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Clarifying some assumptions of coastal management: Analysis of values and uncertainties embedded in beach quality indexes

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ABSTRACT

For the first time, this research addresses the assessment of the quality of knowledge embedded in beach quality indexes from a socioecological perspective. We took the most widespread beach quality indexes and identified, selected and assessed the most important existing assumptions. We scored the robustness of these assumptions, using an inclusive methodology (stakeholder meeting, four focus groups and an online questionnaire). The NUSAP criteria for assessing the value-ladenness of scientific studies (Influence of resource limitations, (Im) Plausibility, Choice space, Agreement among peers, Analysts' subjectivity and Influence on global results) were contrasted and discussed. A final list of the 10 weakest assumptions was presented and discussed. Most of these assumptions are fairly robust, but attention should mainly focus on their influence on global outcomes and (im) plausibility, as the weakest scored criteria. The choice space scores revealed the possibility of including new alternatives to the assumptions, when necessary. Assumptions loaded with framing concepts are weaker than those linked to more concrete objectives. We detected dissociation between the discourse and the operational development of the indexes, in which the narratives prioritizing user satisfaction are predominant and scientific data analysis is often decontextualized. We therefore suggest that science should be opened up throughout the building process of indexes: from the identification of problems to the reporting of results and related uncertainties. The NUSAP method proved to be useful for identifying weak points in beach quality indexes.

1. Introduction

The analysis of beaches as socioecological systems (SES) (e.g. Defeo and McLachlan, 2005, Botero and Hurtado, 2009) has been developed only in recent years, following almost three decades of use of analysis and ranking tools, that, despite contributing to this body of knowledge, failed to truly address the existing complexity of these systems (Ariza et al., 2008). Although traditionally claimed to be an objective process, the choice of which components and interactions are needed to understand the behaviour of SES is biased by scientists' values, interests and background (Rosen, 1993, Sarewitz, 2004, Bremer and Glavovic, 2013). Doing science for policy involves a number of renounces. In this way, approaches to the management of beach SES have traditionally focused on a very limited number of functions, such as beaches as summer playgrounds and buffer spaces for storms (James, 2000, Lozoya et al., 2014, Ariza et al., 2016). The process has prioritized specific narratives over others, resulting in a lack of scrutiny of the overall functioning of the system.

The assessment presented here takes and explores the potential contribution of the Post Normal Science (PNS) – a guiding epistemological perspective that emphasizes the high stakes and uncertainties involved in socioecological problems and alternatives (Funtowicz and Ravetz, 1990) – to beach management, by highlighting the enclosed narratives and contexts. In practical terms, we critically assessed the knowledge embedded in the existing beach quality indexes. We started the analysis with the BQI (see Section 2) and expanded it to 5 other well-known beach quality indexes, through the identification, screening and evaluation of their scientific assumptions. In order to do this, we applied one of the operational PNS tools: the NUSAP method.

2. Background of beach quality indexes and the epistemological framework

2.1. The evolution of beach management tools

A consolidated line of research on beaches has led to the development of management practices and tools. In the first book dedicated to the topic, beach management is defined as a "subset of coastal

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management but with particular reference to pragmatic local management" (Williams and Micallef, 2009). Here, awards, rating schemes and sets of indicators to measure beach performance have been identified since 1985, when the Blue Flag rating scheme was developed as a response from the tourism industry to the crisis of mass tourism and its subsequent impacts on natural resources (Fraguell et al., 2013).

After the Blue Flag rating scheme, different initiatives began to appear in different countries (e.g. Leatherman, 1997, Morgan, 1999), designed to support costal leisure activity on beaches, accounting, in a very limited way, for environmental aspects (Williams and Micallef, 2009). Most importantly, they represented beaches as a static photograph rather than a dynamic system, since their usual methodology consisted of fulfilling a list of requirements for beach performance (e.g. Mir-Gual et al., 2015) ranking "where the 'best beaches' occur" (Williams and Micallef, 2009), most of them regardless of socio-ecological specificities and interactions.

In the late 1990s, the latest advances in sustainability research proposing more systemic approaches, i.e. Environmental Management Systems (EMS) (Seiffert, 2009), started to converge with the research on beach management (Yepes et al., 1999). This led to a more integrative process through the inclusion of different stakeholders in the analysis and decision-making, as is the case of the Spanish UNE-EN ISO 14.001 standard (Williams and Micallef, 2009). Nonetheless, quality standards were limited in their coverage of socioecological beach systems due to their vocation towards market competitiveness in the tourism sector (Yepes, 2005).

The new century brought a turning point, when beaches were expressly defined as socioecological systems and the ecosystem-based management approach was included in the conceptual framework of the field (Ariza et al., 2008). Since then, scientists have proposed that natural beach assets should be better incorporated into classical certification schemes (Fraguell et al., 2016, Lucrezi et al., 2015) and especially new methodologies for capturing beach complexity in order to provide information for sustainable management (Ariza et al., 2010, Botero et al., 2015, Cervantes and Espejel, 2008, Semeoshenkova et al., 2015, Todd and Bowa, 2016, Lucrezi et al., 2016).

The Beach Quality Index (BQI; Ariza et al., 2010, 2012) was the first index designed to cater for different beach systems and functions in an integrated framework (Williams and Micallef, 2009). Hierarchically organized in four levels (Fig. 1), the first corresponds to the overall tool, the second to the three beach functions identified (natural, protective and recreational), followed by a third level composed of 13 sub-indexes, which finally deploy the corresponding measurement variables (fourth level).

2.2. The uncertainty assessment

The methodologies developed to date for capturing beaches as multidimensional systems (more in Table 1) have included non-academic narratives in a limited way, i.e. only beach users' perceptions. They did not consider uncertainty multidimensional assessment during the index building process (Walker et al., 2003), and did not include checks of their usefulness as a guide for political decisions on beach matters.

The PNS, more than an epistemological guide, seeks to bring the uncertainties of contemporary complex problems to the centre of academic studies (Funtowicz and Ravetz, 1990). It offers an alternative for analysing and diagnosing uncertainties: the NUSAP method (Fig. 2). NUSAP is an acronym for Numeral and Unity (traditional statistical approach), extended to the dimensions of Spread (uncertainty and inexactness), Assessment of reliability (methodological) and Pedigree (quality of the production process, epistemological frameworks), in such a way that the value-ladenness of academic assessments can be highlighted (Van der Sluijs et al., 2003).

The NUSAP can be deployed by a pedigree assessment matrix, which may take different forms (e.g. Van der Sluijs et al., 2003, Kloprogge et al., 2011, Laes et al., 2011) through a set of pedigree criteria, such as analyst's objectivity and (dis)agreement among peers about the knowledge base. That used in Van der Sluijs and Wardekker (2015) has been adapted for this work (further details below) and represents a quali-quantitative structural process for assessing the assumptions, numbers and theories behind the available knowledge.

When Mayumi and Giampietro (2006) discussed the four sources of uncertainties presented by Knight (1964) – perception, anticipation, effect and implementation – they selected the first one as crucial for the PNS. The perception and further representation of our surrounding 'reality' is constrained by certain limitations, according to which, facts should be addressed taking into account the means used to put a shared question into perspective. In this regard, the treatment of the strength property is the most innovative part of the NUSAP method, since it is a way of reacting to the perception uncertainty, especially due to the focus on evaluating the process of information production (Ravetz and Funtowicz, n.d.). To date, the NUSAP method has not been used for the analysis of beach SES narratives and assumptions and their associated uncertainties. Therefore, the present research will provide a new methodological and analytical contribution to the field, by approaching the epistemological challenge of beach complexity and beach quality indexes.

3. Methods

The identification of indexes of beach sustainability was performed through a Scopus search using the terms "beach" and "indexes". Those approaching the beach as a multidimensional system (Table 1) were selected.

The knowledge assessment of the abovementioned indexes was conducted through a methodological set delineated hereinafter, as it was approached chronologically. Twenty-five main assumptions (Appendix I) were identified and scored. We identified/tested "*in situ*", with the support of stakeholders of the Catalan coast, assumptions 2, and 7 to 25, of Appendix I, which belong to the BQI (developed for the Catalan coast). The assessment was, thus, extended to assumptions of the rest of the selected indexes (assumptions 1 to 6 of Appendix I). Later in the present article, we discuss the ten weakest assumptions resulting from the whole process.

3.1. Pre-identification of assumptions: highlighting of dimensions and narratives of the Catalan coast

A multi-stakeholder meeting was held in Barcelona on April 1st 2016, to co-define beach management dimensions, narratives and priorities of the Catalan coast. Present at the meeting were fifty-seven stakeholders from the three levels of government (i.e. state, regional and municipal), the private sector (e.g. consulting firms and certification organizations), academic institutions, the organized civil society (e.g. citizens' platforms for the environment) and a combination of the aforesaid types (e.g. clusters for the development of nautical activities). It was the first known attempt at integrating the organized civil society on the scale of Catalonia. In a joint manner, the assistants highlighted and discussed the most prominent coastal issues. By adapting the Participative Planning and Associate Management methodology (Poggiese, 1993), the meeting identified:

3.1.1. Dimensions composing the Catalan beach SES

Following Munda (2005), for this research, dimensions were conceptualized as a level of analysis broad enough to display specific objectives, indicators and variables. Dimensions comprise one or more BQI functions and elements. For instance, the morphodynamics dimension includes the protection function of beaches, but also other elements, such as sediment transport.

Beach SES dimensions in the Catalan coast are: 1. Recreational activity, 2. Morphodynamics, 3. Ecology and natural heritage, 4. Beach