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ScienceDirect
Ocean & Coastal Management 51 (2008) 141–160
Ocean & Coastal Management
www.elsevier.com/locate/ocecoaman

A critical assessment of beach management on the Catalan coast

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Available online 14 March 2007

Abstract

The present status of beach management carried out by the lowest level of administration (municipalities) along the Catalan coast (NE Spanish Mediterranean) was analysed to detect the main problems and priorities. This analysis was undertaken by analysing answers to a questionnaire provided by personnel involved in beach management in 38 municipalities covering a coastline of 430 km. As tourism is the main economic activity in the area, current beach management is recreationally oriented. The beach is considered a product/service on offer to users and visitors. The main concern of managers was the appearance of sediment-management related problems. Although municipalities are the main "receivers" of erosion-induced problems, actions to solve or counteract such problems are decided, designed and executed at a different administrative level. This reflects the complex administrative scheme governing the coastal area in Spain, where three different administrations have different jurisdictional powers over a narrow piece of land.

1. Introduction

Traditionally, recreation and coastal protection have been the main goals in beach management [1]. Consequently, research topics have been related to the social and engineering sciences [2]. However, in recent decades, a new approach has been adopted, in which beaches are considered a multidimensional system where natural, socioeconomic

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doi:10.1016/j.ocecoaman.2007.02.009

and administrative components interact. Therefore, integral system functions should be considered for properly managing beaches [3], i.e. an ecosystem management approach should be used [3,4].

Despite this integral approach, the most common situation in developed countries is that beaches are considered to be natural environments whose main function is to provide space for leisure. Accordingly, they are managed to optimize this user-oriented function, without taking other values or characteristics into consideration. Thus, the management strategy is basically dedicated to addressing aspects that affect the service to be provided (cleanness, comfort, aesthetics) and to fulfilling beach user expectations. As a consequence, beach management is largely standardized and poorly adapted to local environmental factors. The main managerial variations depend on the number of services offered.

The other item that is usually considered is the protective function of beaches, which is mainly addressed reactively, i.e. when the beach is not fulfilling this function properly and there are adverse effects on the hinterland. The overall result is that beach management strategies are mainly designed to cover aspects of both of these topics [5,6].

If beaches were considered as coastal environmental units (without any restrictions), their management would have to be integrated into a broader framework, such as Integrated Coastal Zone Management (ICZM). One of the most recent recommendations for ICZM is to follow the ecosystem management approach. This approach would have to be adapted to beach management. The proper implementation of ecosystem management should accomplish 10 defined principles [7], including: data collection, monitoring, adaptive management, interagency cooperation, organizational change, humans embedded in nature, and the establishment of values. To successfully adapt this approach, the support of applied researchers working on beaches is needed [8]. In addition, the assumption of the principle of subsidiarity by local managers is required, which implies taking responsibility for planning and decision making at the lowest practical level in the governance hierarchy [9].

Coastal areas in major tourist destinations are subjected to additional pressure, as leisure becomes economy. Therefore, as long as the tourism industry requires beaches to support its activity, beach management will be strictly orientated to accommodating this use. In this regard, Spain is a paradigmatic case, as it is one of the world's major tourist destinations within this sector. Tourism accounted for 11.4% of Spanish GDP in 2003. Moreover, much of the tourism industry in Spain is based on the *sun* and *sand* model (see e.g. [10]). Consequently, beaches are considered to be one of the country's major assets.

From an administrative standpoint, the main framework for regulations in the Spanish coastal zone is the 22/1988 Shores Act. This and other regional/local laws that regulate some aspects of beach management such as beach use plans, safety issues and recreational activities and services, constitute the core of existing regulatory legislation on beach systems. Although most mandatory obligations are still centralized at the national level (through the management of the coastal public domain), or at the regional administration level (by managing land use planning), the local administration—municipalities—plays an important role in beach management. Although municipalities have limited authority over management, they experience most of the benefits and problems related to the presence of beaches. As a result, daily beach management practices undertaken by the local administration can be used to identify common problems and concerns that managers must face.

Within this context, the aim of this paper is to identify the main aspects of beach management that local managers have to deal with. The analysis includes a detailed survey of the local managers from 38 coastal municipalities on the north eastern Mediterranean coast of Spain. In this survey, managers ranked usual beach problems according to their impact on management. They also evaluated current beach management processes. Although the paper uses the Catalan beaches of north eastern Spain to illustrate beach management issues, results can be extrapolated to most of the Mediterranean coast or to similar beaches where tourism is the main activity on the coast.

2. Methodology

The main data used in this work consisted of answers to a questionnaire provided by personnel involved in (or responsible for) beach management processes in 38 local administrations (municipalities) along the Catalan coast. The study area extends along the northernmost 430 km of the Catalan coast (Fig. 1), where there are 210 beaches. One hundred and forty of these beaches were included in the study. The remaining beaches are small pocket beaches that are hardly used and on which practically no management processes have been implemented. Thus, all the data percentages presented in the results section were obtained with respect to a total of 140 beaches.

The questionnaire included three main blocks of subjects, covering the most common aspects of local beach management: sediment management, beach use and organizational

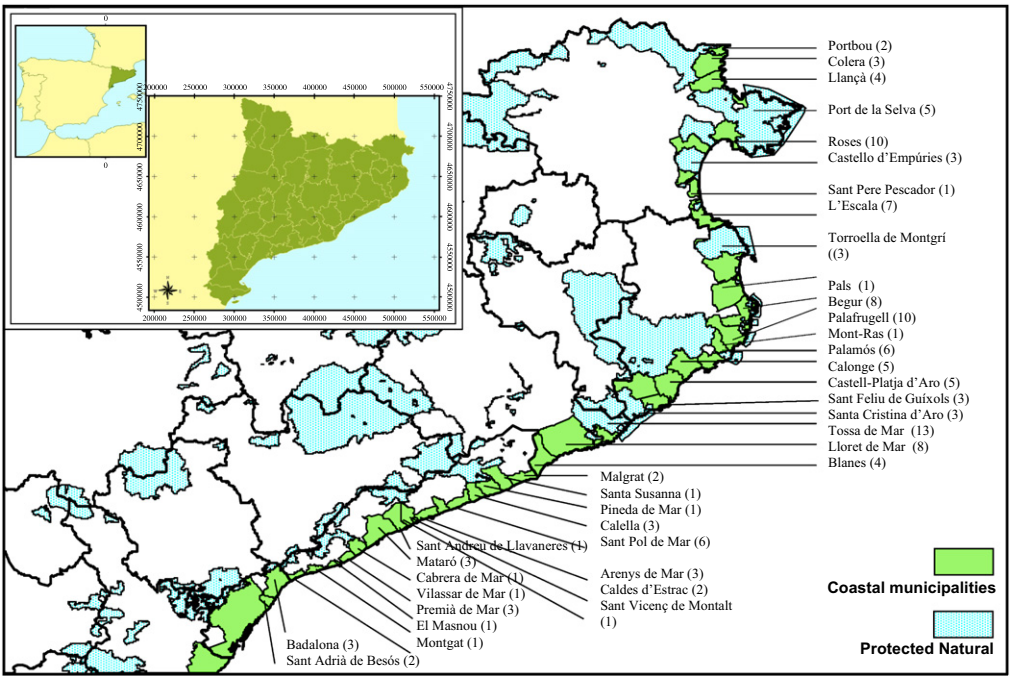

Fig. 1. Map of the studied zone showing "comarcas" (BAR, Barcelonès; MAR, Maresme; SEL, La Selva; BEM, Baix Empordà; and AEM, Alt Empordà) and municipalities. Between parenthesis the number of beaches of each municipality.

issues. These aspects were selected by taking into account the most significant problems that local managers have to face in beaches on the Mediterranean coast [11–17]. The block related to sediment management was specifically included because this is now one of the factors that most affects beach management, due to the frequency and magnitude of erosion along European coasts [16]. The block on beach use was introduced because coastal tourism is the main economic sector in the study area and many of the beaches studied are intensively used. The number of users determines the services (number and type) provided and significantly affects the perception of the beach users [11,13]. Finally, the block concerning organizational aspects was analysed to detect the existence of a beach management system and to assess the degree of implementation of beach management processes. This block also included emergency management and financial investment issues. All the aspects dealt with in the questionnaire were selected by taking local characteristics into account. However, they are general enough to be applied or adapted to other areas.

The physical characteristics of the analysed beaches were obtained from a beach database set up by the Spanish Ministry of the Environment (http://www.mma.escostas/guia_playas) and from our own GIS database of the area [17]. A collection of colour orthophotos at a 1:5000 scale, supplied by the Institut Cartogràfic de Catalunya (Cartography Institute of Catalonia), was used to characterize the hinterland of all the analysed beaches. Socioeconomic data for the municipalities were obtained from official statistics supplied by the autonomous government of Catalonia (www.idescat.net).

Chi-square and non-parametric correlation (Kendall's Tau coefficient) tests were applied to collected data to determine significant similarities and differences between structural (sediment management), socioeconomic and management variables. Statistics were performed by means of the SPSS 12.0 software package. To classify beaches into the selected types, land-use properties of the hinterland along a 500 m wide stretch were analysed by means of non-metric multidimensional scaling (MDS) and cluster analysis using the Primer 5 software package.

3. Administrative, legal and regional analysis

3.1. Regional analysis

The surveyed municipalities are included in five supramunicipal administrations or *comarcas* (equivalent to counties) with different coastal characteristics and uses: Barcelonès (BAR), Maresme (MAR), La Selva (SEL), Baix Empordà (BEM), and Alt Empordà (AEM) (Fig. 1). The latter three areas are located in the north and they comprise a very well known tourist destination in Europe known as the Costa Brava. The main environmental and socioeconomic indicators for these five *comarcas* are presented in Table 1.

The BAR area includes two industrial and residential municipalities just north of Barcelona. The city of Barcelona was excluded from the analysis because it is a highly developed environment and the structure of its coastal area is completely different to the rest of the municipalities. Therefore, there is no point in comparing them. The MAR area is characterized by the presence of what were originally uninterrupted long sandy beaches. Nowadays, there are five recreational marinas and other coastal structures in this area,

Table 1
Socio-environmental report of indicators for the different "comarcas" analysed in the study area; AEM—Alt Empordà, BEM—Baix Empordà, SEL—La Selva, MAR—Maresme, and BAR—Barcelonès (except for the city of Barcelona)

Indicators	Units	AEM	BEM	SEL	MAR	BAR
Total surface	ha	250.2	303.3	103.9	124.3	26.1
Length of coast	km	189.9	131.2	38.6	63.8	6.2
Length of beach areas	m	27,968	20,321	9960	33,467	3230
Number of beaches	Number	62	71	29	44	4
Resident population	Number	34,444	82,912	55,298	275,814	241,433
Population density	Number*ha^{-1}	137.7	273.4	532.2	2218.9	9250.3
Income "per capita"	Euros	12,001	12,201	11,801	11,401	9039
Unemployment rate	% over active population	9.1	10.0	12.2	11.4	14.0
Accommodation coefficient	Hotel beds per 100 inhabitants	43.6	18.3	81.8	12.4	0.1
Motorization coefficient	Vehicles per 1000 inhabitants	891.9	836.9	707.0	616.1	535.3
Construction coefficient	Built houses per 100 inhabitants during last 5 years	7.4	6.9	7.0	4.6	1.9
Impervious soil	Percentage over total soil	8.7	12.1	20.2	27.2	57.6
Protected area	Percentage over total soil	51.0	27.1	26.8	1.8	13.8
Coastal artificialization	Percentage over total length	40.2	57.1	58.9	96.2	100.0

All data are given for the year 2001 except for the accommodation coefficient (2000) and the impervious soil and the coastal artificialization (1997). Data are pooled from different official sources and managed under the environmental information system described in Sardá et al. [17].

which have altered the original sediment transport pattern and induced significant erosion problems.

The Costa Brava (SEL, BEM, and AEM) has a different geomorphology. It is a highly indented coast. Most of the coastline is composed of cliffs, especially in the northernmost area. Bayed and pocket beaches are the dominant beach type. Most of these are composed of coarse- and medium-grained sand. The area's original natural landscape comprises pine forests that reach the coastline.

In terms of beach use, the bathing season in the area extends from the end of May until the end of September. The period that is most intensively used is July and August [18].

To classify beaches in the area, main land uses on the coastal hinterland were analysed. To do this, a 500 m wide strip along the coast was analysed using a GIS database. Beaches were grouped into three general categories: urban, urbanized and natural beaches. Urban beaches are considered to be those located within the main nucleus of the municipality, with at least 60% of urbanized hinterland (of high density). Urbanized beaches are those found in residential areas outside the main nucleus of the municipality, with a maximum of 50% of urbanized hinterland (of low density). Natural beaches are those outside the main nucleus of the municipality located close to very low density urbanized areas (up to a maximum of 30% of the hinterland being urbanized), or in uninhabited areas. Urban, urbanized and natural beaches accounted for 38.6%, 27% and 30% of the total, respectively (Table 2, Fig. 2).

Table 2
Type of analysed beaches and number of beaches reported to experience the selected feature

Type of beach	Number	Blue Flag	Overcrowded	Emergency situation	Nourishment	Sediment movement	Engineering
Urban	54	15	13	21	7	9	7
Urbanized	38	9	11	2	2	3	0
Natural	42	3	6	2	0	6	0
Diverse	6	0	0	0	0	0	0
Total	140	27	30	25	9	18	7

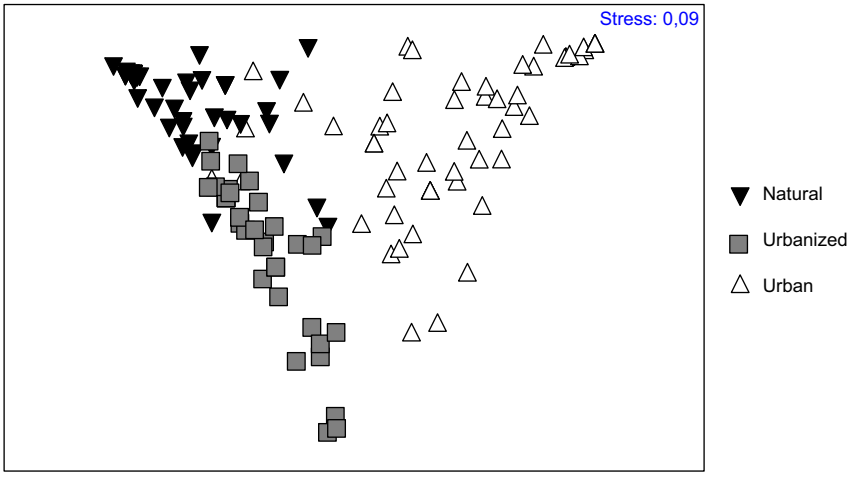

Fig. 2. MDS of beaches according to main land uses adjacent to beaches.

The study area contains four environmental homogeneous management units (EHMUs) defined for the Catalan Coast by [19]: highly natural areas (AEM), seminatural areas (SEL, BEM), semiurban areas (MAR) and high socioeconomic developed areas (BAR). In the former two EHMUs, natural values are dominant and they significantly contribute to the total value of the coastal zone. Thus, some of the beaches are located in natural protected areas or have a protected area in the hinterland (45 beaches with a total length of about 21 km).

Out of all the analysed beaches, around 70% are small pocket beaches (subaerial sand surface lower than 10,000 m^2), 13% are partially open and another 17% are completely open with areas larger than 30,000 m^2 (large bay beaches are also included in this group). Most of the beaches were highly exposed (45.3%) or exposed (23.8%) to dominant eastern wave action.

3.2. Administrative and legal analysis

The main legal responsibilities for beach and coastal management in Spain are regulated by the Shores Act 22/88. The Shores Act 22/88 is designed to protect of the coastline, ensure its proper public use, regulate the rational use of its resources, and to maintain good

water and shoreline quality [20]. This document establishes the legal requirements for managing the Maritime Terrestrial Public Domain (DPMT), which includes beaches and, to a lesser extent, the adjacent area.

The central, regional and local (municipal) governments manage or administer the Spanish coastal area. Each level of government has very different jurisdiction and they regulate activities in different parts of the coastal area.

The Shores Act 22/88 describes the central government's responsibilities for managing the DPMT. It is responsible for the definition, management and guardianship of the DPMT and its rights (the protection area, up to 100 m inland, and its catchment area, up to 500 m inland). It also carries out, supervises and controls studies and projects; it works to protect and conserve the elements of the DPMT; and in particular, it aims to create, nourish and recover beaches. It authorizes sewage discharges in the DPMT and it defines and applies regulations regarding discharges, human safety in bathing areas, and maritime rescue. It also reports on the activities or plans of other administrations when these could potentially affect the conservation of the DPMT.

The regional administration is responsible for land use, land planning and the management of the protection area. Its responsibilities also include the protection of natural communities in coastal areas and beach quality assessment and control (water quality, sand quality and access quality). It is also in charge of passing beach use plans presented by the municipal authority, once the central government has accepted them. In some cases, it can develop projects beyond its responsibilities in a concerted manner, e.g. promenade construction (sharing costs).

Finally, the local administration has the duty to report to the central government on projects in the DPMT. Its main responsibility is to run seasonal facilities and to keep beaches clean and free from waste. It is also in charge of reinforcing requirements established by the central administration for safety and rescue issues [20]. Municipalities draw up plans for beach use before the start of the high season. These plans program and locate the facilities and services to be provided on each beach. Municipal managers may decide about beach exploitation. However, some restrictions are laid down by the Shores Act, such as: facilities cannot occupy more than 50% of the total beach surface; facilities must leave a free area of 5 m in width along the shoreline and they must include safety and rescue services. Moreover, these plans regulate and define other common services such as garbage bins, showers, drinking water fonts, nautical activities, WCs, food and drink stands.

In spite of this, the Shores Act does not establish funding responsibilities nor does it guarantee integrated coastal and beach management. In fact, the present situation in some areas on the Spanish coast in general and the Mediterranean coast in particular, reflects the lack of such a policy over the last few decades [21–23]. At present, the Directorate General for Coasts of the Spanish Ministry of the Environment has promoted the development of a Master Plan for Coastal Sustainability. This will implement ICZM in Spain, according to the EU Recommendation on ICZM (413/2002/EC).

4. Results

4.1. Sediment management

According to the managers' answers, beach erosion and consequently a lack of sand is the major problem and concern identified in the region. Almost two-thirds (20

municipalities) of the managers reported long-term erosion on some of the beaches. This erosion was associated by 75% of managers with construction work performed in surrounding areas (Table 3). The practical consequences of this erosion are that beaches are narrow and the subaerial surface is not wide enough to fulfil usual beach functions, such as protection and/or recreation [12,16]. In addition, 87% of the municipalities also reported the presence of occasional problems associated with the impact of coastal storms. These problems include damage to infrastructures (e.g. promenades) and water and sediment floods during massive overwash events, when storm waves overtop promenades [24].

Although municipalities are the main "receivers" of erosion-induced problems, actions to solve or counteract them are designed and executed at different administrative levels. Thus, as mentioned before, the General Directorate for Coasts (the Ministry of the Environment) is responsible for protecting the Spanish coasts, including the design and execution of coastal protection works. As a consequence, in many cases there is a time lag between the identification of the problems, which is usually done at the lowest administrative level (local), and the execution of the measures, which is carried out at the highest level (state). Moreover, when the state evaluates the need to take action on a given beach, criteria other than the local ones can affect the final decision. This would not be the case if the local administration was in charge.

About 45% of the municipalities experiencing erosion problems reported sand nourishment operations on some of the beaches along their coast. In all cases, these operations were carried out on beaches experiencing long-term erosion processes. As the origin of these problems has not been solved, renourishment operations are required. In addition, 48% of affected municipalities also reported other operations such as sediment redistribution within beaches. This especially occurs in pocket beaches, where this action is needed after extreme shoreline reorientation, to homogenize the beach width.

One of the consequences of these sediment-related problems is that, in many cases, promenades become exposed to unexpected wave action. As a result, they may experience significant damage [25]. A practical consequence of this is that the promenades of some (many) beaches have been reinforced or rebuilt to improve their structural resistance to wave action during storms. These problems were mainly reported for urban beaches (Table 4), probably because their importance is measured as a function of the value of the affected resource or use, which will clearly be higher in urban environments.

All these aspects make problems related to beach sediment management one of the main (if not the top) priorities and concerns of local managers. Moreover, due to the difference between the actors experiencing the problem (local level) and the actors deciding on what action to take (the state), conflicts between local and central government administrators are common.

4.2. Number of visitors and beach use

Problems related to the overuse and overcrowding of beaches were not identified as one of the main priorities by local managers in the study area. In Spain, the beach is considered to be saturated from the recreational standpoint when the available surface area is less than 4 m^2/user (e.g. [26]). In spite of this, 29% of managers acknowledged that some of the beaches in their municipality were saturated, at least for a few days, during the summer season (21.4% of beaches). Twenty percent of these managers stated that the beach was

Table 3
Issues related with sediment management, beach management systems and/or awards and annual investments in beaches by municipalities

Comarca	Municipality	Erosion	Storms	Coastal works	Nourishment	Sediment redistribution	Blue Flag[a] and other systems	Annual investment (1000€)
Alt Empordà, AEM	Portbou	N	Y	N	N	Y	Y (1)	3
	Colera	—	Y	Y	N	Y	N	18
	Llança	Y	Y	Y	N	Y	Y (1)	90
	Port de la Selva	N	N	N	N	Y	Y (2)	60
	Roses	N	Y	N	N	Y	N ISO/EMAS	579.5
	Castelló d'Empúries	N	N	N	N	N	Y (1)	210.4
	St. Pere Pescador	N	—	μ	N	N	N	113.35
	l'Escala	Y	Y	Y	N	Y	Y (4)	140
Baix Empordà, BEM	l'Estartit	Y	Y	Y	Y	N	N	172.2
	Pals	Y	Y	N	N	N	N	38.2
	Bagur	Y	Y	Y	—	—	Y (2)	70.0
	Palafrugell	Y	N	Y	Y	N	Y (2)	—
	Mont-Ras	—	—	—	—	—	N	—
	Palamós	Y	Y	Y	Y	N	Y (1)	104
	Calonge	Y	Y	Y	Y	SÍ	Y (4) ISO/EMAS	—
	Platja d'Aro	Y	Y	Y	N	Y	Y (3)	129.6
	St. Feliu de Guíxols	N	Y	N	N	Y	Y (2)	15.8
	Sta. Cristina d'Aro	—	—	—	N	N	N	(Incl in St. Feliu)

Table 3 (*continued*)

Comarca	Municipality	Erosion	Storms	Coastal works	Nourishment	Sediment redistribution	Blue Flag[a] and other systems	Annual investment (1000€)
La Selva, SEL	Tossa	N	Y	N	Y	Y	Y (1)	150
	Lloret de Mar	N	Y	N	N	Y	Y (1) Q quality (2)	845.8
	Blanes	Y	Y	N	N	Y	Y (3)	258.5
Maresme, MAR	Malgrat de Mar	Y	Y	Y	Y	N	Y (1)	62.2
	Sta. Susanna	Y	Y	Y	Y	N	N	8
	Pineda de Mar	—	—	—	N	Y	Y (1)	—
	Calella	—	—	—	N	N	N	170
	St. Pol de Mar	Y	Y	N	N	N	N	55
	Arenys de Mar	Y	Y	N	—	—	N	56.4
	Caldes d'Estrach	N	Y	Y	Y	N	N	36
	St. Vicenç de Montalt	N	N	N	—	—	Y (1)	—
	St. Andreu	Y	Y	N	Y	N	N	24
	Mataró	—	—	—	N	——	N	175
	Cabrera	Y	Y	Y	—	—	N	42.1
	Vilassar de Mar	Y	Y	Y	—	—	N	117.2
	Premià de Mar	Y	Y	Y	Y	Y	N	157
	El Masnou	Y	Y	Y	Y	N	Y (1)	85
	Montgat	—	—	—	Y	N	N	—
Barcelonès, BAR	Badalona	Y	Y	Y	N	—	N	—
	Sant Adrià	N	Y	N	—	—	N	7

[a]Number within brackets indicate the number of beaches with the award.

Table 4
Relationship between type of beaches and management issues[a]

		Sediment management	Storm damage-chronic erosion	Services	Emergency situation	Overcrowding
Beach type	X^2	84.832	53.093	87.432	100.120	63.640
	Sig.	0.000	0.004	0.000	0.000	0.000
	df	20	29	33	19	19
	N	125	129	125	125	125

[a]Dependence between variables is significant in all cases (p values lower than 0.01).

overcrowded during most of the summer. Four municipalities admitted that a reduction in the number of users would be desirable, sometimes in the range of a 20–50% reduction. However, they did not have a specific plan to achieve this. As expected, urbanized and urban beaches experienced these problems. In order to put these results in context, it should be stressed that this is an area of intensive tourism. In addition, some municipalities have been selected as examples of areas in which the stagnation stage in the tourist cycle of evolution has been reached [27].

Despite these occurrences of beach saturation, no monitoring plan for measuring and/or controlling the level of beach use has been implemented, nor is such a plan foreseen in the area. Existing data to quantify the magnitude of the problem are sparse and, in some cases, outdated (e.g. [14,28]). However, 25 municipalities stated that it would be useful to have tools that enable beach use and state monitoring to be carried out. In this respect, technologies that can provide multipurpose data on beaches for aspects such as protection, safety, use and services are becoming available for use [29].

4.3. Organizational issues

Beach management is carried out according to different administrative schemes in the area's municipalities. A significant number (40%) grouped all beach duties and responsibilities under the jurisdiction of a single department. Four municipalities (Roses, Begur, Calonge and Montgat) have created departments that deal exclusively with beach issues. In most other municipalities, the various aspects related to beach management are shared among different departments. Thus, most municipalities have two or three departments involved in this work (25.7% and 20%, respectively). In addition to beaches, such departments are in charge of environmental issues (23.2%), municipal services (16.2%), urban development (8.1%), tourism and governance (6.06%) or other local construction work (4.0%).

In general, municipalities that share management issues between different departments are the ones that have the largest urban beach surfaces and population. At the same time, they are the municipalities with the largest direct investments in the area's beaches (Figs. 3 and 4). The most important issues for managers were sand and water quality, the adequacy of services and beach cleaning.

From the administrative standpoint, the basic and common management practices in all of the area's municipalities is the development of beach use plans. As mentioned before, municipalities must prepare a use plan in which all the beach services and uses must be specified for the bathing season. In many cases, these plans are closely related to beach

awards, i.e. most municipalities want to obtain awards for their beaches, so that they are able to present them as a quality product to users. These awards force municipalities to adopt a number of measures in order to fulfil the required criteria. The best known award is the Blue Flag (www.blueflag.org). In the summer of 2004, 13% of the beaches in the study area were given this award. This is a proportion similar to the Spanish average. Spain is the country with the highest number of awarded beaches. These percentages increase up to 27% for urban beaches and 24% for urbanized ones. Only 7% of natural beaches have been awarded the Blue Flag. This result is not surprising, since the Blue Flag is mainly designed for recreational beaches offering services to users (i.e. urban and urbanized ones) that natural/rural beaches will rarely be able to offer.

Beside this, other standard management figures are emerging for Spanish beaches [30]. Thus, two of the municipalities analysed have implemented a formal environmental management system, ISO 14001 and/or an environmental management system such as EMAS (European Union's Eco-management and Audits Scheme) on 11 beaches. Moreover, a new award system that is specifically designed for tourist beaches has recently been promoted by the Spanish Ministry of Industry. This is called the Q of Tourism Quality (at present, it has only been applied to 23 beaches in all of Spain).

4.4. Public investments

The average annual declared (public) investment on maintenance, cleaning and conservation by each municipality was €133,113. This cost does not include sand management operations, which are carried out by the Spanish government and are directly funded by the state. However, the range of variation in this average value was extremely

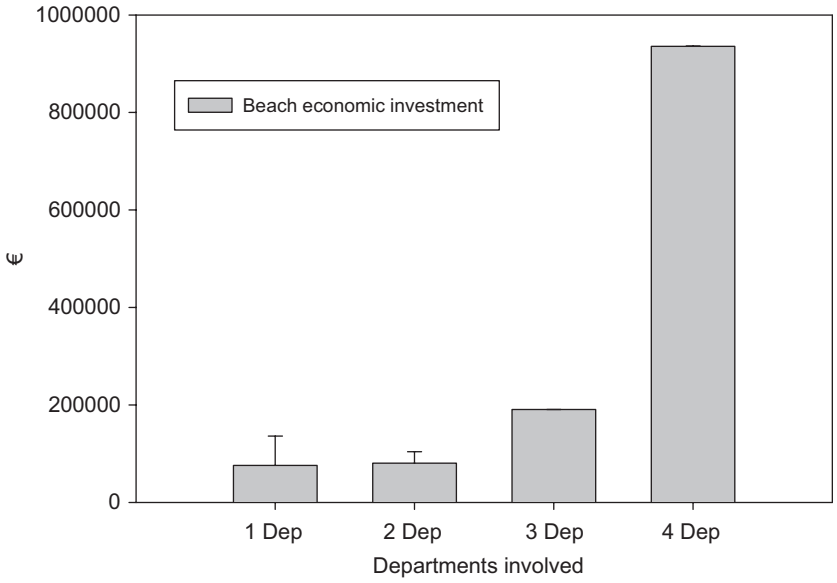

Fig. 3. Number of departments in municipalities involved in beach management organization and economic public investment in beaches.

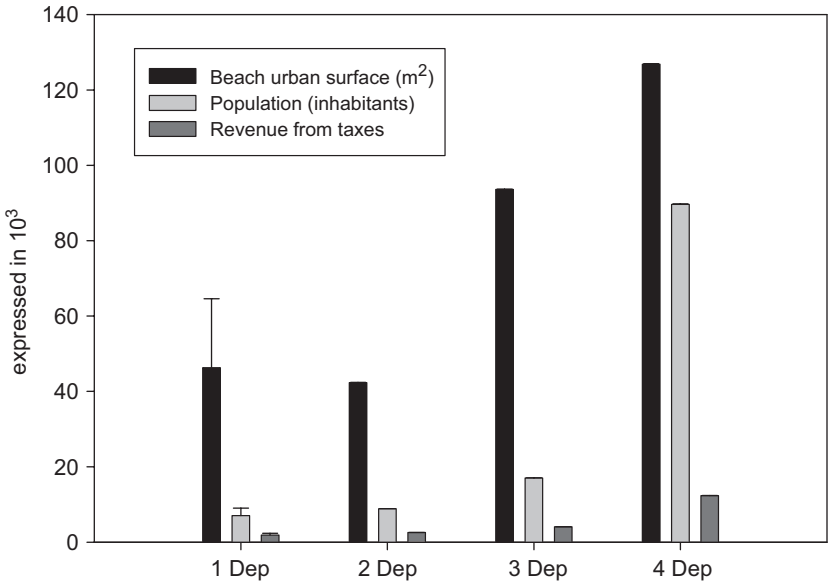

Fig. 4. Number of departments in municipalities involved in beach management organization and some numbers of each municipality.

high. Lloret de Mar (€845,820) and Roses (€579,555) were the municipalities with the largest absolute budgets dedicated to beaches. Portbou (€3000), Santa Susanna (€8000) and St. Adrià de Besòs (€7000) devoted the lowest investments to their beaches (Table 3).

If these budgets are standardized according to the subaerial beach surface in the municipality, the largest investments correspond to Lloret de Mar (6.28 €/m^2) and St. Andreu de Llavaneres (5.58 €/m^2). The lowest correspond to Sta. Susanna (0.09 €/m^2), St. Adrià de Besòs (0.14 €/m^2) and Pals (0.15 €/m^2). The figures for the municipalities' investments were found to be dependent on local socioeconomic factors, management organization and beach surface per municipality. The figures were seen to be most closely dependent on waste production, local tax revenues and GDP (Table 5).

As can be seen in Table 3, the public investment in beaches by each municipality in the area varies widely in both absolute and relative terms (per m^2 of beach). However, when beaches are grouped into *comarcas*, a more or less clear picture emerges (Fig. 5). Thus, the average investment per municipality within a *comarca* seems to be independent of the coastline length occupied by beaches. However, there is a strong relationship between this average investment and the accommodation coefficient. The larger the accommodation coefficient, the higher the investment will be. This coefficient can be used as a proxy of the importance of tourism in the area, since it is calculated as the number of hotel beds per 100 habitants. Consequently, this relationship should reflect the aforementioned tourist/service oriented management of the beaches in the area.

4.5. Other issues

Emergency situations are not infrequent in the study area. These are understood to be events during which the beach is suddenly affected in a drastic manner. Results indicate

Table 5
Relationship between municipal economic investment in beaches and local factors[a]

No parametric correlation		Beach area	Population	Hotel lodging	Taxes revenue	Solid waste	Urban beach area	GNP
Economic investment	Coef.	0.311	0.289	0.273	0.432	0.418	0.268	0.529
	Sig.	0.008	0.013	0.019	0.000	0.000	0.037	0.002
Urban beach area	Coef.	—	0.401	—	0.335	0.372	—	—
	Sig.	—	0.002	—	0.009	0.004	—	—

$N = 36$.
[a]Difference between groups is significant for p-values lower or equal to 0.05.

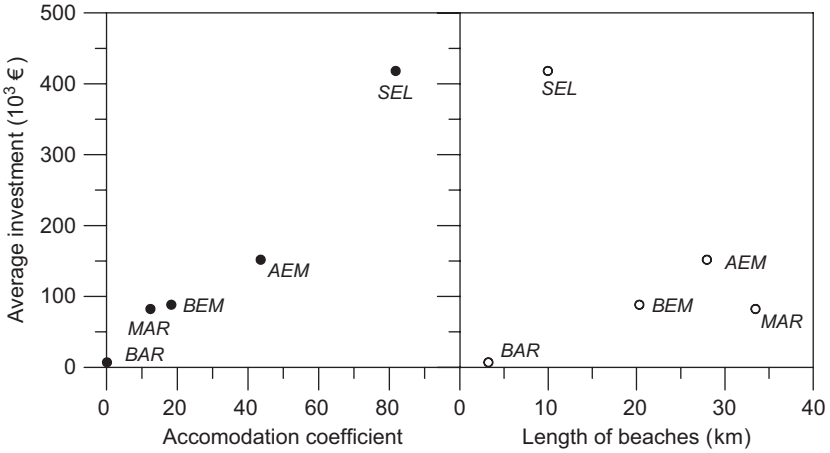

Fig. 5. Comarca-averaged municipal investment vs tourist and physical indicators of each comarca.

that 18% of the beaches had been closed at least once during the five-year period before completing the questionnaire. The most frequent reason for beach closure (62%) was either failure of the sewer systems or heavy rain events, which are typical in the Mediterranean basin. Other less frequent factors for beach closure were: bomb scares, fuel pollution, a jellyfish bloom or falling cliffs. This makes weather conditions the greatest natural factor causing emergency situations.

Again, urban beaches (38.8%) were much more likely to be closed than urbanized (5.2%) and natural beaches (4.7%) (Table 4). This was mainly due to the presence of nearby sewer systems. It was also a result of street flows during storm events when the urban drainage system was badly designed or inefficient at removing surface runoff. In general, to properly manage such situations, an integral analysis of the drainage system must be carried out. Other elements associated with emergency situations are

unpredictable. However, a response plan should be prepared for such events, especially if a list of probable situations becomes available.

Finally, the questionnaire included a final open question to let beach managers specify their main concerns without constraints. Most managers expressed their concerns about quality related aspects (regarding sand, water and services), followed by beach cleaning and sediment management (Fig. 6). Natural values, litter and pollution were not considered to be such important issues, although they are intrinsically important aspects.

In the area, 45.2% of managers stated that their beaches have sensitive natural communities that are legally protected, such as dunes or seagrasses. However, only 43% of these managers expressed their interest in the natural values of these beaches. Moreover, in the case of natural ecosystems that are not legally protected, such as rural environments around beaches, natural values were not considered a priority.

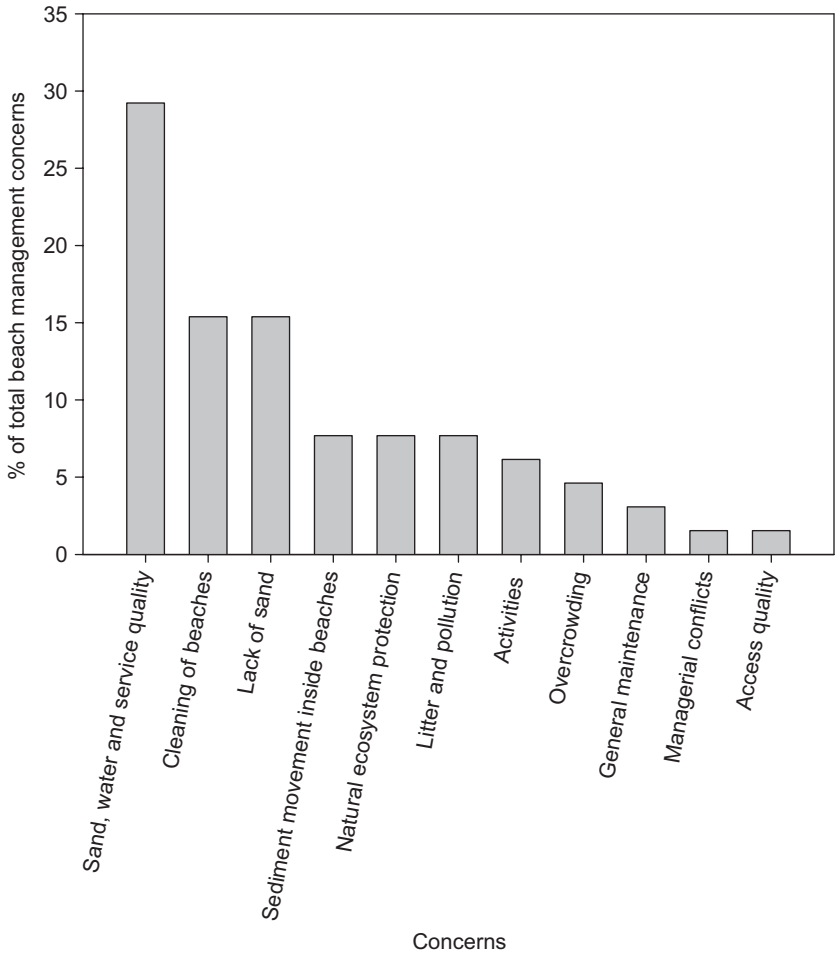

Fig. 6. Main concerns of beach local managers of the studied area.

5. Discussion and conclusions

This paper presents the main current local administration practices for beach management. The management options are determined by the socioeconomic characteristics of this area, in which tourism is the main economic sector and most municipalities depend on this activity. Therefore, the type of beach management that emerges from the analysis is easily understandable, i.e. recreationally oriented management in which the beach is considered a product/service to be offered to users and visitors. The beach use plan is the main management tool. One of the main outputs of the management plan is the delineation of the beach surface into parcels with an allocated use (e.g. the plan allows company X to exploit a beach surface of x m by y m to rent sun beds and umbrellas).

This is also observed in the more or less common lack of interest in managing natural (or quasi-natural) beaches, unless they are protected by an administrative figure that in some cases strictly regulates the type and intensity of uses to be permitted or promoted. Thus, for some of these natural beaches, the only difference in management is the intensity and number or services offered. Other natural beaches are simply not managed.

Although the managers seemed to be interested in the issue of potential overuse of beaches, it is surprising that no periodic quantitative evaluation of the level of use of the beach has been implemented by any of the municipalities. This could be associated with the fact that this is the "normal" situation for beaches with a level of use that is close to the maximum carrying capacity, and which even experience some events above saturation level. As mentioned before, some parts of this area can be considered tourist destinations that have reached the stagnation phase. This means that they have reached the peak number of visitors and capacity levels for many variables [27]. This implies that users of these beaches are aware of the type of beach they are visiting. Under these conditions, the manager accepts use close to saturation level as a usual and normal feature of a beach. However, this can have serious implications, which make it essential to monitor the level of use. For example, if the subaerial surface decreases for natural or human-induced reasons, the beach could easily collapse, i.e. the beach will not properly play their functions. When referring to the recreational function an example of this situation should be the existence of an excessive number of users for the available beach surface. Moreover, due to the local administration's lack of jurisdiction for responding to such situations, unless they can predict when they will happen and ask for help from the national government in advance, there will be a lag between the appearance of the problem and the solution. This could affect the "prestige" of the beach as a tourist destination.

With respect to the last observation, it has to be stressed that the main concern of managers in this area were problems related to sediment management. This illustrates the magnitude and frequency of impacts of erosion problems on the beaches. This is in agreement with the results of the Eurosion project [16], which determined that erosion was the dominant coastal behaviour along European coasts. However, this awareness reflects the main fact that erosion affects beach functions. Thus, as mentioned in the previous point, erosion affects the available surface for beach exploitation, which is a critical issue in intensive-use recreational beaches [12]. In addition, it affects the protective function of beaches by reducing the available surface for dissipating wave energy during a storm. As a result, many promenades are commonly affected [24,25]. In this case, local managers have to deal with the "unexpected" results, such as promenade reconstruction, waterfront

cleaning after overwash events and reparation of minor infrastructures. However, unless they are able to identify the beach's configuration before the storm season (autumn-winter) as a "risky" one, only reactive management options are possible, i.e. to repair damaged infrastructures. As in the case of use analysis, management issues related to sediment and storm-induced damages could be greatly favoured by monitoring the (physical) state of the beach.

Only 45% of municipalities reporting long-term erosion problems had received the benefits of nourishment works. This should reflect the fact that the local administration does not play a relevant part in the decision-making process. Moreover, this issue could also be conditioned by external factors, such as environmental concerns about nourishment operations. Such concerns have meant that a section of society does not have a good perception of these works. This could be a source of conflict between administrations, although it really reflects the difference in the scope of local vs general (regional or national) approaches and interests.

The municipalities' administrative structure that is dedicated to beach management varies widely within the area of study, from a single department up to a total of four departments. In general, the number of departments involved increases with the size of the municipality (the population and beach surface). However, in many cases the distribution is due to the fact that part of the processes or services included in beach management are the same as those offered for other parts of the village, e.g. parks. Thus, with the exception of those municipalities that have a specifically created department for managing beach-related issues, those that share the responsibilities for beaches among several departments lack a figure for beach coordination.

In spite of this, it seems that the usual policy in most municipalities in the study area is to implicitly follow the management guidelines recommended by the Blue Flag award. This is because this award is perceived by the users as a beach quality index. In fact, every year at the beginning of the season there is detailed coverage in the mass media about the number of beaches and ports given awards along the Spanish coast. This could be acceptable for recreationally oriented beaches. However, since this award does not cover natural beaches, no external guidelines can be followed in these areas.

As mentioned before, local administrations' public investment in the area's beaches seems to reflect tourist oriented beach management. If the budgets given in Table 3 and Fig. 5 are combined for each *comarca*, the cumulative values reinforce this idea. Thus, Fig. 7 shows a better-defined relationship between investment and the importance of the tourist sector, measured in terms of the number of hotel beds. If we remove the values obtained for the Alt Empordà (AEM), we can establish that the average annual public investment in beaches in these *comarcas* as a function of tourism is around €30/hotel bed. The values for AEM are about 2.5 times higher than this investment. This high figure is mainly due to the investments made in the municipality of Roses, which were up to 47.7% of the total.

In addition, Fig. 7 shows that the cumulative investment in beaches of the *comarca* is not related to the resident population or the beach length. This lack of relationship seems to indicate that public investments in the area's beaches are not guided to a great degree by local variables. Therefore, the unitary amount per bed could be used as a proxy for part of the (beach-related) public services provided for tourist activities. In this respect, this type of cost could be included in a tourist oriented tax (e.g. [31]). However, to put this last point into context, this amount would have to be compared with the economic value of the

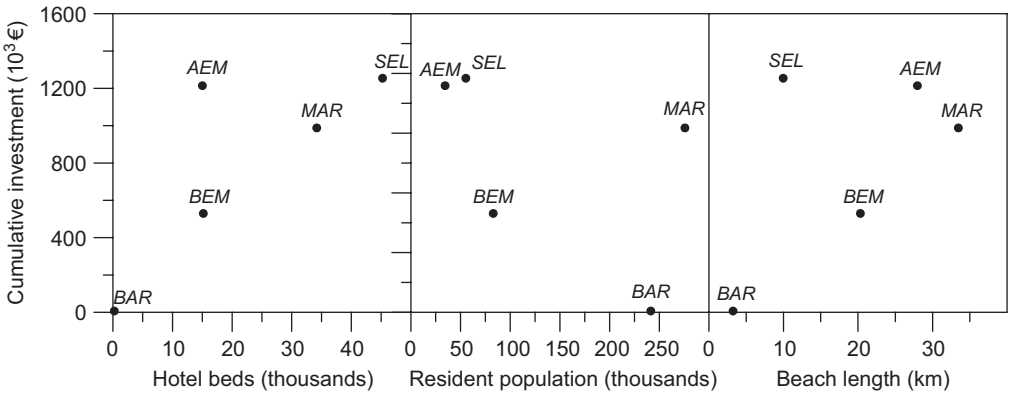

Fig. 7. Comarca-cumulative municipal investment vs socio-economic and physical indicators of each comarca.

beaches, understanding this to be the revenues associated with the presence of the beach [32]. Thus, for instance, [30] has estimated an average revenue of 700 €/m^2 for beaches in the region of Valencia (SE Spanish Mediterranean coast).

Emergency situations that force beaches in the area to close are not infrequent. Therefore, they are an important point to consider in beach management plans. Some studies report that users drive managers' water quality related decisions about when to close/open beaches (e.g. [33]). The government of Catalonia (regional administration) is increasingly planning response strategies to emergencies, such as the CamCat (Contingency Plan for Marine Pollution) and the InunCat (Special Emergency Flood Plan). These plans can be used as general frameworks for integrating responses to these events in beaches.

Finally, the persistence of many of the problems that local managers have to face seems to indicate that the actual beach management strategies are not adequate in the study area. One of the most important issues to be solved is how to efficiently integrate the different jurisdictions of the administrations governing the beach. This is related to the fact that it is necessary to reduce the mismatch between receiving the impact of any management (or lack of) and the management capacity (or lack of) that municipalities currently experience.

In addition, the existence of some natural or quasi-natural beaches in the study area should be explicitly reflected in the management approach. These beaches should be managed in a differentiated manner. The most promising approach should be that based on the principles of ecosystem management [3,4]. This approach has recently been included within the recommended guidelines for ICZM at the World Summit on Sustainable Development (Johannesburg, August 26–September 4, 2002). It requires a strong organizational structure. In this respect, Environmental Management Systems are currently being implemented to manage beaches. These include systems such as EMAS, which use the main points in ecosystem management, including data collection, monitoring, interagency cooperation, adaptive management, humans embedded in nature and values. An adaptation of the current product/service oriented beach management is not likely to be appropriate for natural beaches. In contrast, if the ecosystem approach is adopted, it is flexible enough to be applied to any beach.

Acknowledgements

This work was carried out within the framework of the MeVaPlaya project, funded by the Spanish Ministry of Education and Science, under contract REN2003-09029-C03-MAR. The second author would like to thank the government of Catalonia for its support through the University Research Promotion Award for Young Researchers. The authors greatly appreciate the participation of personnel from the Catalan municipalities cited in the text for providing answers to the questionnaire.

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