCLM) specifically for cities located on the coastal shores, has been developed in which the following can be visualized side by side: the local situation of the city and the surrounding area, the prognosis for the changing impact of climate change, the measures that have been implemented and which are planned, to place next to these results the first observations of nega-tive influence of climate change on water quantity and quality, the situation in the landscape and the well-being of the inhabitants as well as flora and fauna, see Figure 60. The underlying idea of this model is that it can be filled in for cities, as a snapshot of the present with observations that say something about climate-sensitive aspects, about future developments; to compare these snapshots of cities with each other, to copy measures from each other, to learn from each other's strategies, as can be said: 'If the past teaches, what does the future learn?' (Murphy and Crumley 2022).

Because this is a new model, it needs to be tested, and the urban situations of the six in the 'SOS Climate Waterfront' program are ideally suited for this. Therefore, the model has been filled in with the respective participants of the CPONH NGO organization who visited these cities, as a first proof of results, to clarify both the comparability and the practical usability of the model, to improve the model for general use, inside and outside this EU H2020 Marie Curie project.

The six EU test-cities

The participating cities in the 'SOS Climate Waterfront' program are: Lisbon of Portugal, Rome of Italy, Thes-saloniki in Greece, Gdansk in Poland, Stockholm of Sweden and Amsterdam in the Netherlands, and for each the model is filled-in for first comparison and testing its usability.

Lisbon in Portugal:

Lisbon, located on the Atlantic Ocean in the delta of the Tagus River, is an old city from 1200 AC with approx. 500k inhabitants, with initial problems related to climate change: such as overloading of the sewage system with the increasing number of heavy rains, increased risk for the expensive apartment complexes on the ocean side in case of sea level rise and a threat to bird diversity, also quantitatively in the riverbed area south of the Tagus. The draining of water from the river across the border in Spain for irrigating the southern Span-ish provinces also results in extra low water levels in the summer, endangering South-Portugal's own irriga-tion and endangering the riverbed as a foraging area for the birds. See Figure 61 for the result of the filled-in model. Based on the report of Fred Sanders, secondee from CPONH NGO.

Rome in Italy:

Rome of 753 BC, located on seven hills on the river Tiber, is nearby the sea thanks to the suburb of Ostia and has approximately 3,000 inhabitants. Over the centuries, the city has expanded to the river, so that high river levels lead to problems. It is also increasingly hotter in the city in the summer and due to the dense buildings, there is little room to create green open spaces. The city wants to expand and there are plans to take climate change more into account. Based on the blogs of Karel Mulder, secondee from CPONH NGO.

Thessaloniki in Greece:

Thessaloniki of 315 BC is located on the river Vardar and has about 350k inhabitants. the city is located on the Aegean Sea, in open connection with the Mediterranean Sea. The sea level rise in the Mediterranean is still small, but dams are raising the water levels in the Aegean Sea, which, in combination with higher river levels, will lead to flooding in the city, against which few measures can be built due to the abundant UNESCO heritage. Based on the blogs of Jelle-Jochem Duits, secondee from CPONH NGO.

Gdansk in Poland:

Gdansk, located on the eastern side of the Baltic Sea, has a fairly wide Vistula delta. The river flow is drained to the Baltic Sea before Gdansk with a canal to prevent high water in the city. However, the city still has regu-lar floods that flood the centre when the sea level rise coincides with high river levels in the many other smaller rivers that flow through Gdansk. Flood areas have been created to lower river levels, but the effect is until so far limited. Gdansk is therefore inhibited in its ambitions to build new residential areas (Sanders et all 2022).

Stockholm in Sweden:

Stockholm, city in the archipelago, with a population of 900k in the city and 2 million people in the region, located on the Baltic Sea is working on the many sustainable challenges associated with climate change, but will suffer little from sea level rise because the soil of Scandinavia is rising faster, bouncing back without the weight of the last ice-age kilometre-thick layer. Based on Karen Jonkers reporting, secondee from CPONH NGO

Amsterdam in the Netherlands:

Amsterdam area with approx. 1,500k inhabitants and the same number of tourists every year, has the prob-lem that the threats from climate change are great (sea level rise, heavy rainfall, heat stress in the summers and soil subsidence because the 10 meters of peat on which the city is built settles) while there is a huge need of +50% housing. Based on the EU paper (Sanders et al 2022)

The results and the proposed CCLM-model evaluated

Seeing the results of using the proposed CCLM model for the six cities of the H2020 Marie Curie program 'SOS Climate Water-front', there seems to be enough information in the model to place the cities side by side, with the questions: which have the same type of problem and can there be a basis for mutual learning by comparing the implemented and planned measures.

As a first taste of this proposed use of the model it can be said: 1. that the situational conditions of Lisbon and Thessaloniki show to be comparable (threat of sea level rise and high river levels for a classical city with many monuments), 2. Also, the situation in the cities of Gdansk and Amsterdam-area show to be quiet similar (city near a river-delta that suffers from increasingly sea-level rise, causing the old city to suffer from flood-ing, blocking housing developments and putting agricultural production under pres-

sure), and 3. the situation in the cities of Rome and Stockholm are more isolated within the group of six cities in this research pro-gramme: Rome is more inland and mainly has the problems of many large cities in Europe and beyond (summer heat stress and the inability to dealing with heavy rainfall in the autumn), while Stockholm has rela-tively few disadvantages of climate change (no worries about sea level rise because the land surface rises faster, and suffers less from hotter summers and a wetter autumn).

It should be noted that little is known about the state of the flora and fauna in and around these six cities. This may reflect the fact that the project was set up on the basis of architecture and urban planning. But for Scandinavia, for example, Hugo Sanders second of CPOH NGO brought the message (xxxx) that the shift-ing of the seasons due to climate change has a negative influence on the growth of plants and mushrooms, be-cause the mutual symbiosis between crops - the simultaneous availability to each other - disappears, resulting in a decline in growth and maturity. Unfortunately, for information on this we have to talk about side-kick in-terests of the seconds that make the available information limited, such as the decline of the insect world.

The model is only effective if comparable cities are also given the opportunity to learn from each other's situ-ation, to consider measures taken in one situation in the other situation or if they can also be considered. As an example, the comparison of the situation in Gdansk/Poland and Rotterdam/Netherlands (Amster-dam area) can be sought. Both cities struggle with the contradic-tion between the importance of closing the estuary against the high-water situations that already exist, and which are predicted to become worse due to climate change, versus the further eco-nomic growth of the port and the desire of people to apartments on the water. In Rotterdam, a closable barrier has been built for this purpose, which can be closed at high water, when the situ-ation is most critical. This is a protective measure that can also be considered in Gdansk. On the other hand, Rotterdam could consider constructing similar retention basins upstream in the riv-ers that feed the estuary, basins with which Gdansk has achieved good results for artificially lowering the river level when ef-fects accumulate (Sanders et al 2022). In short, it seems effective to clearly visualize the situations and the effects of climate change in order to recognize comparable situations, so that a process of mutual learning can start.

Despite these first relevant results, the model only seems relevant if it provides more than just situational comparability, but

that the influences of climate change and the measures taken and planned can be substan-tively compared and discussed. In order to take that comparison further in depth, it was thought that the model could be improved one step if it could be indicated for each theme whether this is a critical aspect or not. To this end, the model has been expanded with the option (a bar in the diagram) of adding accents or text, see the example of the situation in Amsterdam in Figure 68.

Recommendations

The message of Marie Curie (1867 - 1934) is that where people meet, experiences and knowledge are ex-changed and that both enrich their insights. With that message, there is a logic that the H2020 EU program has opted for a segment Marie Curie program, which seeks new insights to deal with climate change by bring-ing together investigative people from different countries to discuss the situation with each other on location: the urgency and possi-ble necessary measures to have a high-quality conversation.

The introduced CCLM-Model can contribute to this, as an instrument to stimulate a good substantive discus-sion and to engage in depth for the benefit of conclusions. The model only proves itself when it is used in practice. The presentation, the test and the proposed improvement of the model can therefore be seen as a first step and contribution for the use of others, because the more climate change is globally accepted, the more measures will be considered and it will become useful. that cities compare them with each other in or-der to monitor effectiveness and cost efficiency.

Figure 60 Coastal City Learning Model (CCLM) generated to be tested on 'SOS Climate Change' project cities
Figure 61 The filled-in CCLM-model for Lisbon in Portugal
Figure 62 The filled-in CCLM-model for Rome in Italy
Figure 63 The filled-in CCLM-model for Thessaloniki in Greece
Figure 64The filled-in CCLM-model for Gdansk in Poland.

LOCAL SITUATION CITY-ENVIRONMENT	SEASIDE SHORE CHARACTERISTIC	RIVER DELTA SITUATION	CITY CHARACTERICTICS	POPULATION CHARACTERICTICS
CLIMATE-CHANGE IMPACT FORECAST	SEA-LEVEL RICE	RAINFALL	DROUGHT	FLORA & FAUNA
MEASURES TAKEN OR IN PLANNING	PHYSICAL	NON-PHYSICAL	BEHAVIOURAL	RUN-AWAY-FOR
RISK AND IMPACT OBSERVATIONS	WATER	LAND	CITIZENS	FLORA & FAUNA

LOCAL SITUATION CITY-ENVIRONMENT	rising land fromout the sea	lagus river south of city with wide riverbed	city situated on two hills, centre and village ancient	580k citizens; beside tourists, also Brasilian.
CLIMATE-CHANGE IMPACT FORECAST	sealevel-rise as predicted for the Atlantic ocean	more severe rainfall	more dry countryside, and city heat-stress.	riverbed bird populations are in danger
MEASURES TAKEN OR IN PLANNING	no-building oceanshore new sewage in cityecntre	The 1755 flooding line, is made visual in de city	none	the airfield is planned on a new location.
RISK AND IMPACT OBSERVATIONS	flooding of the city centre summer heat-stress	summer-drought in the countryside	older citizens move to countryside	birds breeding grounds flood on floodplains

LOCAL SITUATION CITY-ENVIRONMENT	the seaside on distance.	river bank narrowed by dykes.	densely built city on seven hills	3,000k citizens many global visitors
CLIMATE-CHANGE IMPACT FORECAST	not relevant	less rainfall in general	longer warmer periods.	no information
MEASURES TAKEN OR IN PLANNING	local widening river-bed	none	none	no information
RISK AND IMPACT OBSERVATIONS	flooding along river Tiber	drought in the coustryside	heat-stress among citizens	no information

LOCAL SITUATION CITY-ENVIRONMENT	at the Aegean sea out-to-sac of M-ssa	river westside of city	old city not densed rules UNESCO heritage	358k citizens 2d city Greece
CLIMATE-CHANGE IMPACT FORECAST	water accumulation increase sealevel rise.	no issue	drier summers	no information
MEASURES TAKEN OR IN PLANNING	UNESCO heritage blocks phys.-measures	none	none	no information
RISK AND IMPACT OBSERVATIONS	flooding from the sea	none	none	no information

LOCAL SITUATION CITY-ENVIRONMENT	city at the Baltic sea in between rivers	city in between vistula river and small rivers.	old city with canals	densed city 470k citizens
CLIMATE-CHANGE IMPACT FORECAST	high water levels by sea-water compression	more periods of severe rainfall	no problem	no information
MEASURES TAKEN OR IN PLANNING	canal to relief riverwater water retensie basins	none	none	irrigation polder delta
RISK AND IMPACT OBSERVATIONS	numerous floodings	dry and wet periods countryside	no new housing for city growth	no information

LOCAL SITUATION CITY-ENVIRONMENT	on the Baltic Sea shore	river Söderström in centre	derived city on interconnected islands	900k citizens less immigrants
CLIMATE-CHANGE IMPACT FORECAST	sealevel rise is no issue due to faster land rise	more inters rainfall	longer dry periods	no information
MEASURES TAKEN OR IN PLANNING	none	green architecture	none	none
RISK AND IMPACT OBSERVATIONS	none	none	none	no information

LOCAL SITUATION CITY-ENVIRONMENT	by canal and locks connected to the sea	Dutch rivers flow through Rotterdam delta southern.	compact city with suburb. cities around	800k inhabitants; 1,500k area included, mixed pop.
CLIMATE-CHANGE IMPACT FORECAST	the locks block seelevel. rise on short notice.	rainfall becomes heavier and drainage problematic.	summer starts earlier and warmer, heat in the centre	loss of insects, exotic crayfish introduction.
MEASURES TAKEN OR IN PLANNING	waterretention new areas more coastal defence.	none	none	some households move to eastern higher areas
RISK AND IMPACT OBSERVATIONS	water complexity blocks new housing planning.	to intensive use of agricul-tural production is inhibited	not yet	loss of biodiversity is observated

LOCAL SITUATION CITY-ENVIRONMENT	by canal and locks connected to the sea	Dutch rivers flow through Rotterdam delta southern.	compact city with suburb. cities around	800k inhabitants; 1,500k area included, mixed pop.
		●		
CLIMATE-CHANGE IMPACT FORECAST	the locks block seelevel. rise on short notice.	rainfall becomes heavier and drainage problematic.	summer starts earlier and warmer, heat in the centre	loss of insects, exotic crayfish introduction.
		●	●	
MEASURES TAKEN OR IN PLANNING	waterretention new areas more coastal defence.	none	none	some households move to eastern higher areas
	●			
RISK AND IMPACT OBSERVATIONS	water complexity blocks new housing planning.	to intensive use of agricul-tural production is inhibited	not yet	loss of biodiversity is observated
	●	●		●

Figure 65
Figure 66The filled-in CCLM-model for Stockholm in Sweden.
Figure 67 The filled-in CCLM-model for Amsterdam in the Netherlands.
Figure 68 Updated model after first testing on the 'SOS climate Waterfront' project cities; example Amsterdam.

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Team Project II

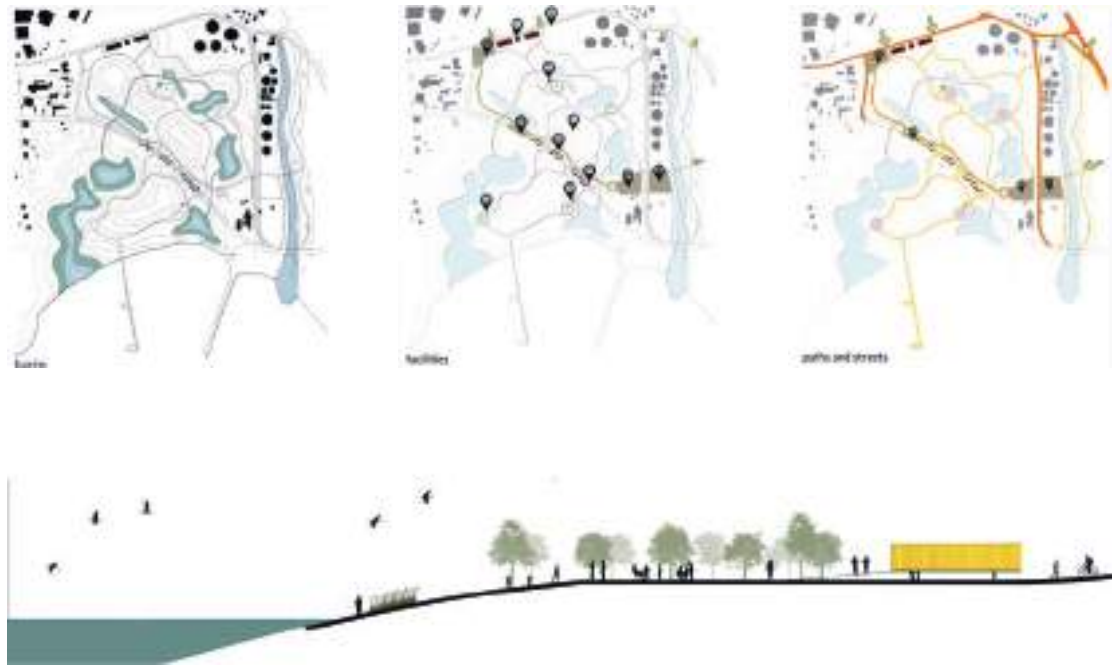
Clean the Soil, Thessaloniki

The main objective of the project is to transform one of the most industrial sites, Menemeni into a new zone for the city, helping the city to grow and improve the standard of living of its inhabitants and especially of the neighbouring districts. To design the project, information was collected on the sea-level raise and geological systems. The main objective of the project is to rebalance natural spaces and industry, accommodating floods, adapting rising water levels in green public spaces, bringing stability to a currently vulnerable area. The aim of the project, is to make the whole area resilient to natural disasters, ensuring the protection of the natural systems of fauna and flora for the enhoyment of the community. Around the area it is a densely populated area that has few spacesf for contemplation and immersion in nature. Considering the surroundings, the industry, the harbour, the marshes and road infrastruture, the project proposes an integrated solution that solves the problems of the waterfront by creating qualified public spaces for the enhoyment of the population.


YACHT HARBOR


ACCESSIBILITY


ECOLOGICAL SYSTEMS



Chapter 3

Porosity

Alkmini Paka
Lina Suleiman
Anastasia Tzaka

Porosity

Introduction

The introduction to this thematic chapter sets the stage for presenting the concept of 'Porosity', and its eventual applications in current urban research issues, and then provides an overview of the four articles that contribute to the theme within the research agenda of the SOS Climate Waterfront project.

Cities today are faced with rapid, unprecedented urbanization and the effects of climate change. The dynamic processes developed historically to help cities adapt to change cannot face the present complex urban realities. As a result, there is an urgent need for new strategic design agendas and conceptual design frameworks for viewing and knowing the city within the present condition. Specifically, waterfront areas and their communities are considered more vulnerable to the effects of climate change and extreme weather events due to their geomorphology and close relationship to water.

'Porosity' is viewed in this chapter as a conceptual framework for developing adaptation and mitigation strategies to tackle climate change, meaning the devastating ecological impacts of storms, floods, rising water levels, heat waves and droughts, while increasing urban resilience.

Exploring the Porosity concept.

"Pore" (from Greek πόρος) means "a minute opening". "Porosity is the noun derived from the adjective porous. Something that is porous has many small holes, so liquid or air can pass through, especially slowly, i.e. porous soil with good drainage or porous brick walls or a porous polymer membrane"[1].The term 'Porosity' is originally used in biology, medicine and organic chemistry[2]. Alongside the concept of Porosity, literature has often discussed the concept of Permeability and sometimes uses the two concepts interchangeably even though defined differently[3]. Porosity refers to the extent or degree of being porous, while Permeability measures the ease of flow through a porous object and not the extent of being porous[4].

The concept of Porosity has been widely applied in various domains and disciplines such as, but not exclusively, material science[5], civil engineering and construction[6], architectural and urban

design[7 8 9], hydrology[10], and soil mechanics[11]. Also, the concept has been used across-disciplines, such as planning and physical design in various scales with an approach of blending architecture, biology, organic forms and processesproviding productive conceptual frameworks that can be reinterpreted, producing new meaning and applications within a new context[12]. As an example of this kind of metaphoric application, Coates[13] describes environmental history as an interdisciplinary scientific endeavour and a receptive porous discipline because of its willingness and capacity to absorb the insights of other disciplines, both proximate and more distant, and to adopt and adapt their methods in developing knowledge.

In the architectural and urban discourse, the concept of porosity and the relative term of porous city relates to the discussion of boundaries, flows, interface, exchange, connectivity, fluidity and absorption, both in material and immaterial, tangible and intangible conditions[14 15 16 17]. Hence, "Porosity" constitutes "a fertile instrument in nourishing ideas, interpretations, and projects for the city and the territory"[18] usefully included in a broad lexicon of terms for understanding the social and spatial world literally and figuratively[19].

Porosity has thus provided a resourceful theoretical foundation for novel approaches of the urban environment to mitigate the devastating effects of climate change[20]. The cross-disciplines applications of Porosity for the study and design of the territory - across architecture, urban design, landscape design, urban planning, landscape urbanism, environmental planning, infrastructure design, water management[21], etc.- is key for the development of holistic design strategies and governance policies in order to achieve a high degree of urban resilience. Such strategies seek to produce effective solutions that combine complex parameters from all scales of urban space, while at the same time activating numerous urban actors and agents and taking into consideration multiple temporalities -histories and records- for the creation, evaluation and adjustment of proposed urban models.

In fact, relevant literature on Porosity within the urban agenda refers to various types of interchanges in the anthropogenic and natural realm. Physical, functional, social, and ecological porosity refer to different types of urban interactions and provide valuable tools to analyze and reorganize urban flows, dynamics and transformations with regards to sustainability and resilience issues[22 23 24]. Porosity can also be conceptually applied to open governance and bottom-up, participatory policies as it characterizes the

flows of communication between decision makers, stakeholders, citizens and specialists involved in the strategic planning processes against the climatic crisis. Moreover, in the fast-growing digital realm the notion of porosity is associated with flows of information and data across disciplines and across regions that are required for tackling the challenges of climate change. Updated information flows are crucial for the management and efficiency of technologically advanced systems that operate in contemporary smart cities projects and for the accuracy and diffusion of meteorological models that provide the basis for all urban adjustment and reorganization in regard to climate change.

Overview of the Thematic Chapter.

The following chapter brings together several veteran scholars from diverse disciplines -Geology and Climatology, Hydraulics and Environmental Engineering, Urban and Regional Planning, Urban and Architectural Design- mainly from academic and non-academic institutions. Their research papers explore a range of issues, focusing on understanding the climate change processes across spatial scales. Their contributions aim at developing inclusive, integrated adaptation strategies to climate change for vulnerable, urban waterfronts.

The paper by P. Tarani and S. Tsoumalakos introduces the concept of Porosity as a critical parameter in the environmental planning of cities in regard to climate change while providing a short literature review on this issue. Departing from this theoretical perspective, it argues that we should consider the emergence of a new "water geography" as adynamic, hybrid, ecosystem paths' network within the city well-connected to its natural elements. This approach provides new key aspects for policymakers and planners, particularly as urban sustainability, resilience, and environmental crisis increasingly reshape metropolitan areas and pinpoint a need to consider these topics yet further. Water geography plays a crucial role in shaping the ecological functions of an urban area, and in this case that of the city of Thessaloniki. Elements such as the minimization of impervious surfaces, the enhancement of urban porosity, and the best management practices of rainwater, can contribute effectively to the preservation of the existing ecosystems and the formation of new ones.

The paper by M. Lazoglou, K. Serraos and G. Spiliopoulou stresses that adaptation strategies to climate change should be inclusive, integrated, and designed locally to the needs, require-

ments, and characteristics of each area. They emphasize the necessity of broad public participation for developing a new urban planning project. The paper refers to the case of 'Mati', in the Attica Region in Greece, an area that was developed outside the formal planning system and severely affected by a great fire that broke out in July 2018. It highlights the significant connection between the national and regional adaptation strategies to climate change and local spatial planning initiatives and examines the citizens' engagement during this process. The paper's objective is to bring attention to the connection between the already-established climate change adaptation strategies and local-level spatial planning initiatives in Greece. The research also explores whether communication of critical issues and information flow between decision makers and relevant stakeholders is adequate for ensuring an inclusive new urban plan, to mitigate and overcome the consequences of climate change.

The paper by S. Leontiadou focuses on urban porosity and criticizes the common soil sealing practices of waterfront sites in the Greek context, arguing for an environmental urban design approach that promotes porous and earthly surfaces. Leontiadou argues that this is particularly important for Greece, the country with the longest coastline in Europe, facing a high risk of urban flooding and sea-level rise, while suffering considerable biodiversity loss. The article discusses various precedents of implementation of soft surfaces in projects in Sweden, UK, Netherlands, and Germany that can inspire initiatives in Greece towards urban transition for a more sustainable environmental planning approach in waterfront sites. Considering the general lack of urban greenways in the dense Greek cities' fabric, sustainable waterfront zones offer a valuable opportunity for the environmental upgrade of Greek cities, as well as the general well-being and living conditions of their inhabitants.

The paper by P. Zanis and K. Tolika argues for the need to reduce uncertainty and enhance the reliability of meteorological and climate data at regional/local level and understand the climate change processes. Improved reliability allows the assessment of the projected impacts of climate change risks on the environment and society. In doing so, the article aspires to develop modeling methods that combine climate change data and observations at the global level using Global Climate Models (GCMs) and Regional Climate Models (RCMs) to monitor the climate change processes and impacts at the regional and local levels. Even though the concept of porosity is not clearly spoken out, it is embedded in the processes of data exchange, dynamics and information/data flows between the global and regional/local scales to enhance our knowledge and understanding in designing plans and strategies for risk absorption.

Notes

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Water Geography: Defining New Ecosystem Patterns in the Thessaloniki Metropolitan Area

Introduction

Thessaloniki's urban body sprawls around an arc of coastline at the top of the Thermaic Gulf. A major spatial characteristic of the city's metropolitan area is the extent and multifunctional coastal line connecting the various urban activities, most of them of regional and national importance, such as the Axios River Delta (Natura area), the Thessaloniki Port, and the Macedonia Airport. With a more than 40 km length, Thessaloniki's shoreline is the city's major geographic and urban feature. We must also acknowledge the allusive structure of the many transverse streams that flowed into the sea and were absorbed by the corresponding urban grid that replaced them. Today, the city's extensive marine zone and the remaining streams are both natural ecosystems and hosts sheltering life, thus acting as a "bridge" between the technical and the natural "body" of the city.

In urban areas, streams are the main recipient of most of the pressures resulting from urban sprawl and its accompanying functions. Degradation of water quality, restriction of the riverbed, and often the transformation of the stream, into a closed underground conduit, are some of the pressures that streams can be subjected to, from the urban environment. In this context, it is very common for streams to be cut off from their natural environment, which leads to changes in the functioning of this natural ecosystem and the individual ecosystems that have developed within them. Human intervention is crucial both in reversing this situation and in encouraging a redefinition of the role of streams in urban areas. Urban streams can be seen as transitional areas where novel and hybrid ecosystems can be created.

The streams in the Conurbation of Thessaloniki have undergone significant changes, and over time, large parts of them have been transformed into closed underground conduits. Therefore, the picture that most streams present is one of partial preservation of the original bed at a specific point and the emergence of new, hybrid, local ecosystems. These ecosystems retain some of the original elements of the stream and they also try to adapt to the new situation and the constraints created by the built environment.

This paper argues that we should consider the emergence of

a new “water geography” as a dynamic, hybrid, ecosystem paths’ network within the city well-connected to its natural elements. This approach provides new key aspects for policymakers and planners, particularly as urban sustainability, resilience, and environmental crisis increasingly reshape metropolitan cities and pinpoint a need to consider these topics yet further.

Water geography and the porous city concept

1. Water geography and the Porous city concept – origins and concept evolution

Creating urban spaces that allow the free flow and penetration of water and other natural elements is essential to the survival of contemporary cities in times of climate change. Porosity can be understood in this context as a city’s capacity to adapt to the natural flow of water, focusing on fluidity and flexibility as essential mechanisms of climate adaptability – elements often neglected in urban development. Breathable void and healthy pore structures, allowing for the flow and penetration of water and other natural values, are thus key necessities[1].

We owe the use of the term “porosity” for urban issues to Walter Benjamin and Asja Lacis. They used a term that originated in earth science and construction with reference to Naples’ urban characteristics. They observed that the city of Naples had a unique quality of spatial and social interconnectedness, where various spaces merged into each other, and the boundaries between different areas were fluid. According to Benjamin and Lacis, this porosity gave rise to a sense of improvisation and unpredictability in the city’s everyday life. The streets, squares, and other public spaces in Naples provided the backdrop for spontaneous encounters, chance encounters, and unforeseen events. This idea of porosity highlighted the dynamic nature of urban life and the potential for unexpected interactions and experiences[2].

In contemporary discourse, the term “porosity” is increasingly used conceptually to describe urban environments that exhibit similar characteristics. It refers to spaces that are open, permeable, and characterized by a fluidity of boundaries.

In this sense, “porosity” has become a theoretical framework for understanding and analyzing urban environments. It suggests a departure from rigid spatial divisions and encourages the exploration of more fluid and dynamic urban designs that foster social cohesion and spontaneous encounters.

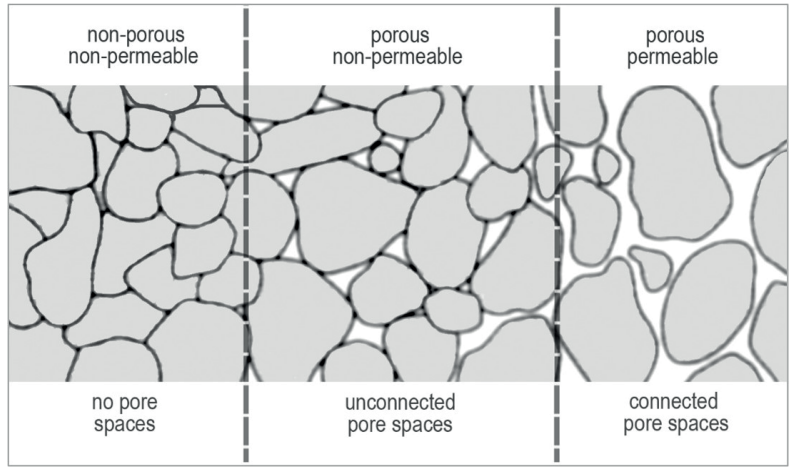

Figure 69 Relation between porosity and permeability, based on a microscopic view of sandstones ranging from very low permeability rock to high permeability rock. (credits: UC Denver)

Because of the term’s “messy flexibility” that referred to various current issues as social interaction, inclusivity, sustainability and more, it is not surprising that it has been taken up more recently, now valued by architects and urban planners as an urban practice dealing with the urban resilience to climate change[3]. In early 00’s, in Paris, during the discussion of the strategic plan of the Grant Paris, Bernard Secchi and Paolo Vigano (Studio 09) introduced the proposal to rethink Paris as an environmentally sustainable and porous Metropolis[4].

More recently, the Bangkok based ‘Porous City Network’ works to make the city porous by transforming underused impervious surfaces into a system of productive public green spaces, and advocates maintaining threatened landscape infrastructure like agricultural land, canals, and ditch orchards, which help mitigate excess water”[5].

Porosity is therefore an essential property of spatial boundaries, which is always present in nature and landscape, and ensures that separate landscape units are connected to each other and to the environment[6].

Various researchers, alongside the term of porosity, referred also to the term of permeability. Porosity and permeability are two interconnected, yet different terms used to describe soil properties related to water and air flows (Figure 69).

Porosity refers to the volume of pore spaces or voids in a soil or sediment. These pore spaces can be filled with air or water. Porosity is a measure of how much water a soil can hold and how well it can retain and transmit water. Soils with high porosity have

more pore spaces and can hold more water.

Permeability refers to the ability of a soil to transmit water or other fluids through its pore spaces. It describes the rate at which water can move through a soil. Permeability depends on the size, shape, and connectivity of the soil pores. Soils with high permeability allow water to flow through quickly, while soils with low permeability have restricted water movement.

Understanding the porosity and permeability of soils is crucial in various applications, including agriculture, engineering, and environmental management. It helps determine water availability for plants, groundwater recharge rates, drainage capabilities, and potential for water pollution. Proper soil management practices, such as adding organic matter, improving soil structure, and preventing compaction, can enhance both porosity and permeability, promoting healthy soil conditions and sustainable land use.

2. Water geography and ecosystem functions

Water geography and ecosystem functions are interconnected concepts that relate to the role of water in shaping and influencing ecological processes and functions within the overall urban ecosystem. Water geography refers to the spatial distribution, movement, and interactions of water bodies, such as rivers, lakes, wetlands, and oceans, within a specific geographic area. Ecosystem functions on the other hand, capture the role that water and vegetation within or nearby the built environment play in delivering ecosystem services[7] at different spatial scales (building, street, neighborhood, and region). It includes all "green and blue spaces" that may be found in urban and peri-urban areas[8].

Water geography plays a crucial role in shaping the ecological functions of an ecosystem. Here are some key points of their relationship:

Hydrological Cycle: Water geography influences the movement and availability of water resources within an ecosystem. Precipitation, surface runoff, groundwater flow, and evaporation are all part of the hydrological cycle, which affects water availability for plants, animals, and other organisms. The spatial arrangement of water bodies determines the pathways of water flow and its distribution across the landscape.

Nutrient Cycling: Water acts as a medium for nutrient transport within ecosystems. In aquatic systems, water bodies serve as conduits for the movement of nutrients like nitrogen and phosphorus, which are essential for plant growth. Water geography determines the connectivity between different water bodies, allowing for the exchange of nutrients and supporting ecosystem productivity.

Habitat and Biodiversity: Water geography plays a significant role in providing diverse habitats for various organisms. Different water bodies offer distinct ecological niches that support a wide range of plant and animal species. Wetlands, for example, are highly productive ecosystems that serve as nurseries for many species, provide habitat for migratory birds, and offer unique ecological functions such as water purification and flood mitigation.

Ecosystem Services: Water bodies and their geography provide numerous ecosystem services that are vital for human well-being. These services include water supply for drinking, irrigation, and industrial purposes, as well as recreational opportunities, tourism, and cultural values. Water geography influences the availability and quality of these services within a given region.

Climate Regulation: Water bodies, especially large water masses like oceans, influence climate patterns and help regulate temperature and weather systems. They act as heat sinks and can modify local climatic conditions, affecting precipitation patterns and wind regimes.

Understanding the relationship between water geography and ecosystem functions is crucial for effective water resource management, conservation efforts, and sustainable development. It allows for the identification of key areas for biodiversity conservation, the assessment of ecosystem vulnerability to climate change and human activities, and the development of strategies to maintain the integrity and functioning of aquatic ecosystems.

3. The role of streams for urban porosity and climate adaptation

Streams in urban areas today have acquired a particularly important role, which is composed of individual elements. Avoiding flooding, maintaining ecological balance and aesthetic improvement are some of these elements, which are inextricably linked to each other. However, streams are constantly becoming the recipients of the negative impact of urban expansion and human activities, which are often to the detriment of the streams[9]. Therefore, the urban or built environment can cause significant alterations or damage to the streams running through it. More specifi-

cally, alterations can occur in a stream's geomorphology, and in its hydrological and biochemical characteristics. Alterations or even permanent damage can also occur to the ecosystems maintained within it[10]. It is worth noting that another factor that is involved in the changes occurring in urban streams is climate change[11].

Within this context, a concept that has been used in recent years, in international literature, is the "urban stream syndrome". This term is often used to describe the consistent ecological degradation of streams that drain away from urban areas[12]. Several interrelated elements contribute to this degradation. The link which connects all the aforementioned is the change that is observed in the hydrological characteristics of a stream. In a fully urbanized catchment, where impervious surfaces - as opposed to natural soil - predominate, the amount of water discharged into the stream can increase significantly[13]. This is often the case for the following three main reasons:

1. Due to the inability of the local drainage network to respond promptly and to remove rainwater from the road network, which eventually ends up in the streams.

2. Because of the predominance of grey infrastructure over green and blue infrastructure in urban areas, this does not allow for the retention and absorption of some of the rainwater.

3. And, finally, because of a combination of the two aforementioned reasons.

Therefore, in order for the stream to be able to meet the ever-increasing hydraulic needs arising from the urban environment, it is subject to significant modifications related to the geometric characteristics of the stream bed (width and depth)[14]. These modifications are the result of human activity, and in some cases, the modifications are so severe that the original natural stream eventually becomes an artificial drainage ditch, where the natural environment is often absent.

As a corollary to the aforementioned, another element contributing to the degradation of a stream is the replacement of the natural soil, both in the stream bed and on the slopes, and its lining with concrete[15]. Very often, in fact, the phenomenon of the complete sealing of the stream bed with the use of impermeable single concrete surfaces is very common. In this case, several aspects of the stream are affected, both at stream bed level and on the banks/ or slopes of the stream[16]. In particular, due to the waterproofing of the bed, the problems observed are: an increase in the flow and velocity of the stream water, an inability to absorb and filter some of the water, a degradation of water quality, an inability to retain sediment, and a destruction of the habitat of many native aquatic organisms (plants and animals). Similarly, on the banks and slopes of the stream with the application of impermeable materials, the problems that arise are: an inability to retain vegetation and animal organisms, an inability to retain and filter incoming water to the stream, a restriction of access to the stream bed. On this basis, the ecosystems that depend on streams in cities are significantly burdened and disturbed[17].

At this point it is useful to refer to another term, "hybrid ecosystems". Hybrid ecosystems are related to the concept of the 'urban stream syndrome' and can be considered a subset of it. According to Hobbs et al[18], the distinction between the two is that in the case of the hybrid ecosystem, the stream, and therefore its ecosystem, experiences changes that go beyond the expected - historically - range of variability, yet it still retains, to a significant extent, the elements of the original system. In other words, it can be described as a stage where there is a shift from the initial 'equilibrium state' of the ecosystem, but without alterations that are not yet reversible[19].

The situation is slightly different when the original natural stream is undergrounded in its entirety and becomes a closed drainage pipeline. In this case, most of the benefits that the presence of a stream, provided in a city, as well as the ecosystems that had developed in it, are lost. This is because the stream loses its physical appearance and becomes a closed drainage conduit. The loss of the natural ecosystems that accompanied the original surface course of the stream is a major factor for the stream. In the past, no matter how many times an attempt had been made to uncover a stream and restore it to its original form, only partial recovery of its natural ecosystem had occurred. The reason is that the ecosystems that develop in a stream are usually quite vulnerable to change, and in some cases, they are particularly difficult to restore[20]. The degradation of the ecosystems has resulted in the degradation of the streams in cities.

To reverse the phenomenon of ongoing stream degradation, new and ecologically sustainable practices have been developed, described as "novel ecosystems" or "sustainable hydrological solutions"[21]. These practices aim to restore natural hydrological water circulation, absorb water and improve water quality. Novel

ecosystems often include the use of green and blue infrastructure, aimed at sustainable hydrology. Indeed, a combination of green and blue infrastructure is often used, both in the wider area of the stream and within the main body of the stream (bed, banks, and slopes). These systems help to restore the natural hydrological balance and reduce the problems associated with urban rainwater runoff, such as flooding, water pollution, and soil degradation.

The case of Thessaloniki

1. An urban form based on the water geography

With a total length of more than 40 km, Thessaloniki's shoreline is the city's major geographic feature. It marks the end of Thermaikos Gulf, following its curve from the Axios River delta in the west to the coastal resort of Karabournou in the south. Its course has many, varied natural features, is full of history and is open to multitude of readings.

The extent multifunctional coastal line is one of the major spatial characteristics of the city's greater urban area, as it connects the various urban activities, most of them of regional and national importance (such as the City Port and the Airport).

The city sprawls around an arc of coastline of the Thermaikos Gulf. Thessaloniki's urban shape differs from other European cities that extend circularly around their historic center. Confined between its natural boundaries of Mt Chortiatis and the Thermaikos Gulf, the city has developed in a linear manner, having its activities arranged more or less in a line along its waterfront. A more careful observation of the urban hinterland will inevitably lead us to a butterfly pattern, whose skeleton consists of the public transport networks. The city does indeed seem to balance symmetrically along the sides of a central axis.

The streams that flowed from the mountain to the sea disappeared under the gradual expansion of the dense urban mass, and only a few sections are now visible (Figure 70).

Figure 70 The evolution of Thessaloniki's urban form across the coastline and the geographical background (terrain topography and streams). Maps based on A. Koussoulakou, et al., E-perimetron, Vol.15, No.1, 2020, pp 46-47

2. Thessaloniki Streams' current situation

From ancient times until today, streams have played an important role in the daily life of the city's inhabitants. However, very often human activities, combined with their accompanying constructions, have come into conflict with these natural elements. This conflict resulted in the obstruction and/or interruption of the smooth moving of water from upstream to the Thermaikos Gulf, especially after extreme rainfall.

In an effort to expand and improve the image of the city, the local authorities made significant changes in the second half of the 19th century. These changes influenced the structure of the urban area and hence the form and function of the streams that ran through it. The disorganized expansion of the city both to the east and to the west resulted in significant changes in the ground surface, which also affected the movement of water. As a consequence of the unruly and disorganized expansion of the city, the occurrence of flooding, as a phenomenon, was often catastrophic or even fatal. For this reason, the first large artificial drainage project was carried out in the same period (Figure 71), aiming to protect the western part of the city from flooding (the Dendropotamos stream)[22].

Figure 71 Dendropotamos Stream after its diversion to the west in 1893. Source: (Cartographic illustration of 1909 - 1910) (source: Thessalonikis Anadeixis - Charton Memories <general editor: P. Savvaidis, 2008, p. 303>, as presented in Blionis and Tremopoulos, 2017, p. 123.)

Thoughout the 20th century, Thessaloniki continued to expand in the undeveloped areas to the east and west of its original core, often at the expense of the streams. Thus, many of the city's streams were gradually covered and replaced by public utilities, roads, and buildings[23]. The covering of the streams was initially done for health and safety reasons, as open streams were perceived as a source of pollution and were considered responsible for floods within the city. Two other factors contributed negatively to this. The first factor was the limited tools and resources available to local authorities, at the time, so as to manage streams and deal with flooding. The second factor was the encroachment, of parts of the stream or all of the stream bed, by unauthorized constructions, which, combined with the absence of integrated planning, exacerbated the flooding phenomena in the town. In the 1950s, the city's second major drainage project, the Circumferential Trench was carried out[24]. This project relieved the streams of eastern Thessaloniki of large quantities of water from the adjacent mountainous area.

Up to the 1990s, many sections of the streams, that previously ran through the urban fabric, before winding up in Thermaikos Gulf, were undergrounded and turned into closed pipelines[25]. This resulted in the loss of a significant part of the natural environment surrounding the streams, the disruption of the natural corridors that served as a link between the peri–urban forest (the Seih Su Forest) and the sea, and the degradation of the water quality of the streams. Today, the picture of the surviving sections of the streams is extremely degrading (Figure 72).

Figure 72 Uncovered Sections of the Streams in the urban area of Thessaloniki in 2023. (source: Personal Archive of Stavros Tsoumalakos, 2023.)

Defining New Ecosystem Patterns for the Thessaloniki Metropolitan Area

As the extent urban mass of the contemporary Thessaloniki ignores or has overridden the city's water geography, and facing the climate change mitigation and adaptation, there is a strong need for a nature-inclusive design that integrates natural features and habitats into the built environment.

There are many ways to rise new ecosystem patterns and paths in various scale of the metropolitan urban body, creating a delicate, touch-sensitive urban surface, aiming to emerge soil patterns, traces, and natural systems that have been evolved. The most efficacious of these patterns are the blue ones; they may consist of various forms that can host various public equipment elements together forming a nature absorbing porosity for the city. Reflecting pools, water walls, water channels in the traces of the pre-existing streams, rain gardens, gardening for wildlife, are some of them (image 05).

To round off, the replacement of any impervious surface, with a more porous one, in the urban area of Thessaloniki, can be considered particularly beneficial. For instance, even the replacement of the asphalt, in a parking lot with a grid of herbaceous vegetation, and cement, could positively affect the microclimate of the area in which it is applied.

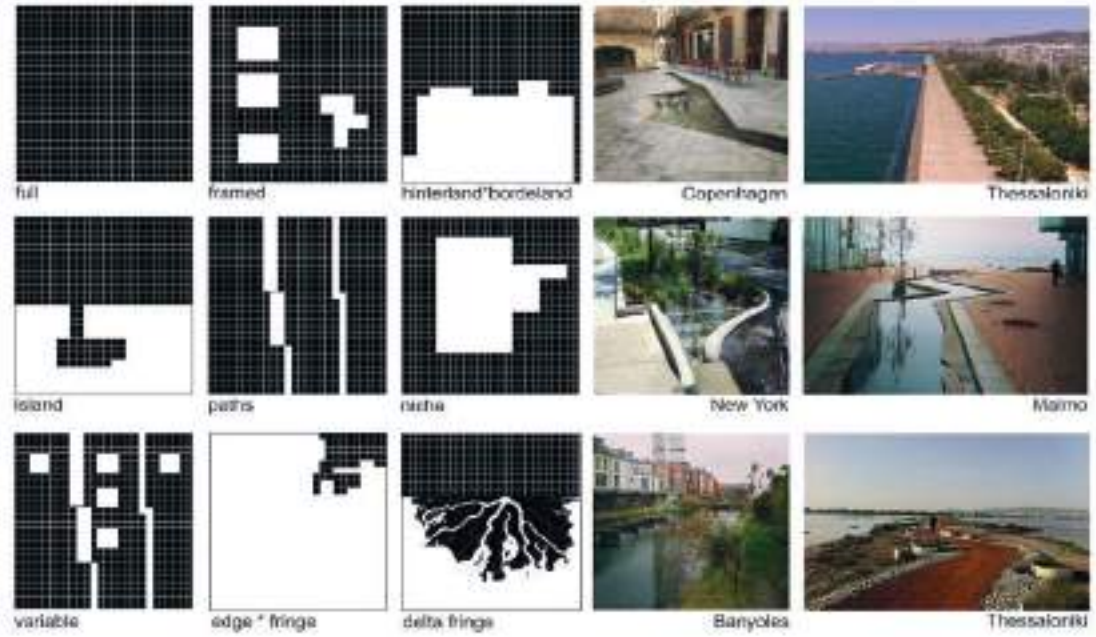

Figure 73 Porosity patterns and solutions for Thessaloniki metropolitan area

Conclusions

Water geography plays a crucial role in shaping the ecological functions of an urban area, such as that of the city of Thessaloniki. Elements such as the minimization of impervious surfaces, the enhancement of urban porosity, and the best management practices of rainwater, can contribute effectively to the preservation of the existing ecosystems and the formation of new ones.

Understanding the intricate connection between water geography and ecosystem functions of an urban area is essential for effective urban sustainable management. The approach of understanding the city's water geography, as a main urban feature, provides new key aspects for policy makers and planners for reaching city resilience and adapt and mitigate the impacts of climate change.

The city's streams or even the parts of the city through which streams used to flow and, which have left their 'traces' in the built environment can be the main points of application/implementation. Streams can be reconstructed and can also act as linear pockets of new ecosystems in the densely built urban area of Thessaloniki. The main aims are:

- To restore, to the maximum possible extent, the degradation of the hydrological cycle in the urban area of Thessaloniki, the effects of which are becoming visible in the remaining streams of Thessaloniki.

- To integrate into the network of new ecosystems, the free surfaces left behind by the undergrounding of the streams over the past decades.

- To spatially reconfigure and ecologically enrich the city's green vertical axes, which form the link between the sea and the forest.

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Spatial Planning, Climate Change, Adaptation and Public Participation:
Evidence from the Mati area in Attica

KEYWORDS:
Climate Change; Adaptation; Public participation; Spatial Planning; Coastal Areas.

Abstract

Adaptation strategies to climate change should be inclusive, integrated, and shaped according to each area's particular needs, requirements, and characteristics, while also paying attention to the necessity of a broad public participation procedure. However, since the attempt to issue combined spatial plans for adaptation to climate change in Greece is entirely new, the experience of participatory processes in decision-making is relatively poor to date.

This research examines the first citizen engagement process for such an urban planning attempt combined with essential climate change adaptation policies, referring to the case of 'Mati', at the northeastern Attica Region. This case constitutes an example of the pathologies the Greek spatial planning system. This area has been severely affected by a great fire that broke out in July 2018, a disaster that is undoubtedly linked to climate change.

The 'Mati' area suffered enormous damages and a large number of victims due to the devastating fire. In response to this disaster, the Greek Ministry of Environment and Energy decided to develop a Special Urban Plan in order to meet all the particular requirements of this second-home area. "Mati" was developed in a pine wooded area through informal urban planning processes and arbitrariness, a fact that added significantly to the fire's negative results.

The present paper's objective is to bring attention to the connection between the already-established climate change adaptation strategies and local-level spatial planning initiatives in Greece. The research also explores whether the residents of a fire-stricken area are prepared and willing to realize the need of collaborating in order to overcome the consequences of natural disasters directly related to climate change parameters.

Introduction

Approximately 50% of the world's population lives within 200 km of a coastline, with projections suggesting this figure will rise to 70% by 2025. This trend is also prevalent in Greece, that is characterized by a high degree of insularity and a long coastline (more than 15.000 kilometers) that is home to more than 60% of the country's population and hosts a variety of activities, landscapes, and ecosystems. Because of the high value of natural and socio-economic assets threatened or lost in coastal cities, it is crucial to identify the types and magnitude of problems related to climate change[1 2].

A series of scientific studies should be used to develop strategies for adapting to climate change[3]. Policymakers can predict the effects of climate change on coastal areas by assessing their vulnerability to effects such as rising sea levels, floods, erosion, and other dangers[4 5]. In addition, the strategies for adaptation to climate change should be shaped according to each location's needs, requirements, and features. Greece's policies and plans for adapting to climate change have rarely emphasized on the significance of public engagement in decision-making to date[6]. However, climate change adaptation requires a new "porosity framework" that allows the flows of data and information to be shared between stakeholders, policymakers, and citizens when formulating policies that combine spatial planning and climate change.

Some of the long-standing pathologies of the Greek spatial planning system include unplanned urban sprawl combined with out-of-plan building, conflicting provisions, legal flaws that cause uncertainty, and an overconcentration of powers and responsibilities within the central administration and bureaucracy. The settlement of Mati was selected as the study area for this article as an illustrative example of these pathologies, many of which are recorded during its urban development.

After the disastrous fire of 23rdJuly 2018, at the 'Mati' area, in Attica, the Ministry of the Environment and Energy announced a Special Urban Plan (SUP), as outlined in L. 4447/16. Until then, most of the area was out of plan, having been built using informal practices without rules, while a significant part of the area has been pine forest land. Four years after the fire, the presidential decree of the SUP was finally issued, defining the urban planning zones, the areas of protection, the land uses, the building conditions and restrictions, the main road network, and additional provisions and restrictions.

The proposed by the SUP town plan includes residential and second-home blocks, vehicular traffic, bike and pedestrian networks, public and green spaces, space for the development of public services and social infrastructure, free places of refuge in the event of a disaster, a footpath along the coastal zone, and open areas (public or private) that connect the coastal zone to the more extensive network of public spaces.

This research investigates the adoption of the town plan during the area's redevelopment through a comparative statistical analysis of the unique objections submitted for the SUP by the interested parties. This approach was used to examine the processes of citizen engagement in the policy-making process using a case study of an area in Greece significantly impacted by a natural catastrophe related to climate change, taking into consideration the new conditions set by the need to adapt to the expected impacts of climate change.

Climate Change Adaptation Policy in Greece

1. National Adaptation Strategy

The Greek National Adaptation Strategy (NAS) and the National Council on Climate Change Adaptation were established in 2016 (L. 4414/2016). The NAS has a 10-year timeframe and defines significant policy objectives and adaptation measures in vulnerable sectors. According to L. 4936/2022, the development of Regional Adaptation Action Plans (RAAPs) should always be followed by the development of the NAS.

The NAS's primary objectives are to[7]: (i) estimate the expected short-term and long-term impacts of climate change on the Greek territory based on a vulnerability assessment analysis; (ii) identify the priority areas in which climate change adaptation measures should be taken; and (iii) outline the legislative measures required to ensure effective adaptation to climate change. The RAAPs provide a comprehensive evaluation of these objectives.

The NAS focuses primarily on[8]: (i) scientific study and documentation to acquire the information essential for a greater comprehension of the problem of climate change and its specific impacts by type, sector, and activity; (ii) follow-up, as the implementation of the NAS should be supported by a monitoring mechanism and appropriate indicators and tools; (iii) public and stakeholder awareness about climate change and its impacts is

the first step towards introducing a new philosophy and way of living and simultaneously designing the policies needed to deal with the new challenges climate change creates; (iv) discussion and conversation, given that the effects of climate change will affect all productive activities on both the local and national levels; thus, the government should build a framework for continuing deliberation and conversation with important economic and social stakeholders and local communities.

2. Regional Adaptation Action Plans

The NAS is Greece's strategic orientation document; as such, it does not evaluate the feasibility of particular adaptation measures and activities at the local or regional level or aim to rank the recommended measures. Such concerns are the responsibility of the RAAPs (L. 4936/2022, art. 6), which elaborate on the NAS's principles by establishing local adaptation priorities.

According to L. 4936/2022, (art. 6), RAAPs must direct regional authorities to: (i) conduct multi-sectoral climate impact and vulnerability assessments; (ii) identify climate risks and impacts by sector and geographical area; and (iii) support regional decision-making and adaptation action planning. In addition, each RAAP details the final selection, prioritization, and timing of the relevant actions and measures depending on the specifics of each region. Each RAAP has a 10-year horizon and evaluates the regional circumstances, requirements, and priorities.

The efficiency of acts is proportional to their potential for climate change adaptation, prevention, mitigation, and restoration. The RAAPs prioritize climate change adaptation measures per sector based on cost-effectiveness and cost-benefit studies. Through public consultations, stakeholders are also involved in selecting adaptation activities.

In addition, L. 4936/2022 requires that RAAPs should be linked with other regional-scaled plans. The Regional Spatial Planning Frameworks (RSPFs) are the most essential of these regional-scaled plans, as most climate change adaptation measures have considerable geographical implications, if not direct spatial reference. In particular, the RSPFs, following L. 4447/16, guide the spatial organization model each region should adopt and suggest steps regarding the structure of each region's residential network[9].This strong relationship between RAAPs and RSPFs creates a new reality for the Greek spatial planning system.

The establishment of the thirteen Regional Adaptation Action Plans (RAAPs) is underway. Many RAAP studies have been completed, while the RAAPs of the Northern Aegean, Crete, Attica, Peloponnese, and Western Greece are already established (January 2023). By mid-2023, it is expected that the rest of the RAAPs will have been approved.

3. Local-scaled adaptation initiatives

The adoption of the Aarhus Convention into European Law (Directive 2003/35/EC) established the right of citizens to receive environmental information and participate in decision-making. These provisions allow citizens to voice their opinions, intervene in policy-making, and effectively participate in forming environmental protection policies, programs, projects, and activities.

The above institutional arrangements highlight the significance of appropriate, effective, and meaningful engagement in policy creation within a schedule that may contribute to the maturity of citizens' perspectives and their substantive participation based on the principles of transparency, justice, and equality. It is also evident that compliance with consultation processes beyond their form and substance provides value and credibility to the policies pursued[10].

Adapting spatial planning strategies to the new priorities that climate change introduces is a complicated and multi-factored task that requires the collaboration of all stakeholders (relevant authorities and the public). Although the issue of climate change has been generally incorporated into Local Urban Plans (LUPs) (L. 4759/20, art. 10) and Special Urban Plan (SUPs), as outlined in L. 4447/16 and 4759/20 and constitute the plans of the 1st level of the Greek urban planning system, the absence of a consistent culture of public awareness and participation in issues relating to local spatial planning initiatives hinders the objective of adapting to the anticipated effects of climate change and the resulting disasters. This becomes more evident in the consultation process of the urban implementation plan that follows (2nd level of urban planning system), as it is described in the case study of the present paper. The paradox is that, in Greece, the process of filing citizens' objections during the creation of an urban plan, has been applied to city plans since 1923, when the first urban planning law was implemented, although primitive and without provisions for climate change. However, it is argued that the depth of time of a process cannot ensure its actual implementation.

The Role of Local Spatial Planning in Promoting Climate Change Adaptation Policy in Greece

1. The outline of Spatial Planning Framework in Greece

The adoption of L. 4759/20 introduced a new reality for local-level climate change-related spatial planning. This conclusion could be confirmed by the fact that LUPs (L. 4759/20, art. 10) require the definition of climate change adaptation measures and emergency measures related to the management of the consequences of natural and technological disasters and other risks. There is also an apparent reference to the incorporation of the National Energy and Climate Plan (NAS), and the National Disaster Risk Reduction Policy during its inception.

The LUPs will establish provisions regarding land uses, building terms and regulations, areas that can be used for residential, environmental, or development purposes, areas that can host major urban planning interventions, and areas that can host specific incentive initiatives.

In addition to the LUPs, many SUPs, as outlined in L. 4759/20, will be developed during the following years, as planned[11]. The SUPs' objectives are urban revitalization, environmental conservation, and disaster recovery projects. Concerning climate change, their primary purpose is to enhance the resilience of urban centers concerning urban reconstruction, environmental protection, and natural disaster assistance programs (L. 4759/20, art. 12). In addition, they are utilized to address urgent spatial issues requiring immediate intervention or prevention (L. 4759/20, art. 12).

2. The case of spatial planning in Mati/ Attica

After the disastrous fire of 23rd July 2018, a SUP was announced by the Ministry of the Environment and Energy. Until then, the greater part of the area was out of a plan, having been built anarchically, without rules, with a significant part of the area being forest land[12]. The scattered-forest character of the area was the main reason the State still needed to integrate the area into urban planning. However, due to the catastrophic fire that left dozens of people dead, the Greek State apparatus got activated in order to resolve the pending urban planning of the area, especially since many people were trapped in dead-end roads leading to the sea, which did not allow access to the coast, since paths were blocked by the coastal properties[13].

Four years later, having overcome several obstacles through 'sur mesure' legislation, such as the declassification of areas incorrectly classified as forest areas since they derive from agricultural distribution, the Presidential Decree of the SUP was finally issued and published in the Government Gazette (398 D'2022). The SUP defined the urban planning zones, the zones that remained outside urban planning for protection, the land uses, the building conditions and restrictions, the main road network, and additional provisions and restrictions. At the same time, the environmental approval of the SUP was granted, and the boundary lines of the streams were validated. Then followed, the town planning draft for the areas indicated by the SUP to be part of a new city plan (2nd level urban plans). These areas are part of five urban units, one of which is the 'Mati' area, which was the center of the disaster and where the majority of the deaths occurred; as a result, it has been chosen as the case study for this paper.

Figure 74 View of the blocked access to the coastal front of Mati (source: Urban Planning Research Lab, 2022).
Figure 75 A burnt building of Mati (source: Urban Planning Research Lab, 2022).

3. Mati's Implementation Plan: Experiences from public participation

The town plan of 'Mati' was posted just two months after the SUP came into force, informing the public and providing the opportunity to submit objections. The process lasted for a month following the current legislation and was completed by the 9th September2022. Objections from the interested parties (that is, the owners of plots and houses) were submitted either to the Municipality, or to the Ministry of Environment and Energy, which is responsible for the entire project. Objections were collected, recorded, and compiled, and the Department of Planning and the Central Council of the Ministry examined their confrontation[14]. It should be clarified that the above process is entirely discrete, following the public participation procedure of the 1st level urban planning (the SUP)which concerns the general planning of the area and does not enter into the scale of each private property. On the contrary, the public participation procedure of the town plan (2nd level urban planning) is confronted with proposals that alter the surface and shape of the property as well as the legal rights upon it.

According to their declarations of ownership in the context of the cadastral survey, the area's permanent residents are 220 in total. That is, 8.4% of the total number of owners have their permanent residents in 'Mati', while 91.6% either use the area as a second-home place or own unbuilt land. There are 2.620 properties, while 71.87% of the plots (1.022 properties) are already built. Considering that 'Mati' has a total area of 1.371.000 sqm, each property is 523 sqm on average, including all existing roads and other spaces left for public use. This intense fragmentation of the land, combined with the huge build rate (72%), and the character of the area being a second-home town, leaves little room for apparent improvement. The proposed urban plan is shown in Fig.2. The town plan implements the SUP and creates residential blocks, roads, public and green spaces, blocks for public utilities, gathering places in case of emergency, a pedestrian road across the coastal zone, and accessible areas -either public or private- that connect to the network of roads and public spaces. In contrast, there is a provision for all existing buildings, although illegally built, to remain until their owners decide to turn them down and rebuild their property according to the new rules.

Figure 76 The proposed layout plan that was posted (source: https://ypen.gov.gr/chorikos-schediasmos/poleodomia/poleodomika-schedia/, September 2022)

For the area of 'Mati', 710 unique objections were submitted, corresponding to 512 properties (almost half of those already built). Each unique objection contained several thematic fields, and as such, they were classified (Fig. 3). The widening of existing streets was the most common reason for objection (346, or 68% of the objections). Then follow the opening of new pedestrian streets (299, or 58% of the objections), public green spaces (292, or 57%), the size of public green spaces (285, or 56%), and linear green public spaces (284, or 55%). Less than 50% of the owners objected for the reduction of their front yard width due to the widening of public space (206 or 40%), which of course depends on the private contribution to land, for which they objected 30% (156) as well as for the opening of new streets, for which they objected 28% (145). Eighty owners objected for the coastal pedestrian street (16% own coastal plots), followed by non-relevant objections such as cadastral data (76% or 15%) and streams (65% or 13%). Moreover, less than 10% objected for public parking spaces (48, or 9%), widening of existing pedestrian streets (35, or 7%), preference for converting land contribution into money (29, or 6%), construction rules (26, or 5%), and their disengagement from urban planning (3, or 1%) and that part of the property is still characterized as a forest (1 person).

In addition to the above, it is notable that eighty-one of the objections -that is, 15% of the total number- belong to five (5) 'types' with identical text where only personal information is differentiated. Type A (39 objections) is for the non-widening of an existing road (Nikitara); type B (14 objections) is for the non-opening or widening of other roads, as well as the project's short period of

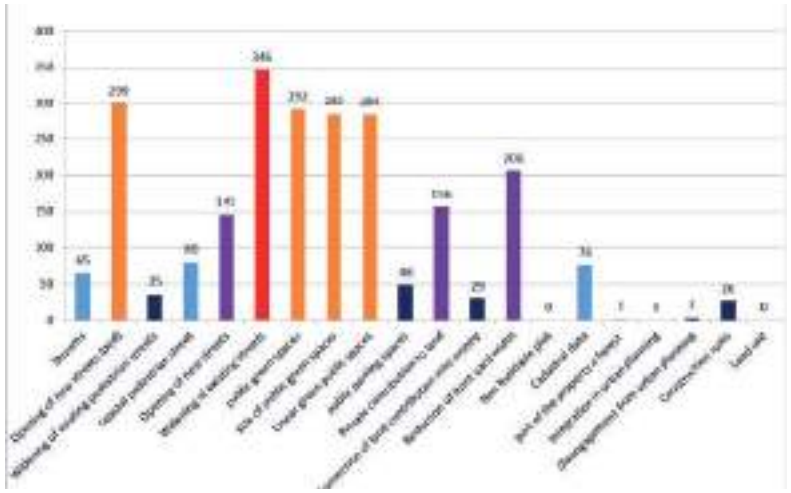

Figure 77 Objections filed against the proposed town plan by thematic area (credits: https://ypen.gov.gr/chorikos-schediasmos/poleodomia/poleodomika-schedia/, December 2022)

public consultation; type C (5 objections) is for the non-widening of Kianis Aktis str and the prohibition of linear green public spaces; type D (6 objections) is for a different street (Posidonos); and finally, type E (17 objections) complain again for the opening and widening of several streets.

More than half of the objections (64%) were rejected overall, 23% were partly rejected, and 13% were accepted in total. In most cases, the interested parties ask for their property to remain as such: not to modify its geometrical characteristics, not to reduce its surface area, not to reduce the front yard by widening the road, not to reduce the back yard by opening a new road, not to change the rules as they are. Respectively, the coastal properties object for the opening of the coastal pedestrian road, the decrease of their front yard's area, and their contribution to the public spaces.

In general, these objections are rejected because the inclusion in the city plan with the increased building ratio entails a reduction of the property by deducting a predefined contribution to land, according to the initial land surface. It falls under the responsibility of the State, however, to properly educate its citizens to accept their obligation to contribute, in exchange to their inclusion in a city plan, which must respond to climate change. The Implementing Act that follows will determine the plots' final geometric characteristics and the owners' compensation for any existing structures.

Discussion

Regarding the adaptation of local-scale spatial planning strategies to climate change, this is a complicated and multi-factored task in which all stakeholders (relevant legal entities, decision-makers, citizens, and academics) should collaborate. Adaptation needs to be improved by the need for a defined and structured culture of public understanding and involvement on issues related to strengthening the spatial resilience of an area. Therefore, it would be essential to construct local (municipal or municipal district) climate change adaptation plans to describe the criteria outlined in the respective RAAP. These plans could increase the effectiveness and relevance of informing citizens, while simultaneously expanding opportunities for engagement, as the issues addressed are much more pushing closer to people's daily lives and better understood. This approach will contribute to the gradual formation of a culture and tradition of consultation, which has been a significant issue for Greece over time.

There is a direct, but non-linear, connection between climate

change adaptation policies and spatial planning, as spatial planning is the instrument through which many important climate change adaptation policies can be implemented. In Greece, consultation procedures in the formulation of spatial planning policies are now well-established. However, climate change adaptation policies implemented in Greece rarely consider public participation as a critical factor. In the case of Mati, a public consultation was conducted, with the Administration making every effort to accommodate the shaped reality.

The public participation in the new town plan of 'Mati' sums up to just one phrase: no one desires alteration of the established rules. Although very few constructions have been built with a building permit since most plots derive from an illegal division of the land, the given opportunity of legalizing illegal actions (constructions, division of the land, etc.) combined with the area's declassification as a 'forest' by a special law –a fact that allows for illegal buildings to get legalized– appears to be the reasoning of an unwanted new urban plan. This is reasonable when most citizens have built illegally their homes but later, have been given the opportunity to legalize them, not to mention the ability to rebuild them with government grants. The question then that reasonably arises is why would anyone agree to join a city plan that requires to lose part of one's property for the creation of new-common areas, when all pending issues, such as the risk of demolition due to lack of building permits, have been already resolved.

Either being within legal boundaries or not, citizens react to change, especially when change enters one's private property. More specifically, the waterfront properties that, before the urban plan, enjoyed total privacy, strongly protest against the opening of the coastal pedestrian road and the widening of the coastal space for the public. They, therefore, refuse to provide other people with the benefit of enjoying the seaside.

Beyond vested rights, the intense fragmentation of the land combined with the high built rate (72% of total plots), and the character of the area being a second-home town -that is, less needs for public infrastructure such as schools- does not leave much room for improvement. Although illegally built, the provision for all existing buildings to remain until their owners decide to demolish and rebuild their property according to the new rules, seems insufficient for owners to accept the new urban plan. In conclusion, even a tragic event of natural disaster does not seem capable to motivate citizens to accept a personal contribution for the public interest. However, it is up to the State to support the common benefit, according to the Constitution and the laws.

Adaptation policies to climate change should be based on a series of participatory, synthetic, and integrated negotiations. They should also follow a process that is adaptable to the needs, requirements, and characteristics of each area. The approach of public consultation in Greece as an essential process of policy formulation so that the effective incorporation of citizens' opinions is possible, emerges as a key condition for the successful management of disaster issues such as Mati, and remains a primary concern. In addition to creating a common framework of rules and procedures, while introducing climate change adaptation policies (ie. NAS, RAAPs), actions that have no impact on the State budget, such as establishing a minimum consultation period and perform the public consultation at an early stage and not when the study is completed, would significantly improve several of the aforementioned issues. Although climate change has been incorporated into spatial planning (LUPs and SUPs), there is an urgent need to reshape how citizens comprehend the benefits of accepting formal spatial planning approaches. It could also be argued that firm political will is required to implement effectively formal spatial planning initiatives (such as fines and demolitions). All the above, of course, presupposes a change in the building culture, which requires buildings to follow the area's inclusion to the urban plan in contrast to building off plan.

Notes

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Rethinking Hard Surfaces in the Greek Urban Waterfront:
Earth Revelations and the Phenomenology of Urban Living

Introduction

Cities are naturally formed through their linkage with the ground/soil[1], creating levels of the city according to morphological land features and relational identifications with the ground, revealing urban ground typologies that may become symbolic interpretations of original geographies and heritage. This paper argues the importance of porous and earthly surfaces as phenomenological opportunities for "active recreation, a green transportation alternative, a venue to celebrate our heritage as well as an opportunity to regenerate sensitive waterfront lands"[2]. It criticizes the tendency to soil seal, which is "one of the main causes of soil degradation in the EU", and which "puts biodiversity at risk" and "contributes to global warming"[3]. Aiming to not only preserve natural soft edge transitions with the water but also take advantage of a site's cultural and historic interest, the discussion also emphasizes the importance of natural arterial continuity (urban greenways) and morphological earth identification, offering alternative solutions to waterfront hardscapes. Although Greece is at the better end of European countries regarding the degree of soil sealing as a percentage of its total land area (1.35%)[4], it is a country which tends to soil-seal its urban waterfronts, despite the great opportunities to create 'earthly' connections not only along the seashore but also through the formation of soil arteries that could potentially reach the surrounding near mountains, from the sea

The original contribution of this paper is the perspective of phenomenology in suggesting softer surfaces over soil sealing[5] within the context of Greek waterfront cities, helping enhance the scientific discussion on the field of environmental urban design and common landscape practices of permeable surfaces as new strategic initiation points towards urban renewal.

The physical attributes of the area in which a city is constructed may greatly influence how that city grows. Cengiz, who writes on improper land uses in cities and ecological landscape planning, mentions the importance of soil conservation and land use laws[6], which according to Milde, are not new concepts, correlating incorrect land and soil use in cities, which in turn can have detrimental effects on the wellbeing of urban ecosystems and human populations[7]. Furthermore, the relationship between a city and the soil on which it stands might result in the establishment of several layers of urban perceptual understanding[8], identified by relational identifications with the ground[9]; proximity to water, the existence of a certain type of soil, and physical land characteristics. In light of this, various sections within a city may reveal unique traits and purposes that speak of a place's identity, its morphological uniqueness, its heritage, and perhaps also cultural and indigenous features.

The belief that humans have a strong bond with the land and the natural environment that surrounds them has been referred to as living within the womb of Mother Earth – an analogy that views Earth as the loving and protecting 'mother'[10] who provides for her habitants a sense of security and protection. Elaborating on this, the phenomenology of 'being' in place[11] describes how people react to and perceive their local environments, and, consequently, attain a sense of connection that is crucial to their general well-being and feeling of identity and belonging. From this perspective, one sees that the relationship between humans and nature is one of interdependence rather than exploitation, where the natural environment is something necessary for human survival and prosperity rather than something that solely exists for use or domination.

Negative Impacts of Urban Hardscapes

In cities, walking on hard surfaces like concrete and asphalt can have a variety of detrimental ecological effects[12], resulting in a decline in biodiversity; more runoff and floods; a heat island effect; a reduction in carbon sequestration, since sealed soils are less efficient at absorbing and storing carbon dioxide than unprotected soils, and; less green space available, impacting people's physical and mental health[13].

One of the significant negative psychological effects found in people, is stress and anxiety, as walking on hard surfaces can exacerbate the overwhelming perception of a city's continual activity, noise, and visual stimuli[14], as a result of hardscapes' ability to reflect and magnify sound. Another consequence is taking away from "nature connectedness: [...] an individual's psychological relationship or emotional bond with the natural world"[15]; a parameter also associated with physical discomfort, considering that walking on hard surfaces can become taxing on the body and cause pain, stiffness, and exhaustion. Consequently, walking or running is not enjoyed as much, causing more people to deter from partaking in physical activity[16].

Furthermore, because hard surfaces are less attractive than softer ones, they may hinder social engagement and community interactions[17], justified due to the physical design of hard surfaces that make a place appear cold and impersonal, and without softness, vegetation, and other natural aspects that typically promote social connection[18]. Furthermore, the amplified noise that is reflected upon the surfaces makes it more difficult for individuals to interact with one another, reducing social contact, while lighting also becomes a problem, especially at night, as hard surfaces reflect it, making visibility more challenging, and the place feel less welcoming and safe[19].

The 'Hardness' of the Greek Waterfronts and Recommendations

Many (if not most) of Greece's picturesque and historic urban waterfronts are composed of hard surfaces, with a lack of vegetation and other natural elements. The challenge is found in many other countries besides Greece, however, the Greek Case has been selected considering that it has a substantially longer coastline than any other country in Europe (excluding Norway's fjords and inlets), with a length of approximately 13,676km, while supporting recent efforts to look into theoretical frameworks that could aid in the redevelopments of Greek urban waterfronts[20]. Having in mind the nationwide common practice of implementing materials like concrete, asphalt, stone, and brick, which are typically chosen for stability and durability, drainage, aesthetics, and public use, this paper realizes the problem that a potential ongoing pattern of soil sealing Greece's urban waterfronts could have, and seeks alternatives.

Furthermore, urban flooding is a big problem in Greek coastal communities[21] as a result of a mix of variables including urbanization, climate change, and natural variability, according to a study published in the journal Water in 2020, which emphasizes the necessity for adaptation measures and enhanced stormwater management systems[22]. According to a 2018 assessment from the

European Environment Agency, urban flooding should be Greece's main environmental concern to face, as increased precipitation, sea level rise, and storm surges can worsen urban floods and harm the country's economy, society, and land[23]. Adding on to the above, Thessaloniki, Greece, was the subject of a case study by the European Commission's Joint Research Centre in 2019, revealing that the city faces a substantial risk of flooding because of its proximity to the sea and its intricate drainage system[24]; a realization that was similarly made for Athens through the European Commission's Urban Adaptation Support Tool, suggesting a variety of adaptation strategies, like the creation of green infrastructure and the enhancement of stormwater drainage systems[25]. Moreover, Greece's natural coastal environments are home to several rare species, and their extinction might result from the encroachment of hard-surface waterfront development. While hardscapes have advantages as well, such as durability and accessibility, it is crucial to balance these against any possible drawbacks[26].

Hardscaping Greek waterfronts has been influenced by a number of environmental, social, and cultural elements: Storm surges, sea level rise, and erosion, have been conditions taking place in Greece's extensive coastline, leading to the creation of seawalls and breakwaters, however, also causing unfavorable effects including the changing of natural coastal processes and diminishing habitat for marine life[27]. To restore these, environmentally friendly methods include adopting soft engineering techniques like beach replenishment and dune restoration[28].

Furthermore, many Greek waterfront regions have a high level of development and habitation with plenty of commercial and tourist activity, causing wide promenades and marinas to be in high demand to accommodate big crowds[29]. However, this causes unfavorable social effects[30], like restricting local citizens' access to the shoreline and fostering a homogenized, commercialized waterfront culture[31]. Creating parks and green areas to increase public access to the waterfront and supporting the growth of small, locally-owned businesses that reflect the culture of the neighborhood are two potential solutions[32].

Moreover, many of Greece's shoreline areas are home to significant historic and cultural landmarks, where hardscaping is used to aid in defending these sites against erosion and other environmental dangers. Ironically, this eventually tampers with the waterfront's historic character. Solutions may be utilizing local, traditional building methods and materials that are sympathetic to the local cultural and historic context while encouraging the preservation and adaptive reuse of historic sites.

The Phenomenological Perspective of Walking on Soil

Reaching the phenomenological level of this investigation contemplates how individuals experience and interpret the soil as they walk on it, their visual and aural perceptions, their sensing of the slope of the terrain[33], and other factors that come along with moving and the simultaneous perception of experiential aesthetics[34]. Phenomenology looks into the link between the walker and the environment[35]; associated feelings and ideas, and recollections related to the experience[36].

According to research, walking on soil might enhance one's sensory perception and connectedness to nature and the uniqueness of a place[37], while it has been observed that soil contact promotes feelings of relaxation, confidence, happiness, and freedom[38], particularly if the ground is soft and loose[39]. Frampton, emphasizes the value of sensory experiences in establishing a feeling of location through the sounds of nature and the textures of the ground beneath the feet[40], also stressed by Corner, who writes: "Sensory experience is always registered in the body, in the manner in which the feet strike the ground, the aroma of a place, the sound of the wind or the crunching of leaves, the visual field and the play of light and shadow, and so on. Thus the phenomenology of the landscape always arises in a corporeal, situated and embodied encounter"[41].

Epistemological Benefits of Urban Waterfront Soil Paths

There are a number of benefits that can be found regarding the integration of soft and permeable surfaces alongside city waterfronts that reach levels of ecological, socio-geographical, heritage, and psychological considerations, adding on to the phenomenology of a place.

On an ecological level, waterfront softscapes may create habitats (e.g. dunes and marshes) for a broad range of animals, including fish, amphibians, and birds[42]. Furthermore, water quality may be improved by minimizing runoff and erosion, which may otherwise have a detrimental influence on aquatic ecosystems[43]. These surfaces can also act as natural barriers between cities and waterways and against storm surges and coastal erosion, trapping pollutants before they reach the water[44]. Moreover, waterfront soil surfaces may provide opportunities for the planting of trees and other vegetation, which can absorb and store carbon, and aid

in the fight against the urban heat island effect and global warming[45].

Economic advantages associated with the argumentation deal with the attraction of tourists, a rise in property prices, a boost in local business growth, and employment. Furthermore, they could provide chances for ecotourism (e.g. kayaking, fishing, birding), consequently helping the local economy[46] and creating opportunities for urban rejuvenation and strategic initiatives for urban rehabilitation, reviving underused or abandoned areas and establishing new public spaces. They may also be utilized to enhance the city's livability through i.e. community gardens and hosting gatherings like festivals and concerts.

On the socio-geographic, but also psychological levels, soft surfaces provide green network opportunities within metropolitan cities, which are otherwise a challenge; these may operate as focal points in the community, offering chances for social contact and civic involvement, consequently benefiting society[47]. These parameters also reach the level of cultural heritage preservation of specific terrain features and particularities of the waterfront morphology, drawing attention to the cultural importance and identity of a certain location.

Waterfront soft surfaces may also be utilized as educational tools[48], giving people the chance to learn about their surroundings, the history of the area, and their cultural heritage, but also increase awareness on environmental concerns like coastal erosion and the effects of climate change.

Good Waterfront Practices Utilizing Soil Porosity

Depending on the unique circumstances and intended results, there are several methods for introducing soil paths in urban waterfronts, promoting ecological sensitivity and all other benefits discussed above. Some of these possibilities include:

Natural soil surface/path:

To create this sort of surface, a way through an existing natural area should be cut, for example, by cleaning the trail of any rubbish and marking it with natural objects like stones or logs. The Malmö Western Harbor in Sweden (Figure 78), designed by the architectural firm Lundgaard & Tranberg based in Denmark, and realized and officially inaugurated in 2001, is an example that had preserved and incorporated its soil surfaces into the design of public spaces, to retain the memory of the once industrial harbor that transformed into an urban district[49]. Its gravel path that follows the edge of the water along the promenade in the Western Harbor provides insight for Greece in terms of its emphasis on pedestrian-friendly infrastructure and using local materials and sustainable design principles, and prioritizing local context and the community's social needs. Another example is found through the organic soil paths and green spaces found in the Harbour Circle of Copenhagen, Denmark (Figure 79), planned and developed by the Copenhagen Municipality from the late 20th until the early 21st century, highlighting Copenhagen's identity as a sustainable and livable city.

Figure 78 Natural soil path at Malmö Western Harbor in Sweden
(credits: Stefan Anderberg, 2015)
Figure 79 The Harbor Circle's natural soil trail leading through a diverse range of landscapes
(credits: Mark Werner, 2016)

Mulch surface/path: To make a sturdy surface for walking, a layer of mulch, such as wood chips or straw, is spread on top of the soil. This kind of route can be readily built and maintained, and it may be used to make a trail that appears to have grown naturally through a forest. The River Lea Greenway (or Lea Valley Walk) in London, UK (Figure 80) is a 26km path along the river established in the 1970s and 1980s and continually developed and improved over the years by the Lea Valley Regional Park Authority, offering pedestrians a picturesque and environmentally friendly route across the city, primarily constructed up of natural surfaces, including mulch. In keeping with the locale's commitment to environmental sustainability and soil conservation, using mulch also encourages sustainable landscaping techniques, while distinguishing itself from other metropolitan areas thanks to the mulch's particular organic texture and color. This example of natural-surface paths may become a precedent for cities with a wider shoreline length.

Packed earth surface/path: This form of walkway entails compacted dirt, which can achieved manually or by using a machine to provide a path that appears more official. This technique is found in the Park Schinkeleilanden (or Schinkel Island Park) alongside the Vecht River (Figure 81); a seaside park in Utrecht of Netherlands, founded in 2005 and designed by Karres en Brands. The park's walks and cycling trails are made of packed earth (dirt, sand, or gravel), and offer a more comfortable, less expensive, simpler to maintain, and more environmentally friendly surface. Such precedent could potentially inspire the design of softscapes along the sea that seek to enhance their corresponding cities' historical

Figure 80 The mulch path at the River Lea Greenway in London, UK
(credits: Paul Gillett, 2013)

and agricultural identities, similarly to the Schinkel Island Park case.

Stone dirt surface/path: Stones or gravel are placed on top of the soil in this sort of walkway, typically preferred for places with high foot traffic, creating a more formal-looking path. The Rheinauhafen waterfront in Cologne, Germany (Figure 82), designed by JSK International and constructed between 2002 and 2006, is one example of a city shoreline in Europe that has walkways made of stone dirt, within the context of a former industrial port area called the Rheinauhafen that has been turned into a mixed-use community with living, working, and entertainment areas. This example, utilizing a network of bike and pedestrian routes composed of natural stone and compacted earth running along the shoreline, may find relevance in shoreline cities with a relatable industrial past and a rich architectural history.

Figure 81 Packed earth trail at the Park Schinkeleilanden alongside the Vecht River in Netherlands
(credits: Guilhem Vellut, 2015)
Figure 82 Stone dirt surface at the Rheinauhafen waterfront in Cologne
(credits: Neuwieser, 2010)

Permeable surface/pavers: This sort of walkway utilizes pavers that are specifically designed to enable water to pass through them and reach the soil beneath, helping reduce erosion and preserve the local area's natural drainage system. In Hamburg, Germany, the HafenCity urban waterfront development (Figure 83) designed by Kees Christiaanse Architects & Planners and realized in the early- to mid-2000s, is an example of an area using permeable pavers for its paths; a once abandoned port and industrial property that was turned into a mixed-use community of homes, businesses, and cultural venues. Permeable pavers allow rainwater to infiltrate the ground and recharge the aquifer instead of running off into the streets or storm drains, lessening the impact of urban heat islands, enhancing water quality, and mitigating urban flooding.

Finally, it is useful to also be aware of case studies that implement combinations of the above types of porous materials, like the S-E Coastal Park in Barcelona, realized in 2004 by FOA (Foreign Office Architects), which uses a variety of permeable paths like crushed stone, sand, and wood decking; the Rhône Riverbanks in Lyon built by In Situ Architectes Paysagistes in 2007, with its permeable concrete pavers, gravel paths, and planted areas with natural soil; the "stabilized gravel" and "porous concrete" of the Vestre Fjord Park by ADEPT in Aalborg, Denmark, constructed in 2019; The BUGA Heilbronn 2019 redevelopment of the riverscape by SINAI Gesellschaft von Landschaftsarchitekten, utilizing concrete pavers, gravel paths, and natural stone paving, and; the Canal Corridor in King's Cross built by Townshed Landscape Architects in 2017, with its resin-bound gravel, permeable block paving, and porous asphalt.

Figure 83 Permeable pavers at the HafenCity urban waterfront in Hamburg
(credits: M. Prinke, 2008)

Greece could learn from the above examples not only from a sustainability point of view, but also from a phenomenological perspective: help people engage with their surrounding unique natural landscape and enjoy the environment's sensory aspects, help organic features become part of the daily urban experience, and create opportunities for enticing and comfortable activities.

Conclusions

Overall, waterfront earth paths offer a variety of ecological advantages, make cities more livable, and allow access to nature, community building, education and awareness, economic growth, and urban redevelopment. Moreover, they also withhold the potential to preserve the cultural legacy of a place and the development of cultural tourism, with consequent economic advantages. Sustainable urban waterfronts' advantages may vary depending on their location, layout, and maintenance. Therefore, the community's and the surrounding ecology's unique demands should be taken into account, with the involvement of the community in their effective planning, development, management and administration. The development of hardscapes in Greek waterfront areas is influenced by a range of environmental, social, and cultural factors, and sustainable waterfront developments should balance the needs of people and the environment. Additionally, considering the context of climate change, urban flooding is a serious challenge for Greek seaside communities, calling for enhanced stormwater management and adaptation measures. Considering the general lack of urban greenways in the dense Greek cities' fabric, sustainable urban waterfronts offer a valuable opportunity for the environmental upgrade of Greek cities as well as the general well-being and living conditions of the inhabitants.

Using soil materials for shoreline urban surfaces can be initially challenging due to issues including cost, maintenance, and the requirement for suitable drainage and irrigation systems. In Greece, however, a variety of waterfront urban surfaces may be successfully constructed to build trails and urban greenways using local soil materials (e.g. topsoil, compost, mulch, gravel stone), while inspired by other European case studies with positive planning and design outcomes. Additionally, the soil may be utilized for urban agriculture and community gardens, for preventing erosion, and for creating natural trails along the coastline, allowing people to genuinely experience their natural surroundings. Ultimately,

the phenomenology of ‘being’ within a picturesque and naturally rich Mediterranean landscape would add to the sense of identity, belonging, well-being, and cultural awareness and growth.

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The Essence of Climate Information from Observations and Climate Models for Studies of Climate Change at Regional/ Local Scale

KEYWORDS:
Climate change, regional scale, global climate models, regional climate models, dynamical downscaling, statistical downscaling

Abstract

Human-caused climate change has driven detectable changes in essential climate variables in different regions around the world since the mid-20th century, and it is projected to cause substantial further changes at both global and regional scales under future warming. To reliably assess climate change at regional/local level, long-term high-quality station-based and satellite meteorological observations, as well as high-resolution climate information from climate models are a prerequisite both for the thorough understanding of key climate processes as well as climate change. The incorporation of the future effects of the evolving climate to climate data allow the assessment of the impacts on the environment and society. Without doubt the demand of reliable, long -term time series for numerous climate variables is constantly growing for the assessment of climate -risks as well as the implementation of efficient strategies and adaptation plans and measures. The observing systems which make up the Global Climate Observing System (GCOS) provide the long-term, high-quality climate data records and products that underpin regional climate change research, assessment and provide the reference basis for climate models. Commonly, Global climate models (GCMs) are the primary tools for attributing past climate change to human activities, and for projecting future climate change under different anthropogenic emission scenarios. However, the majority of GCMs still have a coarse horizontal resolution and so, methodologies such as statistical downscaling or dynamical downscaling with the use of regional climate models (RCMs) are beneficial to enhance the regional/local information provided by global climate models (GCMs).

Introduction

Human-caused climate change has driven detectable changes in essential climate variables in different regions around the world especially since the mid-20th century, and it is projected to cause substantial further changes at both global and regional scales under future warming scenarios. Along with the fact that climate change has become nowadays more than ever a planetary issue, the availability of abundant and reliable climate data is essential for the in-depth comprehension of the Earth system as well as the sustainable societal growth within this system. Undoubtedly, observational data is one of our main and key source of climate change information, since climate change has both large – scale and long -period characteristics (Hua-Dong et al., 2015). Furthermore, the observing systems of station-based and satellite meteorological observations constitute the core for the development of high-quality climate data records and products that provide the reference basis for climate models.

While GCMs are the main tools for attributing past climate change to human activities, and for projecting future climate change under different anthropogenic emission scenarios, their course spatial resolution poses the need of using downscaling methodologies, such as statistical downscaling or dynamical downscaling with RCMs, to enhance the regional/local climate information provided by the GCMs. Overall, to reliably assess climate change at regional/local level, long-term high-quality station-based and satellite meteorological observations, as well as high-resolution climate information from climate models are a prerequisite both for the thorough understanding of key climate processes as well as climate change, since the larger the quantity of the Earth data is (along with the frequency and the thorough coverage), the more robust future estimations on the change of the climate characteristics are. The incorporation of the future effects of the evolving climate to climate data allow the assessment of the impacts on the environment and society.

Climate observations

Without doubt the demand of reliable, long -term time series for numerous climate variables is constantly growing for the assessment of climate -risks as well as the implementation of efficient strategies and adaptation plans and measures. The National Meteorological societies all around the world provide long term time series that reinforce our knowledge on the climate processes and factors that lead to climate change (WMO, 2021). These data, even though with gaps in some cases, are used with numerous techniques and approaches to give robust results for assessment studies of the changes of the mean and extreme climate characteristics all around the world. Vuckovic and Schmidt (2021) highlight that long – time meteorological time – series can provide important and essential information not only for the detection of the mean changes of the climate but also for the understanding and examination of the systematic monitoring of the potential changes of the characteristics of the extreme weather events which can lead to more efficient adaptation and mitigation measures and policies.

However, long term meteorological and climate data not only help us comprehend earth's climate system but also provide useful information on its variability, evolution and physical processes (Noone et al., 2020). Characteristically, Dolman et al. 2016 underline that the conservation and continuation of these data can contribute to monitoring the effectiveness of the Paris Agreement of Climate Change in 2015. Moreover, these time series in synergy with other observations can help for the creation of new and updated reanalysis data archives and estimate the skill of climate models in simulating the present climate conditions (Thorne et al., 2017).

The Global Observing System (GCOS) is an extremely complex undertaking, and perhaps one of the most ambitious and successful instances of international collaboration of the last 60 years, initiated in support of the world weather monitoring and forecasting, and then increasingly in support also of climate and climate change monitoring. It consists of a multitude of individual surface- and space-based observing systems (Figure 85). The observing systems which make up the GCOS provide the long-term, high-quality climate data records and products that underpin regional climate change research, assessment and provide the reference basis for climate models. More specifically, GCOS help on the efficient characterization of the state of the planetary climate system as well as it's trends and variability. It also depicts both

the natural and anthropogenic forcings on the global and regional climate helping also to understand the causes of the observed climate change. In synergy with the more recent addition of satellite data to the ground observations (Figure 86) a noteworthy improvement has been made in all the Essential Climate Variables (ECVs) – atmospheric, oceanic, terrestrial – on the analysis of extreme events and on the risk and vulnerability assessments (WMO, 2011).

Downscaling climate information at regional/local scale from global climate models

Commonly, global climate models (GCMs) are the primary tools for attributing past climate change to human activities, and for projecting future climate change under different anthropogenic emission scenarios. However, the majority of GCMs still have a coarse horizontal resolution to resolve the effects of local and regional scale forcings on regional climate. To reliably assess the impacts of climate change at regional/local level, higher-resolution climate information is necessary, and methodologies such as statistical or dynamical downscaling are beneficial to enhance the regional information provided by global climate models. Figure 86 illustrates a schematic with the typical model types and chains used in modelling and downscaling regional climate information, for climate impact assessment at regional/local level.

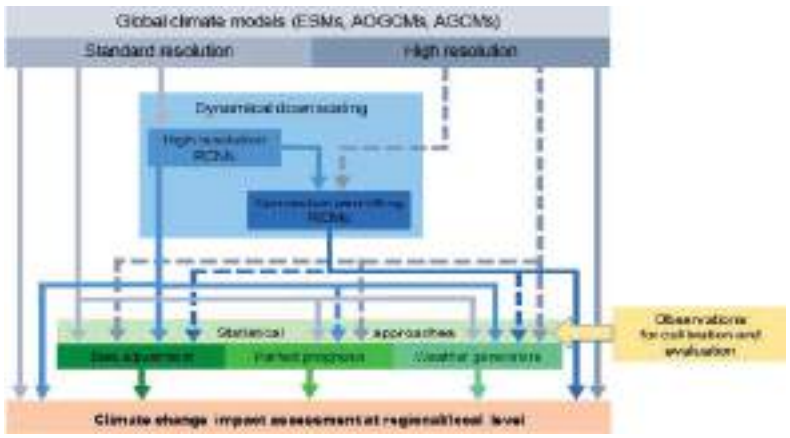
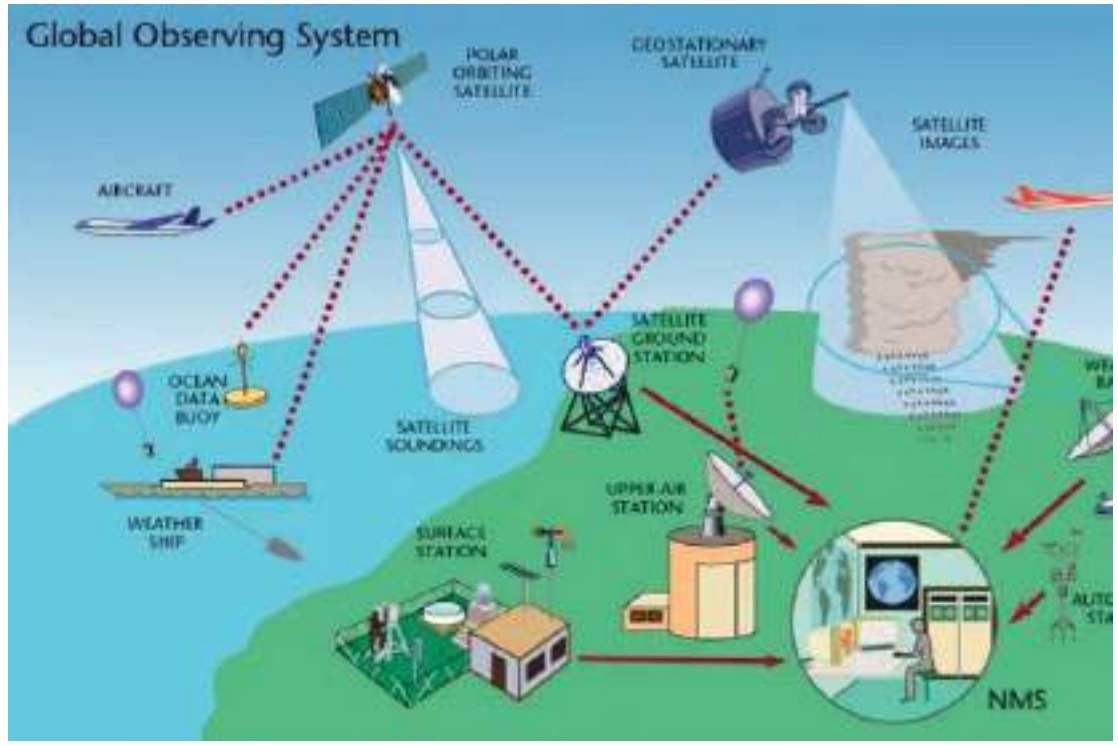
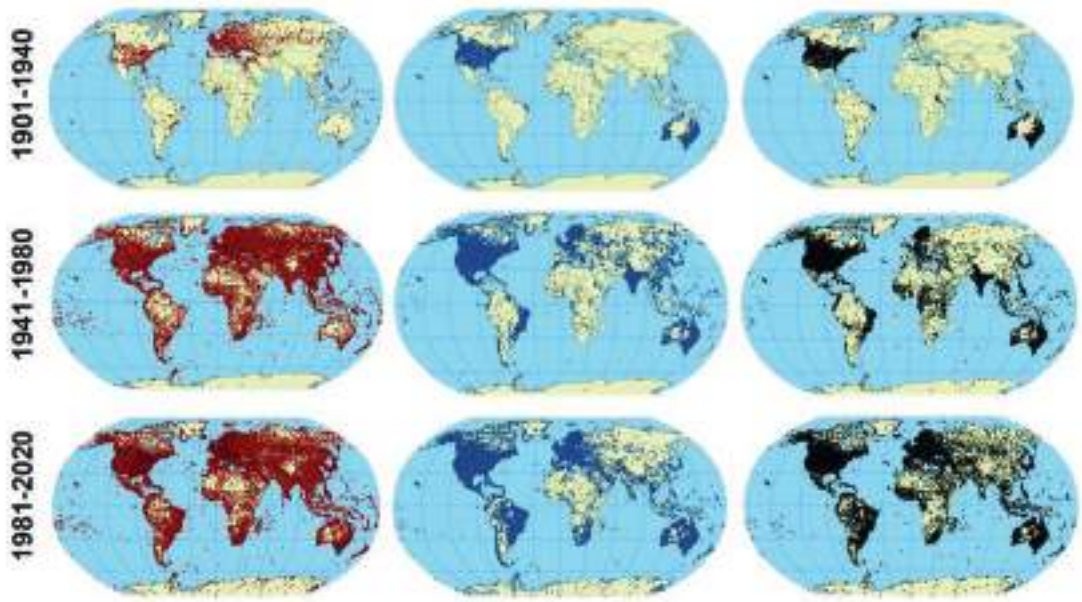


Figure 84 Schematic indicating the typical climate model types and chains used in modelling and downscaling regional climate information for climate change impact assessment at regional/local level (adopted with modifications from Figure 10.5 in Doblas-Reyes et al., 2021).

Figure 85 World Meteorological Organization (WMO) global observing system in support of GCOS which assesses the status of global climate observations towards a world where climate observations are accurate and sustained for studying climate change (source: https://public.wmo.int/en/programmes/global-observing-system).

Figure 86 The evolution and increase of the number of land-based stations on a global scale during the past 120 years (sub-daily stations [red dots], center daily stations [blue dots] and right panel: monthly stations [black dots]). (Adopted with a small modification from Figure 3 in Noone et al., 2020)





1. Global climate models

Global climate models include state-of-the-art Earth system models (ESMs), coupled atmosphere–ocean general circulation models (AOGCMs) or atmosphere-only general circulation models (AGCMs). The global climate models derive climate information both for past and future climates with a nominal horizontal resolution typically in the range of 100–200 km and provide insights for the analysis of regional climate. Future projections with global climate models are affected by three main sources of uncertainty, such as unknown future external forcings, deficient knowledge and realization of the response of the climate system to external forcings, and internal variability (Lehner et al., 2020). Although higher-resolution GCMs (at 50 km resolution or finer) are increasingly becoming available for climate change research (Held and Zhao, 2011) their typical resolution is rather coarse to resolve the effects of local and regional scale forcings on regional climate, such as topographic characteristics (complex mountain ranges, coastlines, peninsulas, small islands and lakes) as well as land-use characteristics and chemical composition of short-lived species (e.g. aerosols, tropospheric ozone). A rapidly developing field for global climate models is the use of variable resolution global models, setting the finest resolution possible in the region of interest, while still resolving the climate processes at the global scale with lower resolution (McGregor, 2015). Nevertheless, increasing resolution by itself does not solve all performance limitations (Doblas-Reyes et al., 2021). Improving global model performance for regional scales is fundamental for increasing their usefulness as regional information sources. Methodologies such as statistical downscaling or dynamical downscaling with the use of regional climate models (RCMs) are beneficial to enhance the regional/local information provided by global climate models (GCMs). This underlines the importance for improving the performance of GCMs as they provide the boundary conditions in RCMs for dynamical downscaling and the input for statistical downscaling approaches, especially when regional climate change is strongly influenced by large-scale circulation changes.

2. Dynamical downscaling with regional climate models

Regional climate models (RCMs) have been developed for the application of dynamical downscaling methods to enhance the regional information provided by GCMs or by the large-scale reanalysis fields (Giorgi and Mearns, 1999). RCMs represent surface features (such as complex mountain topographies and coastlines as well as small islands and peninsulas) with a higher grid box resolution within a limited area of interest, thus resolving atmospheric process in a finer scale than GCMs. Dynamical downscaling using regional climate models adds value in representing many regional weather and climate phenomena, especially over regions of complex orography or with heterogeneous surface characteristics (Doblas-Reyes et al., 2021). RCMs typically have a horizontal resolution between 10 and 50 km, but much finer spatial resolution at kilometer-scale is also employed to fully resolve deep convection and represent sub-daily precipitation extremes (Coppola et al., 2020). They are typically one-way nested, so that there is no feedback from the RCM into the driving global model. Nevertheless, two-way nested global model-RCM simulations are also carried out to investigate regional influence on large-scale climate (Junquas et al., 2016). RCMs can inherit biases from the driving global model in addition to producing biases themselves (Dosio et al., 2015), while spectral nudging techniques are also employed to increase consistency with the driving model (Kanamaru and Kanamitsu, 2007). The Coordinated Regional Climate Downscaling Experiment (CORDEX) initiative provides ensembles of high-resolution historical and future climate projections for various regions, with a large body of literature emerging (Jacob et al., 2014; Giorgi and Gutowski, 2015; Ruti et al., 2016; Vautard et al., 2021; Coppola et al., 2021). RCMs typically do not include all possible Earth system processes, such as air-sea coupling or chemistry-climate interactions, which may influence regional climate. However, over the last two decades, several RCMs have been extended by coupling to additional components like interactive oceans (Ruti et al., 2016), rivers (Di Sante et al., 2019), glaciers (Kotlarski et al., 2010), and aerosols (Zakey et al., 2006; Zanis et al., 2012; Nabat et al., 2015).

3. Statistical downscaling, bias adjustment, and weather generators

Statistical downscaling, bias adjustment and weather generators are post-processing methods used to derive regional climate information, and they are considered useful approaches for improving the representation of regional climate from global and regional climate models. These methods require observational data for calibration and evaluation. Commonly, most methods are applied on temperature and precipitation, although some also represent wind, radiation and other variables with typical restrictions arising from the limited availability of high quality and long

observational records for such applications (Pryor and Hahmann, 2019). Statistical downscaling techniques are subdivided depending on whether the statistical model is fitted using observational data (known as Perfect Prognosis) or using data from a climate model itself (often referred to as Model Output Statistics). In perfect-prognosis statistical downscaling, a statistical model, linking large scale predictors to local-scale predictands, is calibrated to observed data and then applied to predictors simulated by climate models (Maraun and Widmann, 2018). Commonly, the statistical models use regression-like approaches (linear and stochastic), analogue methods and machine learning techniques. Recent developments include stochastic regression models to explicitly simulate local variability, while the use of machine learning techniques has been reinvigorated, including deep and convolutional neural networks (Doblas-Reyes et al., 2021).

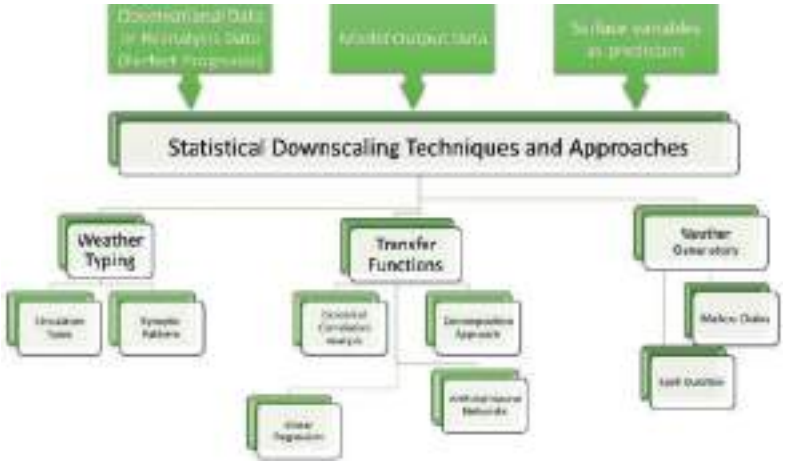


Figure 87 The main approaches and techniques used for Statistical Downscaling.

Weather generators are statistical models that simulate weather time series of arbitrary length. Typically, they require only observed predictands, (although some are conditioned on observed predictors as well) and are calibrated to represent observed weather statistics, in particular daily or even sub-daily variability. Recent research has mainly focused on multi-site Richardson type (Markov-chain) weather generators, some explicitly modelling extremes and their spatial dependence (Doblas-Reyes et al., 2021).

Bias adjustment is a statistical post-processing technique used to reduce the difference between the statistics of climate model output and observations. An important issue for bias adjustment is the correct representation of the required spatial scale. Ideally, bias adjustment is calibrated against area-averaged data of the same spatial scale as the climate model output. Hence, high-quality observed gridded datasets with an effective resolution close to the nominal model resolution are required. Driven by the need to also generate regional-scale information in station-sparse regions, researchers have considered derived datasets that blend in situ and remote-sensing data to produce high-resolution observations to be used as predictands (Doblas-Reyes et al., 2021). However, bias adjustment methods are often used as a simple statistical downscaling method by calibrating them between coarse resolution (e.g., global) model output and finer observations (Maraun and Widmann, 2018). Bias corrections in a climate model output is recommended before using it as input in hydrological model, as climate models have inherent systematic errors due to imperfect conceptualization (Chokkavarapu and Mandla, 2019). Nevertheless, bias adjustment cannot overcome all consequences of unresolved or strongly misrepresented physical processes such as large-scale circulation biases or local feedbacks.

4. Conclusive remarks

Long-term high-quality station-based and satellite meteorological observations, as well as high-resolution climate information from climate models and statistical downscaling methodologies are of key importance for advancing our understanding of climate processes and reliably assessing climate change at regional/local level. The global observing systems constitute the core for the development of high-quality climate data records and products that provide the reference basis for climate models. Dynamical downscaling through RCMs and statistical downscaling methodologies enhances the regional information provided by global climate models, which are the primary tools for attributing past climate change to human activities, and for projecting future climate change under different anthropogenic emission scenarios. RCMs can inherit biases from the driving global model in addition to producing biases themselves. The setup of global initiatives for RCM simulations as well as the related climate research, their model developments and techniques have been considerably expanded over the last two decades, while several RCMs have been extended by coupling to additional components of the earth's system. Methodologies such as statistical downscaling, bias adjustment and weather generators are beneficial as an interface between climate model projections and impact modelling and for realistically deriving many statistical aspects of present-day daily temperature and precipitation, but the performance of these techniques depends on that of the driving climate model.

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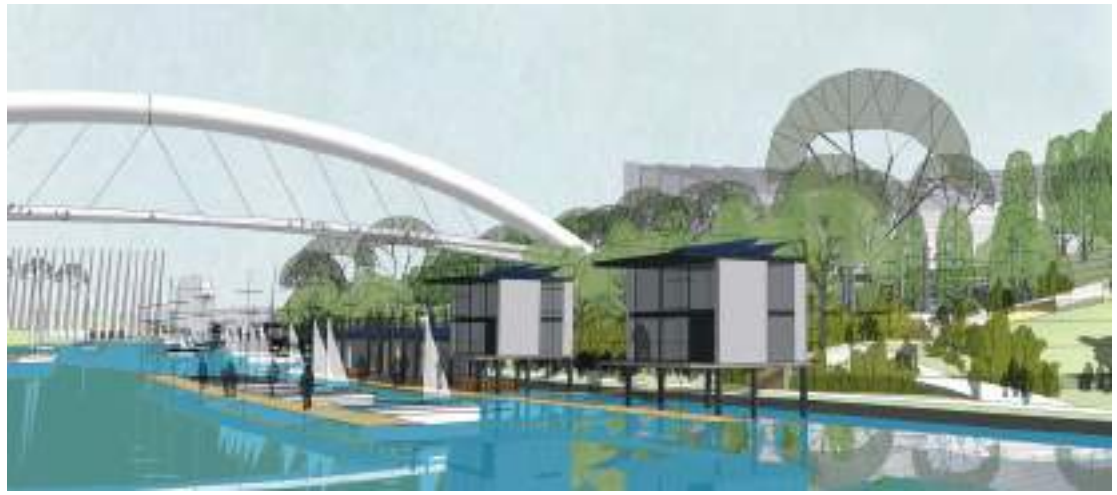
Team Project III

Let it Ti(be)r, Rome

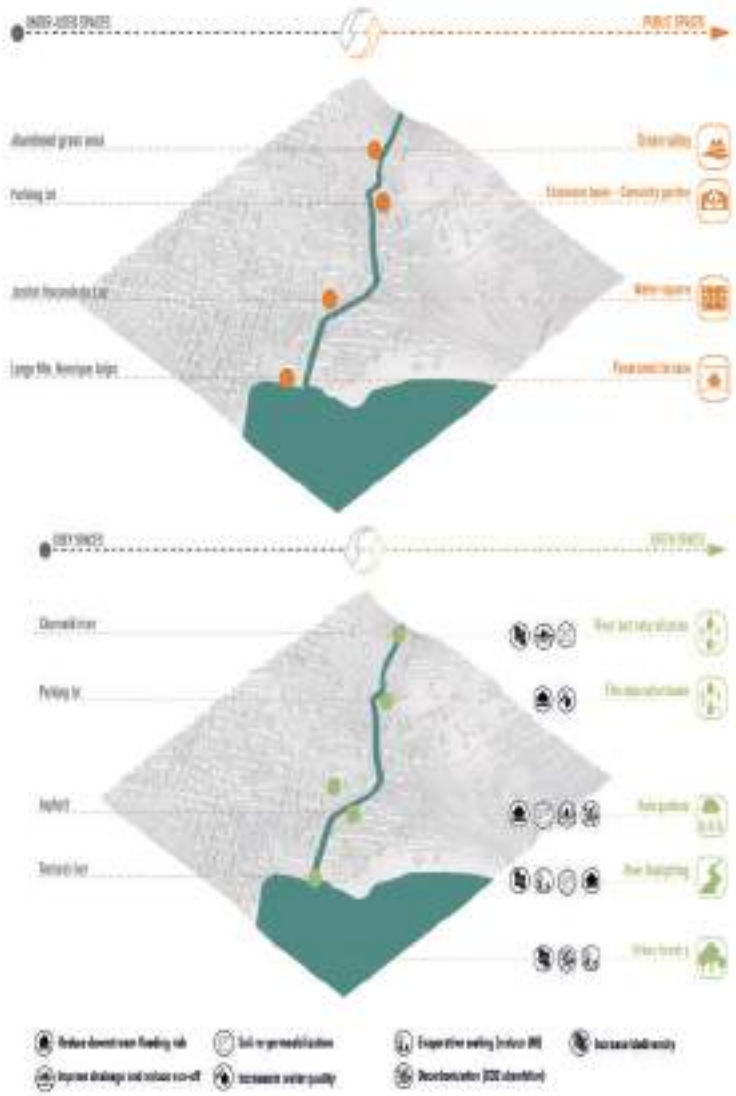
The project in Rome focuses o the revitalization os the Piazza Mancini area in the Flaminio neighborhood, close to the Tiber river. Its main objective is to establish a stronger connection between urban spaces and nature, considering the risks of flooding caused by heavy rains, while improving public access to the river. The complexity lies in redesigning a solution that integrates the traffic node and parking area, the restoration of historic greend corridors, which requires involving public authorities, private organizations and citizen's groups. The proposak design a greener, more adaptable and attractive place for the local community, tourist, museum visitors, citizens, residents and employees living and working nearby, as well as non-human species. The key is to establish connections at all levels, between nature, urban infrastructure and users. The project proposes a multi-level solution, transforming Piazza Mancini into a vibrant freen space with pedestrian and cycle paths accessible to the River Tiber, while all car traffic and parking are located urderground.

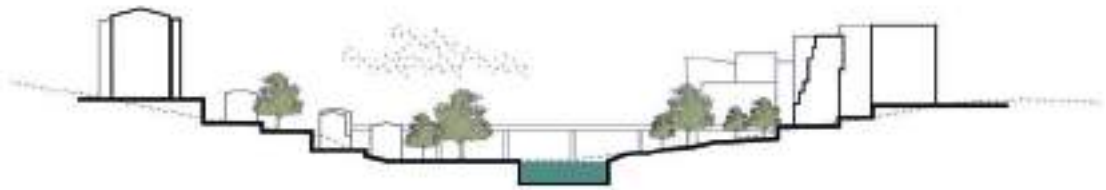


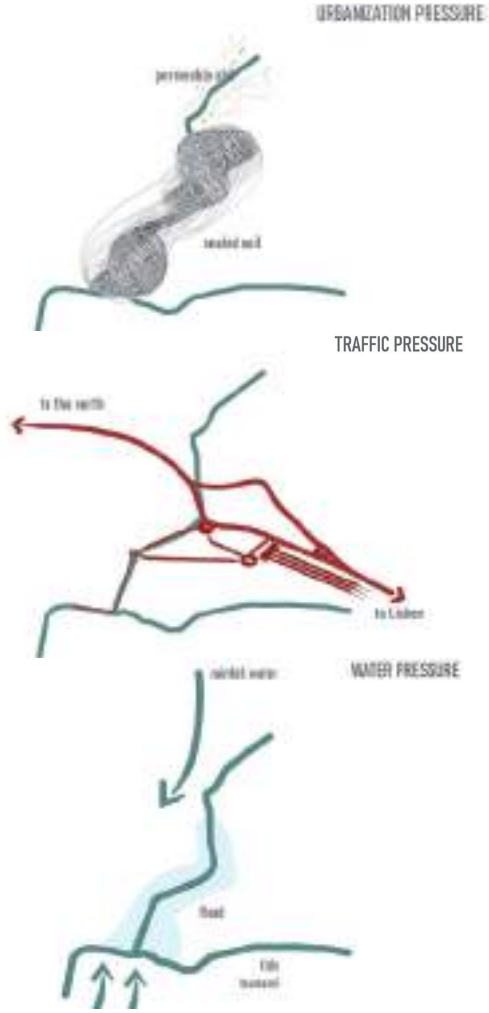
Team Project IV

Vinha as a Pine, Lisboa

In the Lisbon Metropolitan Area severak prominent sites were identifiedm the solution presented here is located in a south-facing coastal area, directly related to the ocean, establishing a continuous but fragmented system of public spaces ending with a promenade and a seak wall. The main problem identified in the Riveira das Vinhas, Cascais, facing floods, sea level rise and other climate hazards, jeopardises community protection and ecological balance in the region. The proposal is in harmony with the morphology of the land that has been ignored by urbanisation in the 20th century. The canalised wagter stream if uncovered and transformed into urban hydrological infrastructures that prevents flooding and accommodates rising sea levels in the Atlantic Ocean. The exposure of an open river would result in an opportunity to expand and improve public space for the local community and create a continuous public space from the seal wall to the hinterland.






URBANIZATION PRESSURE
TRAFFIC PRESSURE
WATER PRESSURE

Partners