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# An Interdisciplinary Analysis of Beach Management in the Catalan Coast (North-Western Mediterranean)

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*This article presents a comprehensive analysis of beach management in the Catalan coast (NW Mediterranean) by introducing and integrating results from different partial projects. They analyzed the legal, political, and administrative framework of beach management, the quality tools available, the practices of management, the processes of beach use, and beach waste/litter dynamics. The information obtained served to create a new beach management tool referred to as the Beach Quality Index, which was developed by an interdisciplinary team of academics from the natural/physical sciences and social sciences that worked together during the course of four years. Information obtained from users and key stakeholders served to create the index. The study demonstrated that as a consequence of the shortcomings in the legal and administrative system as well as inadequate practices of beach managers, beach management in the area experiences coordination problems, insufficient information and lack of proactive management, pollution, and in general problems associated with the satisfaction of short-term user demands.*

**Keywords** institutions, local management, quality

## Introduction

The interdisciplinary practice of environmental management has been widely promoted but scarcely practiced. The difficulties of practicing interdisciplinary have been described

This study integrates findings and results obtained within the framework of several research projects funded by the Spanish Ministry of Education and Science (MeVaPlaya, DEFCON, VuCoMA, Mevaplaya II) under contracts REN2003-09029-C03-MAR, CGL2006-13953-C04, CTM2008-05597/MAR, and CSO2009-14589-C03, respectively. The first author was supported by a Fulbright fellowship from the Fulbright Commission. The authors thank the scholars who participated in the discussion sessions, and the experts and users that responded to the surveys and provided interviews.

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by Lélé and Norgaard (2005). Traditionally, there have been challenges when crossing barriers and communication problems among different scientific disciplines as well as scientists, policymakers, managers, and the general public. It was not until recently that global approaches, such as the analysis of coevolution of science, governance, and the ecosystems have been established (Norgaard, Kallis, and Kiparsky 2009).

The science of coastal management is not an exception. Although much emphasis has been placed in the integration process (Clark 1997; Kay and Adler 2005; Cicin-Sain and Knecht 1998), the number of studies using thoroughly integrated approaches within the coast have been minimal (Shipman and Stojanovic 2007). Although studies have been made by more than one academic discipline, it has been found that general multidisciplinary and transdisciplinary (transdisciplinarity involves coordination among all hierarchical levels of knowledge; Max-Neef 2005) approaches are uncommon inside the academia and in practical management programs. The lack of contributions by certain disciplines (e.g., social sciences) to beach management studies has kept researchers from understanding important coastal processes. Also, in some cases (e.g., coastal sediment researchers/institutional analysis researchers) cooperation among different academic disciplines has been almost non-existent. The traditional division of biophysical and social science is very difficult to overcome, as well as the division among the disciplines in the social sciences (Lélé and Norgaard 2005). Another added problem is the lack of multiscale analysis (Brondizio, Ostrom, and Young 2009; Micallef and Williams 2002). As a consequence of the lack of interdisciplinary studies, there has not been a global vision in which the analysis of the processes working at different scales are articulated (Giampietro and Mayumi 2000).

The contribution of traditional science to the study of beaches has been important in the last decades. The disciplines of hydrology and geomorphology have provided a wide range of knowledge, which has been applied to prevent the widespread of beach erosion in many coastal areas (EuroSION 2004). Although there have been social science studies conducted, they have been found to be less common (West 2005; Breton et al. 1996; Roca and Villares 2008). Some of the studies have taken into account the perception of users in different beach ecosystems (Chapman 2006; Morgan et al. 1996; Villares 1999; Buceta 2000) and others in beach economic valuation (Houston 2002; Stronge 2004; Yepes and Medina 2005).

Generally speaking, beach management research has concentrated on sediment management and recreation (Bird, 1996). Until recently, beach quality standards have been defined using just those studies (Williams and Morgan 1995; Leatherman 1997; Morgan 1999; Cagilaba and Rennie 2005). In spite of the fact that the beach has also been approached by biologists studying dune systems and intertidal areas, as well as submerged communities (Gheskiere 2005; McLachlan and Jaramillo 1995; Janssen and Mulder 2005), the outcome of those studies has not been applied toward beach management research.

In the last decade, some studies have dealt with the complexity of beaches. These studies considered beaches as multidimensional systems where natural, socioeconomic, and administrative components interact (James 2000a; Micallef and Williams 2002; Simm, Beech, and John 1995; Micallef 1996; Williams and Davies 1999). The need for developing integrated studies and using an ecosystem management approach have been recognized (Pirrot, Meynell, and Elder 2000; Ariza et al. 2008), as well as the need to use different scales and units for the valuation of socioecological resources (Martinez-Alier, Munda, and O'Neill 1998). However, research on beach integration has been mostly qualitative and conceptual. The use of available quantitative information has been exceptional.

The study described in the present article provided an opportunity to examine beach management (i.e., at different scales) in a highly frequented tourism area, during the course

of four years. The purpose of the project was to understand the way the various aspects of beach systems are related and interact. This article tries to relate the shortcomings detected in the analyses of the legal and administrative system, with the dynamics of the local management of beaches, the beach use process (including waste/litter generation), and the different potentialities of two available beach management tools (Environmental Management Systems for Beaches and the new developed Beach Quality Index (BQI)). The application of the BQI allowed to detect the strength/weaknesses of management in La Selva Marítima (North-Western Mediterranean). The study also linked the strengths and weaknesses to the legal and administrative framework, the dynamics of local management and the beach processes, which allowed to extract comprehensive guidelines for improving the management of beaches.

The main contribution of this article is a comprehensive review of the different analysis of beach management already done in the area affected by tourism activity. The review was based on a wide multidisciplinary approach and used inputs from different academic disciplines, as well as users and stakeholders, that interacted and interchanged information continuously for a period of four years. In this analysis, different quantitative perspectives and qualitative methods were used, combined, and adapted for the project. This article introduces a reflection based on results and conclusions of different partial studies about the legal framework, beach quality, beach processes and institutional analysis of the beaches in the North-Western Mediterranean. It is important to note that these partial studies were published in separate papers (Ariza et al. 2008; Ariza, Jiménez, and Sardá 2008a, 2008b; Sarda et al. 2009; Ariza et al. 2010, Ariza 2011). This article synthesizes the partial outcome of those studies and provides a reflection on the integration of results from different studies into a common framework.

## The Study

### *The Area of Study*

The research conducted focused on the analysis of beach processes in the Catalan Coast, located along the North-Western Mediterranean coast (in the region known as la Costa Brava). Although extensive research was done on the legal and administrative framework of beach management within Spain, it specifically focused on the local management practices within the Catalan Coast. At the same time, intensive and detailed research was carried out on important beach processes in the Comarque of La Selva (Figure 1). La Selva is an area of the Catalan coast that has been impacted by both construction and tourism during the second half of the 20th century. The study site is significant because it demonstrates the impacts caused by tourism to the environmental resources found along the North-Western Mediterranean coast. The area has approximately thirty beaches and comprises four municipalities (Malgrat de Mar, Blanes, Lloret de Mar, and Tossa de Mar). The study performed evaluated each of these areas with emphasis on the beaches of Malgrat Nord, S'Abanell, Treumal-Sta. Cristina, Lloret, Canyelles, and Tossa-Mar Menuda (Figure 1).

The number of people visiting the Costa Brava is increasing every year. The arrival of mass numbers of tourists to the Costa Brava mirrors the tendencies observed for Spain and Catalonia. From 1950 onward, the number of visitors increased every year and the current forecast still predicts continuous growth, largely thanks to new and improved facilities, low-cost travel, and the restructuring of the tourism sector. When numbers are compared, the role of the coastal tourism of the Costa Brava, considering its importance to the Spanish



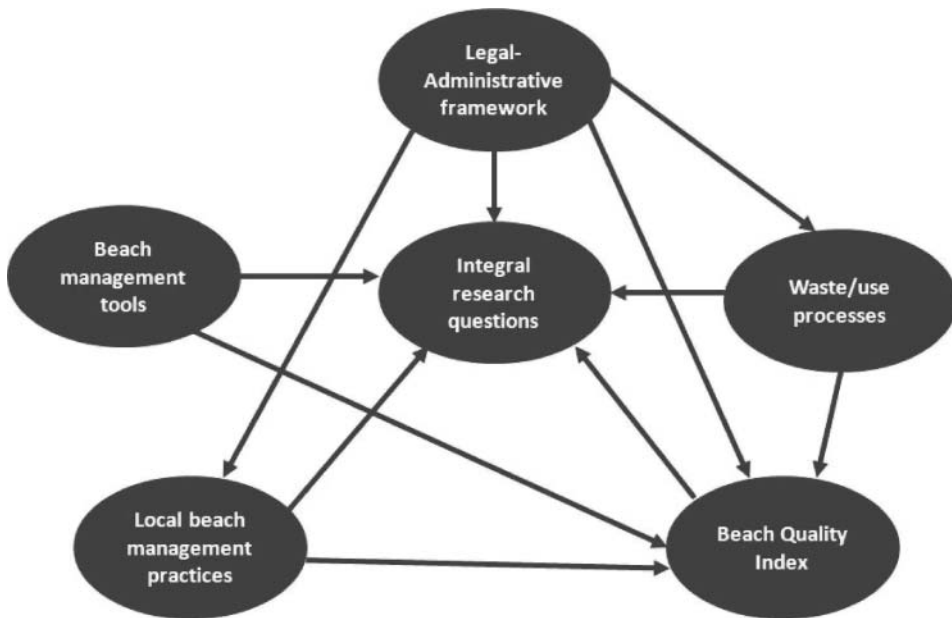
**Figure 1.** Beaches assessed in the research (color figure available online).

coast as well as to the Mediterranean and European tourism, is notably high. As a result of increased human frequentation, many of the beaches on the Costa Brava—the area’s most valuable asset for attracting visitors—have suffered from overcrowding, with the logical consequences of damage to and the depletion of its natural resources.

### *Partial and Integral Projects*

The project was divided into various partial projects. A particular method was used in each of the projects, which are fully available in Ariza et al. (2008), Ariza, Jiménez, and Sardá (2008a), Ariza, Jiménez, and Sardá (2008b), Sarda et al. (2009), Ariza et al. (2010), and Ariza (2011). This section includes a summary of the partial research questions addressed, the results and conclusions, as well as a description of the integral research questions (Figure 2).

*Legal and Administrative Framework.* The legal and administrative framework of the study was analyzed using an integrated coastal zone management (ICZM) framework (planning, transparency, public participation, interdisciplinary coordination, etc.). The study of the evolution of beach management in the region during the second half of the 20th century showed an important increase in human utilization of beaches. The first legislation for the planning and management of beaches was the Shores Act of 1969. It established the Plan for the General Zoning of the Beach (PGOP). The PGOP was later abolished by the Shores Act of 1988 and since then, there has been an absence of long-term planning of beach management. In recent decades, beach management has evolved and a more comprehensive approach has been adopted. Three important strategies have been adopted to develop better beach management: the Spanish and Catalan ICZM strategies and the Master Plan of Land Use Planning of the Coastal System (PDUSC). The study of the legal and administrative



**Figure 2.** Scheme of the research.

framework has demonstrated that the responsibilities are spread among local, autonomic and national management institutions. These responsibilities can be grouped in three areas: (1) Water quality regulation, (2) Beach services and facilities, and (3) Safety and rescue services. A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis revealed interesting results. One of the most important strengths of the framework is the public ownership of beaches and the strict regulation of land use around them. This situation allows planning and management to potentially be implemented in a coordinated and comprehensive way. It also guarantees access for the general public to the beaches. Another very important strength is demonstrated in the data analysis of the National and Autonomous ICZM strategies and some regional plans (the Coastal Sustainability Plan of the Metropolitan Area of Barcelona, the Maresme Strategy Plan 2015, and the Llobregat Delta Infrastructure Plan), which have been adopted into the legal and administrative framework. The main weaknesses of the framework are: (1) Some academic disciplines have not been sufficiently incorporated into the research field of beach management; (2) Very few beach economic studies have been performed; and (3) Beach management has often been done without an organized flow of information and a clear common policy to achieve mid-term goals (there is a lack of available proactive management tools). The most important shortcomings related to planning (specific emergency plans for beaches and continuous improvement strategies are absent), include: (1) Beach characteristics (natural communities and beach user profiles have not been properly studied), (2) Beach use control and monitoring, and (3) The administrative process (the roles of local managers and stakeholders have not been properly defined). The opportunities detected are related to the development of new institutions and tools (ICZM strategies, local Agenda 21, Environmental Management Systems for Beaches [EMSs], and Beach Quality Index) that may promote a more inclusive and proactive management. On the other hand, devised threats include: (1) Ineffectiveness of the present institutions, strategies, and programs in place, (2) Lack of financial resources and proper

participative processes, and (3) Management continues to be done in sectors instead of in a more integrated way. Although possibilities for fundamental change exist, there is a risk that available research is not fully exploited.

*Beach Management Tools.* A second partial project focused on beach management tools. Four of them, likely to be applied to the study area, were studied. The Blue Flag award is a descriptive, environmentally based beach quality tool. The primary objective of the ACA (Catalan Water Agency) is to give explicit information on compliance with regulatory water quality requirements. The CEDEX and Cantabria Indices were developed to help managers rate their beaches. In addition to the aforementioned four tools, the characteristics and potential of EMSBs (implemented in Spain since 2000) were studied. EMSBs are flexible tools based on commitment to an environmental policy, commitment to the compliance with legal and other regulations, and continuous improvement. The tools were compared to see what each one measures and were applied to six representative beaches of the study area. Fourteen quality criteria were selected for this study: (1) Natural systems; (2) Geomorphology; (3) Water; (4) Sand; (5) Comfort; (6) Aesthetics; (7) Access; (8) Services; (9) Activities; (10) Usage, (11) Fulfillment of legal requirements; (12) Management coordination; (13) Continuous improvement; and (14) Emergency planning. Each of the four tools was analyzed according to these criteria. The results show that no single tool takes into consideration all 14 criteria and several criteria were not included in any of them. Of the 14 criteria, only two (water quality and access) were identified in each of the tools. Blue Flag considered eight criteria, the CEDEX Index seven, Cantabria five, and ACA four. The criterion of Natural Function was not thoroughly considered in any of the tools and most of the criteria were associated with recreational aspects of beaches. The primary conclusion of this study is that the assessed tools fail to address important beach quality criteria and that the performance of the four studied tools is usually limited to the achievement of certain predefined goals, but not to the commitment to improving these goals and to setting them higher once they have been achieved. In that sense, the use of EMSBs may help to overcome the limits of the traditional used tools. The combination of EMSBs and specific indicators may help improve beach management in the region of study.

*Local Beach Management.* The third partial project covered the study of local beach management. The analysis included a detailed survey of local managers from 38 coastal municipalities on the northernmost 430 km Catalan coast (140 beaches). Information was collected about sediment management, beach use, and organizational issues (mainly emergency management and financial investment). The physical characteristics of beaches were obtained from a beach database developed by the Spanish Ministry of the Environment, and from a GIS database of the area developed by the research group. Socioeconomic data for the municipalities were obtained from official statistics supplied by the Catalan Autonomous Government. The results showed that beach erosion is a major problem and of concern for many municipalities, and is often associated with construction work performed in the surrounding areas. A large number of managers also reported the impact of coastal storms (damage to infrastructures, and the effects of water and sediment produced by flooding). Although municipalities are most affected by erosion problems, actions to solve or counteract them are designed and executed at different administrative levels (General Directorate of Coasts-Ministry of Environment). There is a time lag between the appearance of the problem and the execution of the solution. Of all municipalities experiencing erosion, nearly 50% reported sand nourishment and/or sediment redistribution. Overcrowding

of beaches is also a problem in some municipalities, although it is not a very important concern for managers. Most municipalities have two or three departments in charge of beaches and average annual investment of municipalities in beach maintenance and conservation is 133,113 Euros (not including sand management operations). Municipalities' investment depends more on local socioeconomic factors than on beach characteristics. Beach closures are also another important problem. They are mainly caused by failure of sewer systems or events of heavy rain. The study revealed that the priorities of managers are the quality of sand, water, and service. Beach cleaning and sediment management are also important concerns. Natural resources, on the other hand, are not a priority: only 45.2% of beaches have sensitive natural resources legally protected, and of them, only 43% of the municipalities express interest in natural community preservation.

*Waste and Litter Processes and Beach Use.* The fourth and fifth partial projects studied waste and litter processes and beach use. The reasons were: (1) the first phase of the research demonstrated that beach use and waste/litter generation have a strong impact on many aspects of beach quality and (2) these processes and uses are also subject to temporal and spatial variability as a consequence of various factors.

Beach waste/litter was analyzed at four beaches with the goal to understand the seasonal evolution of waste and litter on beaches during the bathing season in the study area (Ariza, Jiménez, and Sardá 2008b). The quantity, composition, and characteristics of beach waste as well as the aesthetic quality (presence of visual pollution elements in sand and water, i.e., oil, foam, tar, plastics) were studied at urban and urbanized beaches. A third part of this partial study analyzed the evolution of the appearance of small-sized litter (cigarette butts and other small-sized elements) at one beach: Lloret Centre. Litter was sampled in three different periods of the bathing season (beginning, middle, and end). The results showed that the total production of waste and waste deposition density were greater on the urban beaches than on rural beaches. Waste composition varied over time and location. The highest proportion of plastics, wrapping, and beverage containers was found at the peak of the season and at urban beaches. The visual quality of water was similar on urban and rural beaches, but the visual quality of sand was higher on urbanized beaches than on urban beaches. The study also showed that small-sized litter tended to accumulate as the season progressed due to the low efficiency of mechanical cleaning. Another important problem detected was the loss of sand in the cleaning process.

In addition to the aforementioned research, beach use was studied at nine beaches during the summer season of 2000 by means of photographs taken weekly from specific beach sites, at one-hour intervals between 9:00 am and 8:00 pm (Sardá et al. 2009). The main goal of the partial study was to analyze the use of frequently visited Mediterranean beaches in the light of increases in tourism and possible overcrowding problems. The results were compared with the ones obtained by Alemany in the same region in 1982 (Alemany 1984). The study analyzed beach surface availability per user of selected beaches with different degrees of urban development and facilities, the time spent on the beach by users, and the total number of daily beach users in some of the studied beaches. The results showed that the frequentation of beaches was subjected to pronounced daily fluctuations and that beach use was highest in most beaches at the peak of the tourist season (on the beach of Lloret Centre, the peak daily total number of users was 22,036 in the first week of August). In many beaches (especially the urban ones), overcrowding of beaches was already occurring in 1982. Although the resident population and the number of second homes for families increased sharply during the study period, the number of beach users apparently



did not. It may happen that users have restructured their behavior and now substitute some of the time previously spent on beaches for other leisure activities, such as spending time at swimming pools of hotels and apartments/houses.

*Beach Quality Index Development.* The last partial project was the development of the Beach Quality Index (BQI). The BQI was created using the results and conclusions of the other partial projects. The research constituted a good example of interdisciplinary research in coastal areas. During the research, the values, methods, and models of the different academic disciplines (Lélé and Norgaard 2005) were explained and discussed. The debate allowed the creation of hybrid values, methods, and models adapted to and being more sensitive to beach socioecological processes of the study site (Boada and Sauri 2002). The input of users, managers, other stakeholders, and experts was used in the selection and development of the components and partial indices. The primary aim of the project was to develop a new tool that could be used within EMSBs as a guidance and control system with the final goal of guaranteeing beach quality. The new tool included function analysis. It was constituted by three components (i.e., Recreational Function Index, Natural Function Index, and Protective Function Index) and a set of thirteen sub-indices included in the three components: (1) Water microbiological quality, (2) Beach use, (3) Environmental quality, (4) Services and facilities, (5) Activities, (6) Access and parking, (7) Comfort, (8) Quality of surroundings, and (9) Beach safety. These criteria were included in the Recreational Function Index. Three were included in the Natural Function Index: (1) Natural conditions; (2) Water–sand pollution; and (3) Physical quality. Lastly, one criterion was included in the Protective Function Index: Protection. The inclusion of function analysis made it possible to identify and achieve specific goals. The index was applied to six urban and rural beaches of the study area (each type with its particular weighting). The opinion of experts was used for establishing weightings of the most technical sub-indices and the opinions of users were used for those indices that were based on subjective experience. Results of the application show that scores were low for the key sub-indices (although they were high for aggregate measurements). It showed the need to control beach use, and surrounding area transformation and to protect natural communities. Beach safety and protection should also be improved. The main strengths of studied beaches were in the areas of satisfying short-term user requirements (water quality, environmental quality, services and facilities, activities, comfort, and the absence of water/sand pollution). Weakness were associated with areas affected by strong pressure from human activity (beach crowding, protection of coastal facilities, quality of surrounding areas, and natural conditions).

*Integral Research Questions.* The results and conclusions of the partial studies developed in the project were used as the rationale to formulate and answer various integral/general research questions. The answers to those questions have been developed in this article. It was demonstrated that the present beach management framework does not favor the inclusion of beach management into an ICZM scheme (Ariza 2010). How could this situation be solved? One of the goals of this article was to determine how the shortcomings detected in the legal and administrative framework affect beach quality and local management. The study of local management practices and beach use and waste/litter processes (Sardá et al. 2009; Ariza, Jiménez, and Sardá 2008a) showed some recurrent problems (sediment management, beach closures, overcrowding). How can institutional changes and the new tools (EMSBs and the BQI) help overcome those shortcomings? Another important question to be answered is,

in which way can EMSBs and BQI effectively complement each other in improving beach management in the study region?

## Results

### *Beach Management Practices in the Studied Area*

Beach management in the studied area has been traditionally restricted to water, sand quality control, and beach use planning. A survey was conducted with beach managers to determine main management principles. Results demonstrated that beaches are being managed in accordance with the concept of service management (Ariza, Jiménez, and Sardá 2008a). The vision of managers was rarely integrated (i.e., goals have been narrowly defined, no concern for beach overcrowding or protection of natural communities, see Ariza, Jiménez, and Sardá 2008a). It was commonly found that a managerial concept was in place that considered beaches as static elements for which plans were established seasonally. It was found that, at most, management plans were active for six months of the year with little variation from year to year. These plans only covered the imminent summer season and excluded long-term programs and proactive planning.

Like other countries (James 2000b), Spain has not implemented a beach policy that enables coordinated inclusion of different beach management aspects in a common framework. There is no system for establishing proactive planning on the basis of the most important beach characteristics, which has consequences in the way beach management is developed in practice. The inclusion of sustainable beach management practices in new managerial models—such as ICZM—is difficult, given the available information.

Besides these limitations, new managerial approaches have appeared to guide principles of sustainability in managing the coast. A master plan for coastal sustainability (El Plan Director para el Desarrollo Sostenible de la Costa, or PDSC 2005), which was created to apply ICZM principles to the Spanish coast, has established new indicators to monitor some traditionally neglected beach processes. In regard to the studied area, the development of an integrated coastal management strategy for Catalunya (Pla Estratègic per a la Gestió Integrada de les Zones Costaneres) may be a beneficial tool for improving management practices. Under this strategy, main problems of the Catalan coast have been defined and an inclusive analysis considering many important agents developed. The weak points detected (i.e., erosion, marine pollution, landscape degradation, urban systems sustainability) can be included in programs and measures to overcome them applied.

It is thought that the lack of information on processes that take place in beach environments may, at least, be partially palliated in the near future. Some of the existing limitations resulting from the absence of a beach policy have been overcome in the last decade by the requisites of coastal legislation (the Shores Act 22/88) and the wide use of performance standards, such as the Blue Flag award. In the case of the Shores Act (22/88), it provided legal protection for the public ownership of natural areas and acknowledged natural processes that go further inland than the intertidal area (Ariza 2011). The use of the Blue Flag award has forced local managers to protect natural vulnerable habitats, guarantee legal compliance, develop emergency plans, monitor water quality, ensure beach cleaning and guarantee good access, service quality, and control annoying activities (Ariza, Jiménez, and Sardá 2008a).

Without these, information on beaches would be more limited; moreover, they have triggered improvements in Spanish beach management in recent years. However, further action is required.

### ***EMSBS: Needs, Characteristics, and Adaptation to North-Western Mediterranean Beaches***

Currently, characteristics of beach management tools available are such as not to guarantee effective direction (Micallef and Williams 2004). In order to properly adapt an ecosystem management philosophy to beach management, a further step is being taken, namely, the implementation of EMSBs. The use of EMSBs may ensure the permanent and proactive management provided by the Ley de Costas 22/88 (Yepes 2002), and may make it easier to manage a single, complex socioecological system. Its application may be overcome by the typical division into natural and human ecosystems (Redman, Grove, and Kuby 2004). This management approach, however, needs to be supported by applied researchers working on beaches (Underwood 1995), by the constant establishment of new management goals, and by local managers assuming the principle of subsidiary and thereby assuming the responsibility for planning and decision-making at the lowest practical level in the governance hierarchy (Olsen 2001).

In spite of the fact that natural beaches are not within the scope of this research, EMSBs are considered to be valid in the use of urbanized and pristine beaches and may serve to integrate all available information to a single conceptual framework. Its main utility is that it is capable of integrating specific defined functions and of assigning resources and responsibilities that allow for temporal proactive planning for individual beaches. Guidelines established for beach management, such as local management directives, conservation programs, and the development of design and valuation tools (Micallef and Williams 2002; Simm et al. 1995), are in perfect accordance with the EMSBs. It is recommended the establishment of weighted function indicators based on knowledge of processes occurring on beaches. In order to obtain the necessary information, different dimensions of beach management need to be considered (Micallef and Williams 2002), and the definition of consumption patterns, resource exploitation, and waste production should be assessed.

The use of EMSBs could solve some of the problems detected in beach management at the local level (Ariza et al. 2008), as follows:

1. Organizational change is necessary in order to coordinate the interventions by different authorities and to adequately respond to local sediment problems.
2. Proactive planning would enable the development of more definitive solutions to storm problems and avoid repeated investment in repairing infrastructures damaged by wave energy year after year.
3. Coordinated action between local managers and central government is needed to avoid chronic overcrowding of beaches (by developing plans to limit beach use, for example).
4. Proactive planning is necessary to prevent beach closures and to develop emergency plans that minimize the impact of emergencies whenever they occur.

The study of local beach management structures reveals that most local councils do not have a specific beach management body. Beach management is typically included in departments in charge of environmental issues (23.2%), municipal services (16.2%), urban planning (8.1%), tourism and governance (6%), or public works (4%). The implementation

of EMSBs may help to establish necessary municipal beach management structures and avoid a dispersion of responsibilities among different municipal authority areas.

An important advantage of devising a more formal and permanent planning approach is the implementation of managerial goals. Once the first priorities have been achieved, others can be considered and monitored. This would allow diversification of management actions and the introduction of a continuous improvement principle. Our study of local beach management needs revealed that the efforts of managers were focused on a few objectives, that mostly consisted of water, sand, service quality, beach cleaning, and the lack of sand (Ariza, Jiménez, and Sardá 2008a). This vision is not compatible with the vision of a beach environment, in which the integration of natural, sociocultural, and managerial systems require managers to work in different areas concurrently (James 2000a).

As noted earlier, the EMSBs need to include indicators that monitor continuous improvements in all beach processes (e.g., physical, social, and biological). This would ensure environmental performance, defined as a weak point in ISO 14001 (an internationally recognized quality standard; see Ariza et al. 2008) when no specific indicators are used (Elefsisiotis and Wareham 2005). Most of the analyzed beach performance standards and assessment measurements do not cover all aspects relevant to Mediterranean beaches. Consequently, although they can be used to monitor partial aspects, other indices need to be added within the framework of the EMSBs. For this reason, the BQI was created, which includes new partial indices in its structure (e.g., beach use, transformation of surrounding areas, waste composition, protection of human infrastructures; Ariza et al. 2010). It also quantifies aspects that are treated qualitatively in other management tools (e.g., services and facilities, or beach safety). The inclusion of new partial indices has many potential benefits. Landscape assessment is especially necessary, due to construction dynamics in the area of study and the importance assigned to landscape by users. Before the development of the BQI, this feature had only been considered in a few beach management tools (Morgan 1999; Micallef and Williams 2004). In the case of beach use, despite the fact that municipalities have not established monitoring measures, local managers consider that beach use control may be profitable for planning and management purposes (Ariza, Jiménez, and Sardá 2008a). The study of beach use is essential for assessing and understanding the quality of other beach processes. In the studied area, beaches were found to be highly used, which explains, at least in part, the problems of waste and litter management previously described. Beach use is not constant during the bathing season, so cleaning services (i.e., segregated waste collection, educational campaigns, and the withdrawal of small-size litter) should be adapted to its temporal variability.

A central focus of this research is the inclusion in beach management of function analysis (with the three BQI components: Recreational Function Index, Natural Function Index, and Protective Function Index), which had been seldom considered (Micallef and Williams 2003). This new approach enables different management practices to be implemented according to beach characteristics and seasons. Taking into account the regional climate of the study area, Valdemoro and Jiménez (2006) proposed a cyclic change in beach managers' target. Thus during the winter and spring, beach managers should search for beach optimum, based on the protective function perspective, since it is the period in which incident wave energy is the highest. On the other hand, during the summer months there should be a stronger focus in the recreational function, since the number of beach users drastically increases and storms are unlikely to affect the beach. Therefore, beach management must be applied accordingly throughout the whole year and not just during the bathing period, as has traditionally been the case in the area. The definition of management priorities is very important in assuring the high integral quality of beaches. Results

obtained in the application of the BQI sub-indices to the area reflect the importance assigned by managers to different aspects of beach ecosystems in recent decades (Ariza, Jiménez, and Sardá 2008a). In this study, new priorities have been defined for urban and urbanized beaches. They take into account user and expert opinions as well as an in-depth look at other studies conducted. These priorities are defined in the selection of sub-indices, and the definition of weights for the function components (Ariza et al. 2010).

Monitoring carried out with the BQI sub-indices may assist to accurately characterize particular beaches and define needed investment and resources. The partial indices may also assist to better define the economic value provided by beach ecosystem services. It has been found that economic investment by local managers is not linked to resident populations or to beach surface, but to tourism (Ariza, Jiménez, and Sardá 2008a). Although Ariza, Jiménez, and Sardá (2008a) provided some data on municipal investments on beaches in the study area, more detailed data is required, including a better description of investments, revenues, and services provided by beach environments. It would enable the development of economic analyses and the verification of a clear financial return. This data is still not included as an indicator of adequate management, although it has been recommended (Micallef and Williams 2002). Economic beach analyses are very important if solid and balanced management guidelines are to be established for the Mediterranean coast. They should, moreover, include an analysis of the multiplicative effect produced in coastal municipality economies.

The thirteen sub-indices can be used at different stages of the EMSBs (Renau and Planas 2004; Ariza et al. 2008). Environmental Diagnosis may be based on the results obtained for the different sub-indices. Environmental policy may be formulated on the basis of an Environmental Diagnosis and expert and user opinions of beach quality priorities. The joint use of the BQI and EMSBs may serve to advance the proactive requirements of beach management, as well as the inclusion of the much-needed functional analysis in the management of coastal environments. The establishment of environmentally significant aspects and of an environmental program may be based on sub-index scores. Although not directly reflected in these scores, other goals may be included in the program, such as improving litter assessment methods, parking facilities, and or bathing facilities for handicapped people. Accessibility to urbanized beaches managed by neighborhood communities (which establish parking fees for external beach users) should also be considered, as well as the requirements established in the bathing water quality directive 2006/7/CE and the water framework directive 2000/60/CE (Ariza et al. 2010). In monitoring, measurement, and operational control, the set of established partial indices may also be a very useful tool. EMSBs may also enable procedures for technical operations to be formulated, and those for beach management for the study site could consider beach use regulations and waste and litter management.

### ***Beaches and Beach Management in the Selva Marítima***

The application of the partial indices of the BQI indicate that human pressure in the region is the main factor responsible for the low quality of the surrounding areas and the natural beach communities (Ariza et al. 2010). Future efforts should be directed at improving the control of beach uses as well as maintaining the natural and landscape beaches communities. In this sense, the Master Plan of Land Use Planning of the Coastal System (El Pla Director Urbanístic del Sistema Costaner, or PDUSC) is aimed at protecting areas that still have not been urbanized (Departament de Política Territorial i Obres Públiques, 2005). This plan will play a key role in directly protecting the areas surrounding non-urbanized beaches.

Indirectly it will help to limit beach use and improve the quality of the natural communities. Its requirements should also be accounted for in the EMSBs.

In the research conducted, some natural beach communities (e.g., submerged, intertidal, or dry sand) were not specifically studied, but some known aspects of the area were taken into account in the study. For example, the dry sand community is very scarce when compared to other Mediterranean beaches (Colombini et al. 2003). This is probably because human pressure has not allowed the natural sand communities to develop accordingly. Of the studied beaches, Malgrat Nord is the beach with the highest number of littoral vegetation species (5). However, this number is low, bearing in mind that up to 30 species have been found on some beaches on the Catalan coast. In spite of the fact that the number of natural beaches has been reduced as a consequence of the massive urbanization of Catalan coastal areas since the 1950s (Martí 2005), our analysis reveals that the number of urbanized and natural beaches is still important (Ariza, Jiménez, and Sardá 2008a).

Taking into account the significant number of beaches with non-urban characteristics, as well as the fact that important differences exist in the environments of urban, urbanized and natural beaches (e.g., use profile, waste and litter characteristics), it seems reasonable to establish alternative management practices for different types of beaches. Currently, no specific management measures are applied. Practices are based on the degree of urbanization in the vicinity, but the principles of management are generally similar with few exceptions. Future research should concentrate on the ecology of beaches, so that more information becomes available for monitoring processes of natural beaches. The ecology of many Mediterranean beaches is not fully understood, and none of the analyzed awards/rating systems have defined indicators for beaches with important natural communities. Consequently, the impact of human activity on beach communities remains largely unknown. Local characteristics, in spite of being considered important for beach management (Micallef and Williams 2002), have not been explicitly included in these systems. In the case of the physical state of beaches, its inclusion (in some cases) is related to comfort, not to other important processes, such as protection of the coast and/or the inherent physical condition of beaches.

Although beach users, in general, prefer fine-grained sand and gentle slopes, they tend to adapt to the reflective beach profile of the analyzed beaches (e.g., coarse-grained sand and steeper slopes). The wave regime, as in all Mediterranean regions, is not as intense as the open ocean beaches, although there are currents that pose risks to bathers and consequently cause sediment problems during storm events (e.g., when sand is reallocated inside beaches or removed by waves). Human population is very high on the coast and in the whole region. The overcrowding of beaches is not a recent phenomenon in the southern Costa Brava. Some beaches have experienced overcrowding for many years, since long before the increase in resident population numbers and the second-home explosion (Sardá et al. 2009). Users and managers are quite adapted, according to information collected in the questionnaires (Ariza 2007). Reducing beach use is not a priority for them, in spite of the detected problems and that local managers consider that controlling and monitoring beach use is useful.

The fact that the aggregated BQI scores were high for all the studied beaches (Ariza et al. 2010) should not be confused with beach quality standards in the area. Most beaches scored low in key partial indices (e.g., beach crowding, surrounding quality, beach safety, and natural condition), and for S'Abanell beach, the protection partial index was also low. These scores indicate that important beach processes are not functioning properly. Sustainable management of beaches must be reflected in an established minimum value for all partial indices. The best-managed areas are those traditionally most in demand by users,

and the areas with most problems are those that require some limitations to be imposed on the expansion of human use. The exceptions are physical quality, safety, and protection of infrastructures. The physical quality scores for beaches were high for the six beaches in the study because no sand management practices (nourishment) or engineering work had been carried out in response to tourist requirements (the central government has the main authority in this area). In the case of beach safety scores, the lack of clear regulation on resources and beach safety practices in Spain has meant that municipalities can establish beach safety and rescue services based on their own criteria. Very demanding standards have been established, for example, in Barcelona's beaches, due to intense use. Malgrat de Mar and other municipalities within the Catalan Coast do not provide their beaches with the same level of resources. Protection of the coast is the other exception. In the study area, damage occurred repeatedly to promenades and facilities located in the back of the beach (Jiménez, Valdemoro, and Sánchez-Arcilla 2002; Ariza, Jiménez, and Sardá 2008a). The lack of local management capacity for applying corrective management measures in the DPMT (beach Public Domain), and the lack of coordination between central and municipal authorities in terms of beach management issues, means that the establishment of definitive corrective measures for beaches where human facilities are not properly protected by sand is complex (and so uncommon). A sediment management policy is needed that will allow planned proactive management in conflictive areas.

### **Implications for Beach Management in the Catalan Coast**

The research conducted, including the application of the BQI, components, and sub-indices to beaches, is the first attempt to evaluate the integral quality of beaches along the Catalan coast. According to the criteria included in the BQI, two of the most important potential threats for beach management frameworks deal with urbanization and severe pollution episodes (Ariza 2007). Although the effects of these threats have been demonstrated, the impacts are likely greater. Indirect effects were not estimated since they could not be properly quantified, but they certainly exist and are likely to diminish quality. Therefore, prevention must also be a priority of management. Measures should be defined as soon as possible and they should be based on the coordinated action of different agents and stakeholders with coastal-related responsibilities (not just local managers). Integration of proactive beach management into the ICZM strategy is also necessary in order to protect beaches from these two potential dangers.

In order to develop a strategy for coastal areas where beaches could be proactively managed within a coastal management framework in Spain, a change in the perspective of beaches is needed. The Shores Act 22/88 enabled a substantial improvement in the quality of beach processes. One of the most important contributions was that it accounted for the conservation of natural heritages and the legal coverage of public ownership of natural areas, acknowledged natural processes that go further than the intertidal area, established restrictions on the protection area, and guaranteed the conservation of the public area. It did not trigger, though, the implementation of beach ecosystem management. Therefore, other management tools are necessary in order to integrate the highly complicated body of regulations concerning beach management issues in Spain. They should include a set of indices that monitor beach processes and local characteristics, a concrete protocol for coordination among departments, ministries and different authorities, stakeholders and civil society, and a beach environmental program with objectives, responsibilities, time schedules, and resources. In this regard, the BQI/EMSBs may allow a very precise and

complete monitoring of beach factors and application of ecosystem management practices in the North-Western Mediterranean.

In Spain, there has been traditionally a lack of appropriate political, legal, administrative tools and institutions that impede for beaches to be managed collectively, with common goals and proactive planning. As a consequence of the shortcomings in the legal and administrative framework, there has not been adequate information available that addresses beach processes. Consequently, this has made it difficult to develop integrated beach management practices. The need to assure coordination among different managers and improving knowledge of local processes has been remarked.

The analysis of beach quality tools has been of importance to interdisciplinarity. If these tools are properly designed, they may be very useful. However, it has been shown that tools traditionally available for managing beaches need to be improved in order to guarantee integral, proactive, and proper monitoring of beaches in the North-Western Mediterranean Coast. Consequently, a new BQI has been created. The process for its development has been very interdisciplinary, as academics from the natural and social sciences have shared their knowledge during the past three years. The BQI is especially adequate to be used with the EMSBs and offers the possibility of implementing a function analysis. If BQI and EMSBs are adopted by different organizations in the North-Western Mediterranean Coast, they may help to solve problems that include organization, proactive management, pollution, and coordination.

The development and implementation of the BQI during the study of beaches provided the opportunity to identify the strong and weak points. The analysis of current beach management processes in the area of study yielded the conclusion that it is basically service-oriented. The recreational function is the main beach function considered by managers and the main concerns of beach managers were quality-related aspects (e.g., water, sand, and services), cleaning, and sediment management. The loss of the protective function of many beaches has determined that beach erosion and sediment management are major concerns in the region. Although reactive measures are applied periodically, no global solution has been defined for improving coordination between authorities and reducing the time lag in responding to problems. Other detected problems are the frequency of beach closures and beach "overuse." The apparent generalization of these problems should indicate that current beach management strategies need to be modified and proactive measures implemented.

The strongest aspects of beach management were generally related to user short-term demand: water quality, environmental (aesthetic) quality, services and facilities, activities, comfort, and the absence of water-sand pollution. The weakest aspects were related to the consequences of human "over-use" of the area: beach use, quality of the environment and natural resources, and the protection of infrastructures.

The steps in beach integrated research need to be directed to the valuation of the natural, social, and cultural resources of beaches. The economy of North-Western Mediterranean beaches needs to be studied more precisely, as well as natural communities of beaches and institutions in charge of managing socioecological resources. Some steps have already been taken for studying and managing the North-Western Mediterranean beaches in a more integrated way. However, more work is required to overcome the shortcomings detected in the research conducted.

Presently, there is an important gap between the practices and measures proposed in this article and the ones in use. The use of indexes for monitoring the different processes has not been established yet and measures to improve coordination among stakeholders have not been debated and implemented. The use of EMSBs is becoming more common in the area, although the effectiveness of the implementation remains untested. The change



toward an ecosystem management approach is a social challenge and involves not only local managers and formal stakeholders, but also the civil society. In this sense, there is no a proactive attitude among the coastal community. The main concerns of people in charge still are short-term goals very narrowly defined: avoiding erosion and attracting as many tourists as possible.

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