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Multi-criteria assessment of a proposed ecotourism, environmental education and research infrastructure in a unique lagoon ecosystem: The Encañizadas del Mar Menor (Murcia, SE Spain)

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ABSTRACT

Coastal lagoons host important values and provide irreplaceable services to society. Communication areas with the sea (gullets, 'golas' in Spanish) are dynamic environments with a key role in their overall functioning, often representing also strongholds of biodiversity, which increases their conservation value and social demand for nature-based activities. In 2013 the Regional Assembly of the Autonomous Community of Murcia adopted unanimously the creation of a pedestrian walkway to promote ecotourism, environmental education and research in the area of the 'Encañizadas del Mar Menor' (EMM, thereafter), a space between the aforementioned lagoon and the Mediterranean Sea. The agreement was conditioned upon the completion of an environmental feasibility study which was commissioned to the University of Murcia. The area affected concentrates several habitats and species of community importance listed in EU Habitat and Bird Directives, including habitat 1140 (Mudflats and sandflats not covered by seawater at low tide) and many seabird and waterbirds. Traditional fishing has not only preserved its ecological uniqueness but increased cultural value. The multi-criteria evaluation developed by a multidisciplinary team has combined the basic information available with specific models of response to the presence of the infrastructure and its use by visitors, especially regarding hydrological and sediment dynamics, and biodiversity (birds and habitats). Although constrained by the complex regulatory and administrative framework, and by the quality of the environmental information available, the design and development of this study provides a model for the evaluation of projects with strong public demand in ecologically sensitive areas of Mediterranean coastal lagoons. The assessment was made on the basis of four groups of viability criteria (socioeconomic, environmental, administrative and legal, technical), weighted by expert panels to rate the alternatives previously drafted. A specific social consultation provided information on the preferences and attitudes of actual users and the regional public on the intervention and its alternatives. A combined analysis of socioeconomic (positive) and environmental (negative) impacts was used to select the alternative that concurrently maximized social preferences and environmental integration. Although the possibility of building a footbridge was rejected, the selected alternative (peripheral boat itinerary) still had good social acceptance, was consistent with ecotourism policies and matched experiences carried out elsewhere. Additional utilities of such multidisciplinary assessments are their performance as public information and participation processes, and the possibility to use them as a basis for drafting initiatives for the valorisation or restoration of other sections of lagoon complexes.

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1. Introduction

Semi Enclosed Coastal Systems (SECS), such as bays and coastal lagoons, represent one of the environments of greater biological and socio-economic value of the world, often enriched by a remarkably rich historical and cultural heritage result of the close interaction between man and the environment throughout history (Viaroli, Lasserre, & Campostrini, 2007; Newton et al., 2014). This enrichment is especially evident in the Mediterranean, whose coastal lagoons hoard important values and provide irreplaceable services to society (Pérez-Ruzafa, Marcos, & Pérez-Ruzafa, 2011). The communication areas of coastal lagoons with the sea (gullets, 'golas' in Spanish) are environments of great dynamism and high biodiversity, with a key role in the overall functioning of these systems (Pérez-Ruzafa, Marcos, & Gilabert, 2005). For this dynamism and the importance of their functions and uses, the environmental assessment of infrastructure development projects in these areas share features and pose the same constraints, saving the differences of scale, with those performed in estuarine systems (Comisión Europea, 2011).

In September 2013 the Regional Assembly of the Autonomous Community of Murcia (SE Spain) adopted unanimously the creation of a pedestrian walkway to promote ecotourism, environmental education and research in the area of the 'Encañizadas del Mar Menor' (EMM, thereafter), a space between the aforementioned lagoon and the Mediterranean Sea. Its dynamic, pseudo-tidal habitats are critical elements for both biodiversity and society. The creation of public infrastructures, though inspired by pro-environmental attitudes assumed by the general public and the scientific community, may impose additional pressures on these fragile ecosystems.

The regional representatives conditioned the agreement upon the completion of an environmental feasibility study which was commissioned to the University of Murcia in 2014. We present this assessment exercise as an example of the process that should guide the design and planning of public infrastructures in such habitats, covering all the sectors, agents, scales of approach and methods that should be integrated in a proper evaluation. The case study is used as a model assessment that can expand the scope to adopt when dealing with such issues, placing them into the adequate social, political and scientific context.

The study had as main objectives, in accordance with the inspiration and drafting of the political agreement, i) to analyze the environmental implications of the walkway's draft project, with particular reference to its repercussions on natural protected areas designated at regional and international level (Natura 2000 Network and international agreements like the Ramsar Convention and the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean); ii) to assess the alternatives through which it could be developed; and iii) to make proposals for achieving the target set, i.e. the revaluation of the cultural and environmental heritage of the area, based on the promotion of ecotourism, research and environmental education.

2. Materials and methods

2.1. Study area

The target area (EMM), a semi-natural gullet of the Mar Menor lagoon breaking through its closing barrier (La Manga), is the last functional communication between the main basin of the lagoon and the sea, both in terms of landscape setting (open scenic view) and regarding ecosystem dynamics (active physical and biological exchange). It belongs to the Regional Park 'Salinas y Arenales de San Pedro del Pinatar', and as a section of the Mar Menor Lagoon complex, it takes also part in a number of protected area networks designated under international agreements and European legislation (Ramsar sites, Special Protected Areas of Mediterranean Importance and Natura 2000). With an extension of 181 ha and dominated by canals, shallow muddy areas and vegetated islets, the EMM area provides one of the best examples of how a traditional fishery system can convive in harmony with the environment and the species that inhabit it. Moreover, its geographical location, in the southwestern corner of the Iberian Peninsula, determines that many waterbird species use this area as a roosting and feeding place during their migrations, many others staying there in winter or using it for breeding in spring-summer.

Within the Mar Menor lagoon complex, it is precisely this area what supports its most unique ecosystem type (Ballester et al., 2003). Such uniqueness is clearly expressed both in its physical and ecological characteristics, as well as in its great cultural and ethnographic diversity (Ballesteros, 2014; Belando, Ruiz, García, Ramos, & García, 2014). It concentrates several habitats of community importance and bird species listed in EU Habitat and Bird Directives, including habitat 1140 (Mudflats and sandflats not covered by seawater at low tide) and thriving populations of European important species of waders and seabirds. The historical modifications for the practice of fishing (using virtually medieval techniques) have not only preserved its ecological uniqueness but also increased its cultural value.

2.2. Methodological steps

The study has been developed along four phases, not necessarily consecutive or exclusive as to the type of information required (Table 1). The assessment *sensu stricto* includes at least two phases (1, 3) in which particular inputs of biological information were needed, and through which the range of alternatives considered was shortened.

In the results, we first present the process by which the planned infrastructure was assessed, acknowledging the multidimensional nature (scientific, technical, socio-economic, legal and administrative) of the problem. A multidisciplinary team was built, integrating experts on all the fields involved, and identifying sources and methods able to supply the information needed. Assessment criteria and their weights were set by consensus among those experts. The political agreement

Table 1
Methodological steps of the assessment exercise and types of information used in each phase.

Phase 1	Background compilation and identification of limiting and conditioning factors.	Environmental factors Administrative and legal factors Socioeconomic factors Technical factors
	Drafting of alternatives	Location (3 main itineraries or corridors) Extension/interference (point-peripheral vs linear-continuous) Displacement mode (pedestrian vs boat)
Phase 2	Analysis of alternatives	Assessment by block of criteria Multi-criteria assessment Pre-selection: alternatives optimizing socio-environmental demands and constraints
Phase 3	Repercussions on NATURA 2000	Restricted assessment and decision among pre-selected alternatives (accept, discard, modify)
Phase 4	Complementary proposals	Internal (other proposals) Local replication (other ancient, derelict outlets within the Mar Menor complex) Mediterranean network