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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Abstract

Agendas to reduce the risks associated with climate change and increase resilience to impacts have become rather inclusive in the types of social effects that they consider, also acknowledging their embeddedness in socioecological networks, geographies, and scales. Heritage, as many other semantically rich social and cultural notions, is both under-represented and under-specified in climate change policy assessments. It is therefore important, beyond merely recognising the importance of heritage, to keep sketching out how this importance looks like 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 eurozone's regional economies.

1. Introduction

The preservation and incorporation of heritage in the planning and functioning of urban and rural regions and territories has shown to yield 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 heritage to also reduce the risk of climate change impacts in their host region.

More specifically, natural and mixed cultural-natural heritage represents a unique type of living heritage that adds ecosystem functions, goods and services in the already substantial list of benefits found in non-natural heritage [1]. 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. It is therefore a type of living heritage whose spread and degree of integration into multiple social and ecological processes of a territory renders it as 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 [2], 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. Our focus is on seven experimental open-air laboratories across Europe—located in Austria, Finland, Germany, Greece, Ireland, Italy, Scotland—and we demonstrate by the means of fuzzy cognitive maps and scenarios [3] how natural and mixed natural-cultural heritage can be part of a wider 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 [4].

2. 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 [1,4]. More recently, literature has been also 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 [5-6]. 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 in their definition of the value of heritage. The difference is not just theoretical but has ramifications for how each approach can best inform policy making and climate action.

The social complexity approach is rooted in 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 by 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 their premises, both latently merging the intrinsic and extrinsic qualities of heritage.

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.

3. Representing the role of heritage in socio-ecological systems

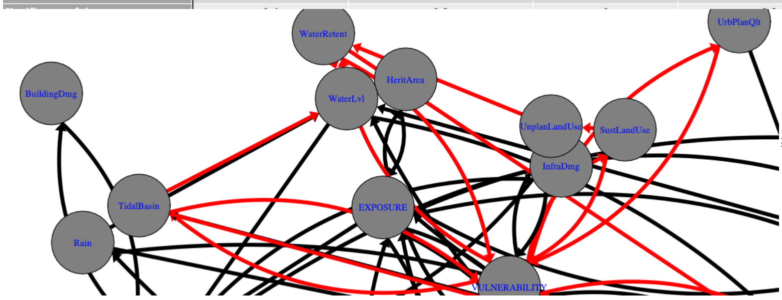
Form a climate change perspective, IPCC [7] has highlighted that the specific entanglements of vulnerability and exposure with socioeconomic pathways, governance, and concrete adaptation and mitigation actions are crucial in reducing climate change risks for humans and the environment in the context of hydrometeorological 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 [8]. Sustainability transitions are contextualised; firstly, in relational spaces that are socially constructed and of pronounced materiality [8-9] and, secondly, across multiple scales [10].

Both approaches (social complexity, economic utility) towards the value of heritage can therefore provide practical guidance for delineating the functional roles of living heritage in a geographically contextualised socioecological system but 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, place-making to highlight the pervasive presence of heritage in the makeup of well-functioning and resilient communities [1]. As noted, a distinctive feature of this approach is emphasis on communities as geographies of socially constructed materiality, in which heritage has multiple and overlapping end points. 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 of 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 socioecological networks by also adding a participatory component with what-if scenario explorations.

A fuzzy cognitive map (FCM) is an artificial intelligence method—a form of neural network—that represents (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) explores how the interactions between the components or changes in them will cause new states of the system. The fuzzy component enters by two ways into this approach. Firstly, as a soft computing method, by forcing the computer to operate with linguistic constructs about a socioecological system as opposed to the opposite direction (as happens, for instance, in statistical analysis). 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). A more thorough technical presentation of the method is provided in [3], whereas [11] provide an application to a real community's collaborative understanding of their socioecological system.

IRELAND	Sustainable land use policy	Unplanned land use in floodplain	Water retention capacity	Wetland management capacity	Quality of Tidal wetland	Tidal basin	Quality of urban planni
VULNERABILITY	-0.5	0.5	-0.5	-0.5	0.5	-0.5	-0.5
Sustainable land use policy	0	-0.5	0	0	0	0	0
Unplanned land use in floodplain	0	0	-0.5	0	0	0	0
Water retention capacity	0	0	0	0	0	0	0
Wetland management capacity	0	0	0	0	0.5	0	0
Quality of Tidal wetland	0	0	0	0	0	0.5	0
Tidal basin	0	0	0	0	0	0	0
Quality of urban planning	0	0	0	0	0	0	0
Flood proofing of properties and buil	0	0	0	0	0	0	0
HERITAGE POLICY	0	0	0	0	0	0	0
Income/revenue	0	0.2	0	0.2	0	0	0.2
Commercial space	0	0.3	0	-0.3	0	0	0.2
Tourism	0	0	0	-0.2	0	0	0
Recreation	0.2	-0.2	0	-0.2	0	0	0.2
Entertainment	0	0	0	0	0	0	0
Community image	0.2	-0.2	0	0.2	0	0	0.4
Environmental quality	0	0	0	0	0	0	0
Aesthetic quality	0	0	0	0	0	0	0
Valorisation of existing assets	0	0	0	0	0	0	0
Social interaction	0.4	0	0	0.5	0	0	0.5



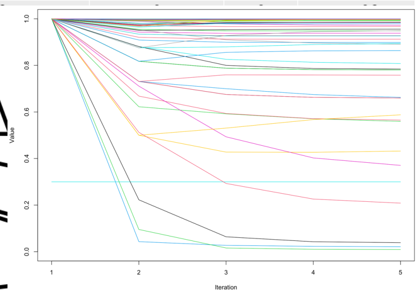


Figure 1. Top: A contingency matrix showing a subset of the interactions between vulnerability and heritage aspects in the Dodder River floodplain in Ireland. **Bottom left**: A subset of representation of the fuzzy cognitive map. **Bottom right**: A visual example of system components behaviour during scenario exploration.

A combination of community and expert knowledge led to the development of impact chains for each of the seven open-air laboratories (OALs) [12]. These impact chains are mental maps of the multiple interdependencies between significant components of the socioecological system in each OAL, focusing on hydro-meteorological hazards, and largely arranged according to 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 for each OAL, producing a second version of contingency matrices and subsequent fuzzy cognitive maps. The fuzzy cognitive maps can be therefore used for exploring the influence that decisions about components of the socioecological system have on its resilience to hydro-meteorological hazards, to understand both the role of and impacts to 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 cognitive maps are available, with and without living heritage, the truly interesting feature of this research is not exploration and minimisation of trade-offs, but a richer understanding of the structural changes in the resilience of a socioecological system when living heritage is actively fostered and pursued as a policy. For instance, statements such as an x% increase in the overall level of heritage policies yields a y% decrease in community breakdown during a storm can be explored with this approach, which further helps to substantiate the direct and indirect effects of alternative strategies.

4. 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 socioecological systems, a further question begs to be asked: does a formal acknowledgement of heritage represent any detectable monetary added value for the public sector? We explore this question by adopting an economic utility approach at the regional scale. We hypothesise that the total economic value of living heritage [4] 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 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 their 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 yield 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.

5. 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 [13], 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 character of the value of living heritage that is highlighted by social complexity views of heritage. This is especially valuable when identifying policies or configurations that can transition a socioecological system outside its current lock-ins, while still maintaining its essential identity and structure [13]. A regional economics perspective, on the other hand, 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 approach can be applied at more local scales as well, but the question of what benefits should be measured is much more contextualized per area and scale. The two approaches are complementary and produce qualitative and quantitative information that is usable in a wide range of governance and public policy paradigms, since the inputs of the economic approach to cost-benefit analysis can be readily supplemented by the non-monetary inputs of both approaches to non-monetary cost-effectiveness or multicriteria analysis.

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7. References

[1] Osipova E et al. (2014) The benefits of natural World Heritage: Identifying and assessing ecosystem services and benefits provided by the world's most iconic natural places. IUCN.

[2] OPERANDUM – OPEn-air laboRAtories for Nature baseD solUtions to Manage hydro-meteo risks. https://www.operandum-project.eu

[3] Kosko B (1986) Fuzzy cognitive maps. Int. Journal of Man-Machine Studies 24(1): 65-75.

[4] Throsby D (2019) Heritage Economics: Coming to Terms with Value and Valuation. In E Avrami et al. (Eds.) Values in Heritage Management: Emerging Approaches and Research Directions. Getty.

[5] De Groot RS, Wilson MA, Boumans RMJ (2002), A typology for the classification, description and valuation of ecosystem functions, goods and services, Ecological Economics 41(3): 393–408.

[6] UK National Ecosystem Assessment Follow-on (2014) The UK National Ecosystem Assessment Follow-on: Synthesis of the Key Findings. UNEP-WCMC, LWEC, UK.

[7] IPCC (2012), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (Cambridge University Press).

[8] Coenen L, Benneworth P, Truffer B (2012), Toward a spatial perspective on sustainability transitions, Research Policy, 41: 968–979.

[9] Hansen T, Coenen L (2015), The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field, Environmental Innovation and Societal Transitions 17: 92–109.

[10] Raven R, Schot J, Berkhout F (2012), Space and scale in socio-technical transitions, Environmental Innovation and Societal Transitions 4: 63–78.

[11] Özesmi U, Özesmi SL (2004), Ecological models based on people's knowledge: a multi-step fuzzy cognitive mapping approach, Ecological Modelling 1-2: 43–64.

[12] Shah MAR, Renaud F, Wild A, Anderson C (2019), Vulnerability and risk assessments of socio-ecological systems (SES): conceptual framework, impact chains and indicators, Deliverable 6.2, H2020 OPERANDUM project.

[13] IPCC, 2014: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130.