The Role of Natural and Mixed Cultural-Natural Heritage in Increasing the Resilience of Socio-Ecological Systems to Climate Change Impacts

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Agendas to reduce the risks associated with climate change and increase resilience to impacts have become rather inclusive in the types of social effects they consider. They also acknowledge their embeddedness in socio-ecological networks, geographies, and scales. Heritage, like many other semantically rich social and cultural notions, is both underrepresented and underspecified in climate change policy assessments. It is, therefore, important, beyond merely recognising the importance of heritage, to keep sketching out how this importance looks in practice and how it can connect to policy assessment. In this paper and accompanying talk, we overview our ongoing research work to clarify two complementary aspects: the benefits of heritage within the exposure and vulnerability structure of seven living socioecological systems and the monetary added value of UNESCO inscription in the eurozone's regional economies.

Keywords: natural heritage, nature-based solutions, resilience, fuzzy cognitive maps

Le Rôle du Patrimoine Naturel et Mixte Culturel-Naturel dans l'augmentation de la Résilience des Systèmes Socio-Écologiques aux Impacts du Changement Climatique

Les programmes visant à réduire les risques associés au changement climatique et à accroître la résilience aux impacts sont devenus plutôt inclusifs quant aux types d'effets sociaux qu'ils prennent en compte, reconnaissant également leur ancrage dans les réseaux socio-écologiques, les géographies et les échelles. Le patrimoine, comme de nombreuses autres notions sociales et culturelles sémantiquement riches, est à la fois sous-représenté et sous-spécifié dans les évaluations des politiques sur le changement climatique. Il est donc important, au-delà de la simple reconnaissance de l'importance du patrimoine, de continuer à esquisser à quoi ressemble cette importance dans la pratique et comment elle peut être liée à l'évaluation des politiques. Dans cet article et l'exposé qui l'accompagne, nous passons en revue nos travaux de recherche en cours pour clarifier deux aspects complémentaires : les avantages du patrimoine dans la structure d'exposition et de vulnérabilité de sept systèmes socio-écologiques vivants ; et la valeur ajoutée monétaire de l'inscription par l'UNESCO dans les économies régionales de la zone euro.

Mots-clés: patrimoine naturel, solutions fondées sur la nature, résilience, cartes cognitives floues

El Papel del Patrimonio Natural y Cultural-Natural Mixto en el Aumento de la Resiliencia de los Sistemas Socioecológicos a los Impactos del Cambio Climático

Las agendas para reducir los riesgos asociados con el cambio climático y aumentar la resiliencia a los impactos se han vuelto bastante inclusivas en los tipos de efectos sociales que consideran, reconociendo también su arraigo en redes, geografías y escalas socioecológicas. El patrimonio, como muchas otras nociones sociales y culturales semánticamente ricas, está subrepresentado y subespecificado en las evaluaciones de políticas de cambio climático. Por tanto, es importante, más allá del simple reconocimiento de la importancia del patrimonio, seguir esbozando cómo se ve esta importancia en la práctica y cómo se puede conectar con la evaluación de políticas. En este documento y la charla que lo acompaña, revisamos nuestro trabajo de investigación en curso para aclarar dos aspectos complementarios: los beneficios del patrimonio dentro de la estructura de exposición y vulnerabilidad de siete sistemas socioecológicos vivos; y el valor añadido monetario de la inscripción de la UNESCO en las economías regionales de la eurozona.

Palabras clave: patrimonio natural, soluciones basadas en la naturaleza, resiliencia, mapas cognitivos difusos

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Introduction

The preservation and incorporation of heritage in the planning and functioning of urban and rural regions and territories have yielded a significant range of benefits that spread over multiple sustainable development goals and subgoals. A less frequently explored aspect that merits a more systematic look is the concurrent capacity of natural and mixed cultural-natural heritages to reduce the risk of climate change impacts in their host regions.

More specifically, natural and mixed cultural-natural heritage represents a unique living heritage that adds ecosystem functions, goods, and services to the already substantial list of benefits found in non-natural heritage (Osipova *et al.*, 2014). Natural and mixed heritage can therefore be approached also as a nature-based solution that can reduce the risk of severe weather and climate change impacts while at the same time providing the more fundamental benefits of heritage. Therefore, it is a type of living heritage whose spread and degree of integration into multiple social and ecological processes of a territory render it a high-potential strategy for addressing the resilience and sustainability of the local socio-ecological system.

In this paper, we demonstrate, based on ongoing research work by the European Commission research project OPERANDUM, how the interconnections between heritage and socio-ecological systems can be represented and explored in the context of reducing hydro-meteorological risks in rural and urban communities (OPERANDUM, no date). Our focus is on seven experimental open-air laboratories across Europe - located in Austria, Finland, Germany, Greece, Ireland, Italy, and Scotland - and we demonstrate, by means of fuzzy cognitive maps and scenarios (Kosko, 1986), how natural and mixed natural-cultural heritage can be part of a broader strategy to increase community resilience to climate change impacts while concurrently offering a sustainable approach to reducing the associated risks. Lastly, we touch upon an analysis of the regional economic effects of UNESCO-inscribed heritage in European regions as a means to demonstrate that the benefits of heritage move beyond local communities and have measurable impacts at the regional level (Throsby, 2019).

The Question of Value in Heritage

Literature on the importance of heritage for individuals and society is diverse, encompassing, among others, knowledge from history, cultural studies, anthropology, economics, political science, and sociology (Osipova *et al.*, 2014; Throsby, 2019). More recently, literature has also been raising the fact that, in addition to social and economic importance, natural or mixed natural-cultural heritage represents ecosystems too, therefore providing the multitude of functions, goods, and services documented in ecosystem service assessments in the past (De Groot, Wilson and Boumans, 2002; UK National Ecosystem Assessment, 2011). Two main approaches to the benefits of heritage can be recognised: a social complexity perspective and an economic utility perspective. The two have significant overlaps as to what is important, but their distinguishing difference is their definition of the value of heritage. Not only is the difference theoretical, but the difference has ramifications for how each approach can best inform policy-making and climate action.

The social complexity approach is rooted in the humanities and perceives the value of heritage as intrinsic and non-derivative: heritage is an intrinsic value and constitutive attribute of human communities, and, although in many cases this generates contingent

monetary benefits, the value of heritage is not derived from these monetary benefits. The economic utility approach is rooted in empirical positivism, perceiving the value of heritage as extrinsic and derivative: heritage is instrumentally valuable because it is useful to people, generating clearly defined monetary benefits that are unwise to forgo for alternative investments. In practice, neither approach stays true to its premises, latently merging heritage's intrinsic and extrinsic qualities.

Table 1. Differences between social complexity and economic utility approaches to the value of heritage

Approach	Premise	Value for socioecological systems
Social complexity	Intrinsic, non-derivative value	Heritage is valuable per se as a constituent of geographically embedded socioecological networks, with pervasive connectivity to other key components.
Economic utility	Extrinsic, derivative value	Heritage is instrumentally valuable, representing a total economic value too great to forgo for alternative investments or socioecological configurations.

Representing the Role of Heritage in Socio-Ecological Systems

From a climate change perspective, the Intergovernmental Panel on Climate Change (IPCC, 2012) has highlighted that the specific entanglements of vulnerability and exposure with socioeconomic pathways, governance, and concrete adaptation and mitigation actions are crucial in reducing climate change risks for humans and the environment in the context of hydro-meteorological hazards. Concurrently, research in the geographies of sustainability transitions has highlighted that the diversity of transitions is due to the diverse geographical contexts in which these transitions occur (Coenen, Benneworth and Truffer, 2012). Sustainability transitions are contextualised, firstly, in relational spaces that are socially constructed and of pronounced materiality (Coenen, Benneworth and Truffer, 2012; Hansen and Coenen, 2015) and, secondly, across multiple scales (Raven, Schot and Berkhout, 2012).

Both approaches (social complexity and economic utility) towards the value of heritage can provide practical guidance for delineating the functional roles of living heritage in a geographically contextualised socio-ecological system. However, they will highlight different aspects of the transition towards more sustainable and resilient configurations.

The social complexity approach discusses the role of living heritage in the well-functioning of a community. Consequently, such an approach to heritage centres on such notions as identity, social capital, community resilience, and place-making to highlight the pervasive presence of heritage in the makeup of well-functioning and resilient communities (Osipova *et al*., 2014). As noted, a distinctive feature of this approach is an emphasis on communities as geographies of socially constructed materiality, in which heritage has multiple and overlapping endpoints. This conceptual paradigm is primarily qualitative to avoid reducing the semantic richness of heritage into a few quantitative variables. As a result, we test the grounds for utilising this complexity analytically. The method of fuzzy cognitive mapping is particularly suitable to highlight the semantic richness of heritage, as it can maintain the representation of the multidimensional role of living heritage in socio-ecological networks by also adding a participatory component with what-if scenario explorations.

A fuzzy cognitive map (FCM) is an artificial intelligence method—a type of neural network—that represents and explores (a) the mental and physical components of a system as

perceived by groups or individuals, (b) the structure and strength of connectedness between the components, and (c) how the interactions between the components or changes in them will result in new states of the system. The fuzzy component enters by two ways into this approach. First, as a soft computing technique, by compelling the computer to operate with linguistic constructs about a socio-ecological system as opposed to the other way around (as is the case in statistical analysis, for instance). Secondly, through an imprecise approach to the strength of interactions between the system's components by corresponding linguistic expressions of strength (e.g., "rather strong positive influence") to a numerical interval (e.g., 0.7). Kosko (1986) provides a more comprehensive technical presentation of the method, whereas Ozesmi and Ozesmi (2004) demonstrate its application to a real community's collaborative understanding of its socio-ecological system.

A combination of community and expert knowledge led to the development of impact chains for each of the seven open-air laboratories (OALs) (Shah *et al*., 2019). These impact chains are mental maps of the multiple interdependencies between significant components of the socio-ecological system in each OAL, focusing on hydro-meteorological hazards and arranged mainly according to the IPCC's risk framework in hazard, exposure, and vulnerability clusters. We subsequently approached these impact chains as the first stage in developing fuzzy cognitive maps by first converting the impact chains into contingency matrices (see Figure 1 top), producing one version of fuzzy cognitive maps (see Figure 1 bottom). We subsequently utilised our groundwork on heritage values and inserted the heritage effects relevant to each OAL, producing a second version of contingency matrices and subsequent fuzzy cognitive maps. The fuzzy cognitive maps can therefore be used to explore the influence that decisions about components of the socio-ecological system have on its resilience to hydro-meteorological hazards and to understand both the role of and the impacts on the heritage of such decisions. Standard explorations include setting a desired level of quality or quantity for one or more community attributes and exploring the trade-offs between alternative decisions in a collaborative setting. However, since two sets of fuzzy

IRELAND	Social interaction	Significance of the area	Historic legacy	Contribution to educatio	Political network c	Identity and sense	Increased know	Increased confider	Community resilience	Conflict resolution
VULNERABILITY	0	0	0	0	0	0	0	0	0	0
Sustainable land use policy	0,1	0,4	0	0	0	0,1	0	0,1	0,3	0,2
Unplanned land use in floodplain	0	-0,4	0	0	0	0	0	0	-0,3	-0,3
Water retention capacity	0	0	0	0	0	0	0	0	0	0
Wetland management capacity	0	0,4	0	0	0	0,1	0	0	0	0
Quality of Tidal wetland	0	0,4	0	0	0	0	0	0	0	0
Tidal basin	0	0	0	0	0	0	0	0	0	0
Quality of urban planning	0,3	0,4	0,2	0,2	0,2	0,4	0,1	0,5	0,6	0,2
Flood proofing of properties and buildings and	0	0	0	0	0	0	0	0	0,5	0
HERITAGE POLICY	0,5	0,4	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Income/revenue	0	0,4	0	0	0	0	0	0,5	0,5	0
Commercial space	0	0	0	0	0	0	0	0	0	0
Tourism	0,6	0	0	0	0,3	0,1	0	0	0	0
Recreation	0,4	0	0	0	0,1	0,1	0	0	0	0
Entertainment	0,4	0	0	0	0,1	0	0	0	0	0
Community image	0	0	0,2	0	0	0,7	0,2	0,5	0,1	0,1
Environmental quality	0	0,4	0	0	0	0	0	0	0	0
Aesthetic quality	0	0,4	0	0	0	0,6	0	0	0	0
Valorisation of existing assets	0	0,4	0,5	0	0	0,5	0	0	0	0
Social interaction	0	0,4	0	0	0,7	0,6	0	0,5	0,5	0
Significance of the area	0	0	0,5	0	0	0,5	0	0,5	0	0

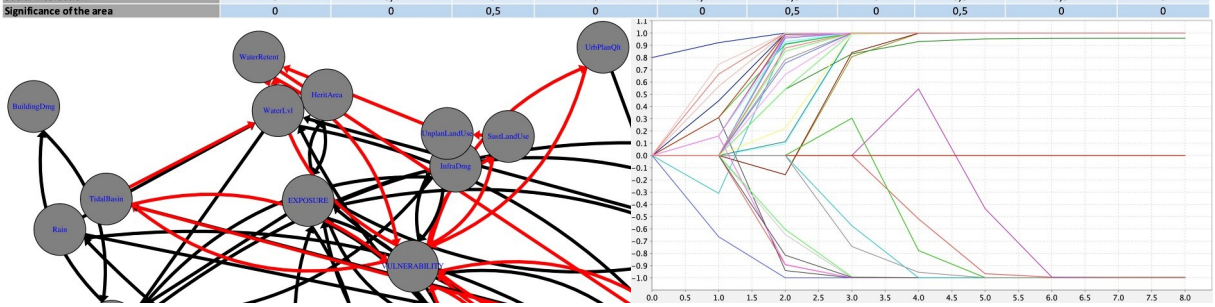

Figure 1. (Top) A contingency matrix showing a subset of the interactions between vulnerability and heritage aspects in the Dodder River floodplain in Ireland © own elaboration (Bottom) A subset of representation of the fuzzy cognitive map © own elaboration

cognitive maps are available, with and without living heritage, the truly interesting feature of this research is not the exploration and minimization of trade-offs but a richer understanding of the structural changes in the resilience of a socio-ecological system when living heritage is actively fostered and pursued as a policy.

The Economic Dimension: The Added Monetary Value of Formal Inscription

Given that a social complexity approach can be exploited with state-of-the-art methods to substantiate the multidimensional role of heritage in socio-ecological systems, a further question arises: Does a formal acknowledgement of heritage represent any detectable monetary value added for the public sector? We explore this question by adopting an economic utility approach on the regional scale. We hypothesise that the total economic value of living heritage (Throsby, 2019) will be reflected in the long-term in the wealth of a territory, traceable in key performance indicators (KPIs) of that territory. Thus, instead of measuring the individual monetary benefits of heritage, we attempt to understand whether the formal incorporation of heritage in the economic inputs and outputs of a regional economy (as hinted by the social complexity approaches) has an aggregate long-term effect. Moreover, we approach living heritage as a composite public good and explore whether different attributes of the inscribed sites contribute differently to the added monetary value they bring to their territory. Due to readily available statistics, we focus on the eurozone's NUTS-2 and NUTS-3 administrative levels and test whether the presence of UNESCO-inscribed sites in those territories yields added-value (measured by KPIs such as gross domestic product and per capita gross domestic product), how much, and with what contribution from individual qualities of the formal heritage site, controlling for known macroeconomic factors of regional economic performance such as unemployment, population, and degree of territorial development.

Concluding Remarks

Our demonstrations aim to contribute to the wider effort to represent and substantiate the multiple roles of living heritage in the resilience of local socio-ecological systems and communities - in particular, their capacity for adaptation, learning, and transformation - in a sustainable manner (IPCC, 2014), while at the same time clarifying the monetized incentives of integrating heritage in wider regional development policies.

Fuzzy cognitive mapping is well suited to represent the relational nature of the value of the living heritage that social complexity views of heritage highlight. This is especially valuable when identifying policies or configurations that can transition a socio-ecological system outside its current lock-ins while still maintaining its essential identity and structure (IPCC, 2014). On the other hand, a regional economics perspective appears useful in communicating the public monetary benefits of formally recognising living heritage in a territory—in our case, through UNESCO inscription in European administrative regions. Such an approach can also be applied at more local scales, but the question of what benefits should be measured is much more contextualised per area and scale. The two approaches are complementary and produce qualitative and quantitative information usable in a wide range of governance and public policy paradigms since the non-monetary inputs of both approaches to non-monetary cost-effectiveness or multi-criteria analysis can readily supplement the inputs of the economic approach to cost-benefit analysis.

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