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Review

Integrated beach management in large coastal cities. A review

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ABSTRACT

Beaches are attractive areas that are subject to multiple pressures. Some of these beaches are located in large coastal cities with which they interact on a physical and social level. Facing this particularity, we propose a state of knowledge dedicated to the management of beaches in large coastal cities, here defined as cities with more than 500,000 inhabitants. Using the WoS and an analysis grid, 53 articles were identified and studied. This analysis shows that these beaches at the interface of a large coastal city are mainly the subject of sectorial studies and that the interactions between the city and the beach are relatively little studied. In this context, this article aims to highlight the need to develop integrated management model specific to beaches located in large cities.

1. Introduction

Following the 1992 United Nations Conference on Environment and Development, coastal zones have been identified as very sensitive environmental settings requiring integrated management at various scales (Chua, 1993; Kenchington and Crawford, 1993; Vallega, 1999). Today, they are at the center of many concerns related to sea level rise (Abadie et al., 2020; Nicholls et al., 2021), biodiversity erosion and anthropogenic pressures (Todd et al., 2019), and economic development issues, all calling for both a sound understanding of the functioning of these social and ecological systems, as well as the management and spatial planning of human activities. In this context, large coastal cities exceeding several hundred thousand inhabitants are of high interest, in particular where beaches are concerned.

Compared to small and medium sized cities, large coastal cities deal with bigger problems of wastewater treatment, a growing environmental issue (Amorim et al., 2014). They must ensure the accessibility of their shores to a larger number of urban dwellers all year round (Kim and Nicholls, 2016; Kim et al., 2019), in a context of increasing social expectations in terms of public spaces and quality of life (Banister, 1998; Nicholls, 2001; Antuna-Rozado et al., 2019). Some of these cities already implemented heavy developments to reconquer spaces on the seashore, turning former industrial and port-oriented areas into new recreational areas open to the population (Gu et al., 2013; Timur, 2013; Fageir et al., 2020). Of course, these cities are also confronted with the many climate change induced risks (Nicholls, 1995; Hallegatte et al., 2013; Rashid et al., 2021), which are challenging as the urban fabric cannot easily be adapted. Due to these multiple pressures and challenges, maintaining and managing beaches within cities of several hundred thousand inhabitants is a real challenge for local authorities. It requires the design of specific management models, where all the interactions between the beach, the sea and the city need to be handled, as Tomlinson et al. (2011) showed for Barcelona, Spain. Also, integrated management of beaches in such a context requires decentering from the beach itself and developing planning and management strategies at various scales (Kenchington and Crawford, 1993). Indeed, jurisdictional boundaries do not necessarily comply with the geographical area concerned by the functioning of a social-ecological system. In the case of beaches located in large coastal cities, these works suggest that beach management should integrate different aspects of what makes a beach within a large city a typical system.

Beaches are social-ecological systems where bio-physical, social and management components interact. Three papers of the early 2000s clearly exposed this perspective (James, 2000a, b; Micallef and Williams, 2002). They later inspired many papers on beach management, showing that a social and ecological system-based approach should be favored to develop coherent and effective management models. Some of these works involve evaluating management systems with managers (Ariza et al., 2008a) or directly with beach users to strengthen local public policies (Lozoya et al., 2014). However, other studies show social-ecological approaches are still not implemented because they require a strong integration of all stakeholders associated with beach management (Sarda et al., 2015). Also, several authors demonstrated that beaches differ in many ways because of their ecological, social and

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economic environment. In relation to the beach system components promoted by James (2000a), it has been shown the beach geographical location has an impact on the social practices of the users (Breton et al., 1996; Morgan, 1999; Roca and Villares, 2008; Roca et al., 2009) as well as on the environmental quality of the beach, whether it be the bathing water quality (Lefevre and Lewis, 2003; Amorim et al., 2014), the beach ecology (Berry et al., 2013; Burger and Niles, 2013), or the sediment dynamics (Gomez-Pina and Muñoz-Pérez, 2004; Cohen et al., 2008; Jiménez et al., 2011). Now, what about the specificity of beach management in large coastal cities? Is there any dedicated scientific literature on this issue? If so, what are the main questions and findings of these works?

The objective of this paper is to investigate the scientific literature to draw relevant works dealing with beaches in large coastal cities. Our focus is to identify recommendations for beach management in such settings. To meet this objective, a review on beach management in cities with more than 500,000 inhabitants was conducted on the Web of Science (WoS). This threshold, somewhat arbitrary, was decided with the view that coastal cities exceeding half a million inhabitants are places where urban pressure is rather high, citizens' expectations numerous, and important local decisions can be made for an efficient and sound beach management (funds, originating from the public sector or private investors, can be found).

2. Materials and methodology

Our study was performed following a classical strategy in terms of literature review, like it can be seen in Sierra-Correa and CanteraJaime (2015), Dupont et al. (2020), and Metze (2020). The first step consisted in listing the relevant keywords and expressions to investigate the Web of Science database. Then, successive queries were made to progressively reduce the results to the most convincing data set, which we analysed following criteria allowing the filling of a descriptive grid. The final aim was to characterize how, in cities exceeding half a million inhabitants, the selected papers analyse the beach system, deal with interactions between the beach and the city, and propose some recommendations in terms of management.

2.1. Identification of papers on beach management and/or beach in urban settings (Data set 1)

In a first phase, our investigation on the WoS was made to gather papers dealing with beach management and/or beach in urban settings. To perform our selection, we used different words and expressions relevant to this vast area of interest. Indeed, preliminary investigations on the literature referring to beach management and urban beaches revealed that, frequently, authors do not explicitly mention they study beach management, beaches in urban settings, or beaches in large cities. Sometimes, they do not even mention these specificities at all. For instance, it is possible to find a paper on beach management which does not mention that the study area is a large city (though the city name is given), nor saying that the beaches concerned are "urban beaches".

We queried the "topic" of the articles, meaning that the search was made on the title, the abstract and the keywords of the papers. Because ICZM principles were progressively elaborated in the 1990s, only the papers published between January 2000 and February 2020 were considered. Furthermore, for a more consistent search, papers in languages other than English were not selected.

After various tests, a set of queries proved to be efficient in order to grasp the largest number of papers dealing with beach management and/or beaches in urban areas (Table 1). It is made of six expressions: two to get articles which clearly mention they deal with beaches in an urban setting (« Urban beach »; « Coastal Cit* + Beach ») and four to get articles where there is no doubt that the topic is about beach management (« Beach Management »; « Beach Plan* »; « Beach development »; « Beach Policy »). The six queries were made separately, so that duplicates were expected and accepted at this stage. The results allowed to extract the bibliographic data (authors, titles, keywords, abstract) of 446 papers, which compose a first data set (Data Set 1).

Table 1
Queries participating to the building of Data Set 1.

Query_ID	Query_cont	Nb_Papers
Q1	Beach Management	297
Q2	Coastal Cit* + Beach	59
Q3	Urban Beach	48
Q4	Beach Development	30
Q5	Beach plan*	11
Q6	Beach Policy	1
Total number of papers in Data Set 1		446

Query_ID: query identification number.
Query_Cont: expression used for the query.
Nb_Papers: number of papers corresponding to the query.
* symbol to mean different possible spellings (i.e.: cit* can be used for "city" or "cities").

2.2. From Data Set 1 to Data set 2: selection of papers dealing truly with beach management in large coastal cities

From Data Set 1, a second phase was implemented to adjust the list of papers to the target of our study. This was made in three steps (Table 2). First, papers in languages other than English, duplicates and aberrations were removed. Indeed, the reading of the 446 papers' abstracts revealed that some were not written in English and that others were off topic. For example, some of the papers found focused on the ophthalmological dangers of the sun or on fishermen's nets lying on the sand. Accordingly, 86 papers were removed after this step. Second, articles whose study area is a city of less than 500,000 inhabitants were removed too. The location of the study area was searched in the title, keywords, abstract, introduction or the methodology section of the papers. Then, the number of inhabitants of these geographical places was collected from the national statistics institutes' websites. As a result, 297 papers dealing with one or several beaches located in a city having less than 500,000 inhabitants were removed. Third, close reading of the remaining articles enabled to eliminate those where the expression "beach management" is never mentioned. Thus, 10 papers dealing with beaches without referring to their management were removed. The result of this second phase is a reduced data set composed of 53 papers (Data Set 2).

2.3. Content analysis of Data set 2

An analysis grid was elaborated to characterize the contents of the papers composing Data Set 2: what part of the beach system do they deal with? Do they propose specific models or at least recommendations for integrated beach management in large coastal cities? In relation to the precepts of integrated management, the grid was designed to show whether the papers deal with beach management according to the model developed by James (2000a), where a beach is seen as a system whose ecological, social and management components interact. It also makes it possible to check whether interactions between the beach and the city

Table 2
Steps leading to the building of Data Set 2.

Step_ID	Operation	Nb_Papers
Step 1	Removal of papers in a language other than English	12
	Removal of duplicates	10
	Removal of aberrations	64
Step 2	Removal of papers that do not have a beach located in a city of more than 500,000 inhabitants as a study area	297
Step 3	Removing papers not referring to management	10
Total number of papers to remove from Data Set 1		393
Total number of papers in Data Set 2		53

are mentioned. Accordingly, the grid is composed of two levels. It offers four categories (first level), which are then divided into a series of items (second level) to describe the papers' content in relation to the three components of the beach system, the different interactions between the city and the beach, and the approach to management recommended by authors (Table 3).

Implemented as a table, the grid describes the papers (listed in lines) with the items of each category (presented in columns). In each cell, three responses are possible for each item: "Yes", "No" and "Quoted". The difference between "Yes" and "Quoted" lies in the fact that some papers may refer to an item without truly developing or arguing it. In such case, the value given in the grid is "Quoted". Conversely, if the item is in the core of the article or is convincedly addressed and not merely mentioned, the value is "Yes". In addition to the characterization of the papers by using this grid, we quantified the number of papers dealing with each of the categories relating to the beach system, the city-beach interactions, and the approach to management. We had a look at the journals publishing these papers, at the countries and cities concerned, and finally made an analysis of how beaches are studied in relation to management in large cities.

3. Results

3.1. Time, space and journals distribution of the papers

The very first results of this review are about the time and space dynamics of the beach management issue in large coastal cities. Interestingly, the vast majority of the articles we identified were published after 2010 (n = 45). It can then be said that it is a rather new concern in the literature. In terms of geographical distribution, the analysis highlights great disparities between countries where study areas are located (Fig. 1), with an over-representation of papers dealing with large cities in Australia (n = 10), the United States (n = 10) or Brazil (n = 7). However, several articles have the same city as study area, like Gold Coast, Australia, or Recife, Brazil, emphasizing that the studies we are looking for are rather scarce and conducted by few research groups only. Accordingly, some geographical areas are very poorly studied, such as the coasts of Africa or Central America, or not studied at all, such as the Pacific coast of South America. Curiously, Europe (n = 3) and Japan (n = 1) are not well represented either, while the number of large cities located on their coasts could suggest more studies.

The 53 papers composing Data Set 2 are published in 32 different journals. Although this result suggests a great distribution of the papers between various supports, papers are concentrated in 4 journals only: *Journal of Coastal Research* (11), *Ocean & Coastal Management* (5), *Journal of Environmental management* (4), and *Marine Pollution* (4), i.e. a total of 24 papers, accounting for nearly half of the total (Fig. 2).

Except two papers published in *Coastal Education & Research Foundation*, other papers were identified in journals where they were the only paper dealing with beach management in a large city between 2000 and 2020. This suggests that a very small number of journals focus on beach management in large coastal cities. Also, the important number of journals dedicated to biology (*The Wilson Journal of Ornithology*, *Journal of Wildlife Management*, *Journal of the Marine Biological Association of the UK*), to water analysis (*Water resources*, *Water research*) or to environmental quality (*Chemistry and Ecology*, *Waste Management & Research*) highlights the importance of environmental sciences in beach management research.

Table 3
Categories and items for the content analysis of Data Set 2.

Categories	Items
A: Beach system	A1 - Biophysical component
	A2 - Social component
	A3 - Management component
B: City influence on the beach	B1 - Accessibility from the city
	B2 - Social practices
	B3 - Users representations
	B4 - Facilities and equipment
	B5 - Beach ecology and environmental quality
	B6 - Sediment dynamics
C: Beach influence on the city	C1 - City development and urban projects
	C2 - City infrastructures
	C3 - Tourism development
D: Approach to management	D1 - Interactions between services
	D2 - Interactions between local authorities and civil society

3.2. Sectoral approaches still prevail

The content analysis of the papers provides a first result on how many of them consider beach management from a systemic perspective, as recommended by James (2000a). Interestingly, data from the grid show that the number of papers where management is a key issue is low (n = 12 in Table 4). Although management is mentioned in all papers, this is not the main topic in the majority of them (n = 41). It is mostly evoked in the introduction or conclusion, enabling a claim for the added value of the research reported in the articles but, globally, a sectoral approach dominates the articles.

Another important result is the imbalance between the beach components treated in the articles (Table 4, Table 5). Most of them deal with the biophysical component of the beach, while the other two components of the beach system are paid much less attention.

Table 5 shows that the majority of the papers are focused on A1 only (n = 33). These 33 papers deal with beach sediment dynamics (Corradi et al., 2004; Patterson, 2007; Brignone et al., 2012; Rollnic and Medeiros, 2013; Mallmann and Pereira, 2014), wildlife (Elias et al., 2000; Cohen et al., 2008; Suzuki et al., 2013; Wu et al., 2020), natural hazards (Kweon et al., 2011) or environmental quality (Noble et al., 2010; Phillips et al., 2011; Enns et al., 2012; Pirez et al., 2013; Sarafraz et al., 2016) without ever addressing the social component of the beach, and referring only to beach management at the beginning or at the end of the paper.

Regarding the social dimension of the beach (A2), Table 5 shows there are very few papers specifically dedicated to this component (n = 6). Among them, five also refer to A1 category as they deal with landscape or bathing water quality, whose influence is studied in the representations and practices of users. One paper investigates users' willingness to pay to improve beach quality in Karachi, Pakistan (Talpur et al., 2018). Another estimates the recreational value of beaches in Gold Coast, Australia, using the travel cost method and a survey (Zhang et al., 2015). And three others focus on the representations and preferences of beach users in Mazatlan, Ensenada, Rosarito and Oceanside in Mexico and California (Cervantes et al., 2008), and in Cartagena, Santa Marta, Riohacha, Manaure and Puerto Colombia, Colombia (Botero et al., 2013a, 2013b). Similar to papers focusing on the biophysical dimension, these ones refer to management because authors believe their findings can benefit management. Finally, only one paper (Dominguez-Tejo et al., 2018) gives a central place to both A2 and A3, investigating the consideration of users' representations in management models in Sydney, Australia.

Table 5 also highlights that the number of papers focusing on two components of the beach system is very low (n = 6). On one hand, four papers are both dedicated to A1 and A3. They deal with sediment dynamics management in Gold Coast, Australia (Turner and Anderson, 2007), the management of beach environmental quality in Adelaide, Australia (Tanner et al., 2014) and Miami, USA (Marshall et al., 2014), and the management of coastal hazards through an application on the beaches of San Francisco, USA (Ewing, 2015). On the other hand, only one paper addresses both A1 and A2, investigating beach users' representations of both erosion and services offered on the beach in Brisbane, Australia (Windle and Rolfe, 2014). Finally, the last paper deals specifically with A1 while referring to the other two components (A2 and

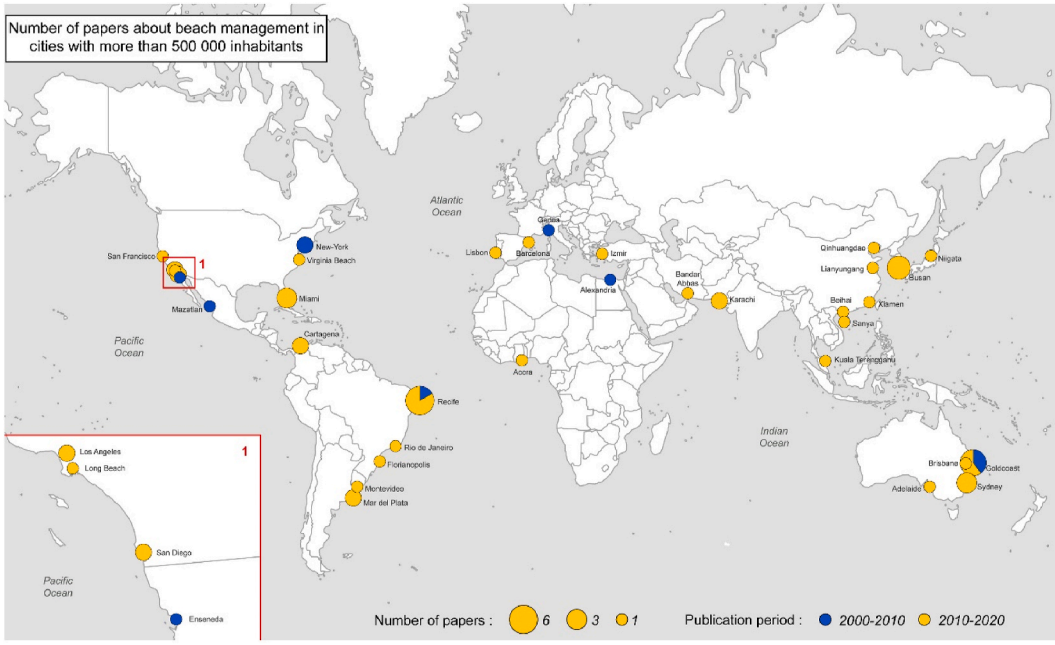

Fig. 1. Spatial and temporal distribution of articles included in Data Set 2.

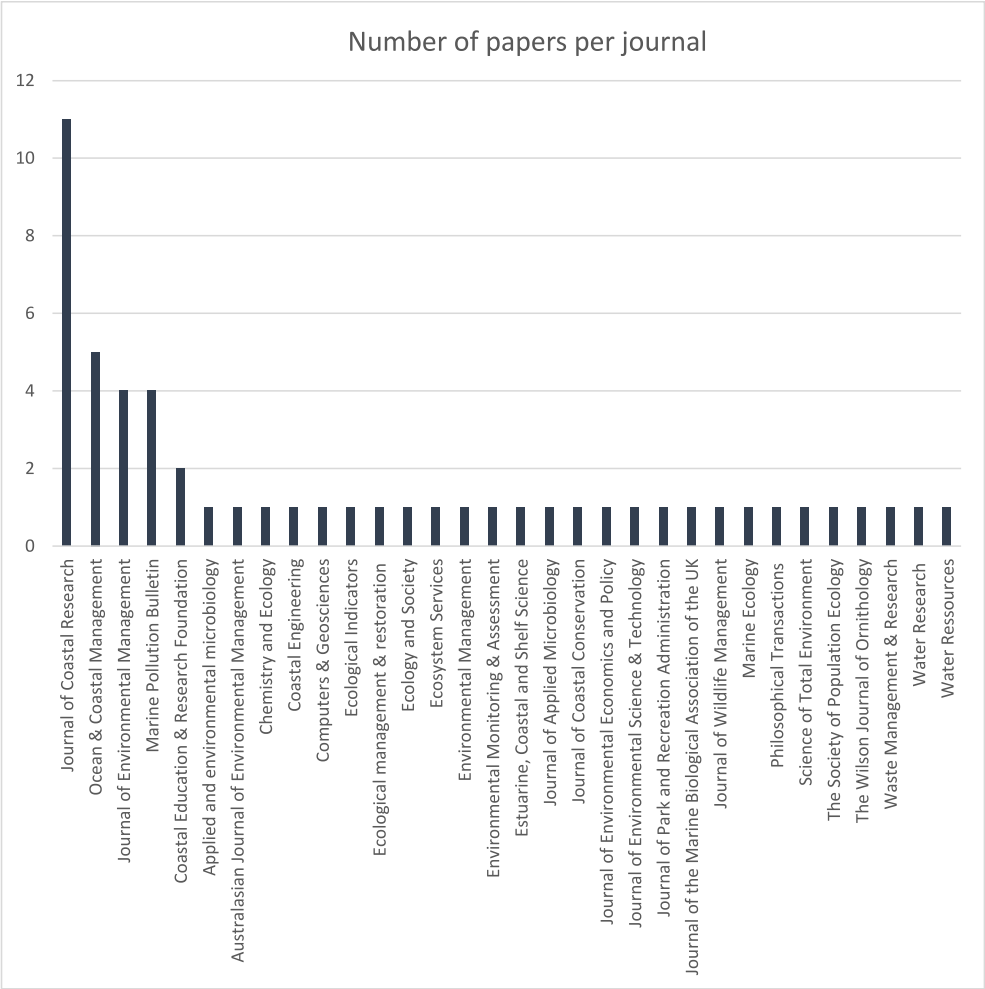

Fig. 2. Papers distribution between the 32 journals.

Table 4
The most studied beach system components in Data Set 2.

	Biophysical Component	Social Component	Management Component
Yes	45	14	**12**
Quoted	7	15	41
No	1	24	0

Sums only make sense in column; each column equals 53.

Table 5
Beach system components analysed or quoted in each paper.

Papers	A1	A2	A3	Papers	A1	A2	A3
Elias et al. (2000)	X		*	Tanner et al. (2014)	X		X
Corradi et al. (2004)	X		*	Victoria et al. (2014)	X	*	*
Iskander et al. (2007)	X	*	*	Windle & Rolfe (2014)	X	X	*
Patterson (2007)	X		*	Ewing (2015)	X	*	X
Turner & Anderson (2007)	X		X	Zhang et al. (2015)	*	X	*
Cervantes et al. (2008)	*	X	*	Angnuureng et al. (2016)	X	*	*
Cohen et al. (2008)	X		*	Lee et al. (2016)	X	*	*
Silva-Cavalcanti et al. (2009)	X	*	*	Sarafraz et al. (2016)	X		*
Costa et al. (2010)	X		*	Todd & Bowa (2016)	X	X	X
Noble et al. (2010)	X		*	Yu et al. (2016)	X	X	X
Widmer & Hennemann (2010)	X	*	*	Kacar & Omuzbuken (2017)	X		*
Kweon et al. (2011)	X		*	Usher & Gomez (2017)		X	*
Phillips et al. (2011)	X		*	Vaz et al. (2017)	*	*	X
Tomlinson et al. (2011)	X	X	X	Arshad & Farooq (2018)	X	*	*
Brignone et al. (2012)	X		*	Dominguez-Tejo et al. (2018)	*	X	X
Cooper & Lemckert (2012)	X	X	X	Li & Zhu (2018)	X	*	*
Enns et al. (2012)	X		*	Searcy et al. (2018)	X	*	*
Botero et al. (2013a)	*	X	*	Silva-Cavalcanti et al. (2018)	X	X	X
Botero et al. (2013b)	*	X	*	Talpur et al. (2018)	*	X	*
Isla (2013)	X	X	X	Bagheri et al. (2019)	X		*
Kim et al. (2013)	X	*	*	Besley & Birch (2019a)	X		*
Pirez et al. (2013)	X		*	Besley & Birch (2019b)	X		*
Rollnic & Medeiros (2013)	X		*	He et al. (2019)	X		*
Suzuki et al. (2013)	X		*	Kim et al. (2019)	X	*	*
Hubbard et al. (2014)	X		*	Pinheiro et al. (2019)	X	*	*
Mallmann & Pereira (2014)	X		*	Wu et al. (2020)	X		*
Marshall et al. (2014)	X	*	X				

A1: Biophysical component; **A2:** Social component; **A3:** Management component.
X: the paper effectively deals with the component.
*: Component only quoted.
[blank]: not quoted.

A3). This article presents a typology of the beaches of the Lisbon metropolitan area, Portugal, according to their characteristics and the possible criteria to be considered for their management (Vaz et al., 2017).

3.3. *A few studies explicitly focused on the three components of the beach system*

The three components of the beach system as promoted by James (2000a) are rarely studied all together (Table 5). In the six papers we classified in this category, management is given a central place while the social and environmental dimensions of the beach are also considered. Two papers are of particular interest as they rely on collaboration with local authorities. One is an article in which authors experiment with local authorities in the application of a systemic approach to the beaches of Barcelona (Tomlinson et al., 2011). The other focuses on the management challenges faced by coastal cities due to urban sprawl induced by the attractiveness of beaches and seaside tourism (Isla, 2013). Two other articles are focused on the design of indicators and the assessment of management models. One proposes a beach quality index for Gold Coast that includes data relating to the biophysical and social dimension of the beach; the paper deals also with the management systems implemented (Todd and Bowa, 2016). The other is an article consisting of a comparison between two management systems in Xiamen and Pingtan, China, in which the authors seek to define the model that is most likely to ensure integrated management of the beach in a large coastal city (Yu et al., 2016). Finally, the two remaining articles are about coastal risks management: one dealing with the management and prevention of rip current risks among beach users in Recife (Silva-Cavalcanti et al., 2018); and the other related to coastal risk management through the development of scenarios relating to sea level rise in Gold Coast (Cooper and Lemckert, 2012). To a certain extent, these are the six papers that come closest to the theoretical framework created by James (2000a).

3.4. *City-beach interactions poorly studied*

The importance given to interactions between the city and the beach was assessed in each of the papers. It reveals that in 26 of them, the city is merely mentioned in the title, the introduction and/or the methodology. This simple figure suggests that in half of Data Set 2, city-beach interactions are little studied and the fact that the beach is located in a large city is no more than contextual data.

Regarding the influence of the city on the beach (category B in Table 3), the analysis allows the ranking of the most frequent item in the papers (Table 6). First, the importance given to issues related to the ecological dimension of the beach is massive (items B5 and B6), whereas those linked to the social dimension are paid much less consideration (items B1, B2, B3). Moreover, the grid reveals that the number of papers which focus on more than two items is very low (n = 7).

The city influence on the beach is studied through only B5 in 24 papers, and through only B6 in 5. Of these 29 papers, 14 do not address or quote any other item. These include studies focusing on fauna (Elias et al., 2000; Suzuki et al., 2013), ecological quality (Noble et al., 2010; Phillips et al., 2011; Costa et al., 2010; Pirez et al., 2013; Sarafraz et al., 2016; Besley and Birch, 2019a, b; He et al., 2019), risk in Pusan, South Korea (Kweon et al., 2011) or morphodynamic analysis linked to beach nourishment in Genoa, Italy (Corradi et al., 2004), video observation in Accra, Ghana (Angnuureng et al., 2016), or drowning accidents in Sanya, China (Li and Zhu, 2018). Table 6 also shows that three papers jointly deal with B5 and B6 items without ever addressing any other items (Patterson, 2007; Iskander et al., 2007; Mallmann and Pereira, 2014).

Regarding the influence of the city on the social dimension of the beach (B1 to B3 items), it appears that this is mainly studied through 11 papers dealing with the social practices on the beach (B2). Also, two papers focus on B3 (Botero et al., 2013a; Dominguez-Tejo et al., 2018); two jointly focus on B2 and B3 (Zhang et al., 2015; Usher and Gomez, 2017); two others address both B1, B2 and B3 (Botero et al., 2013b; Talpur et al., 2018); and finally, a last article focusing largely on the social dimension of the beach (B1, B2, B3) also deals with B4 and B5

Table 6
Items related to the city influence on the beach.

Papers	B1	B2	B3	B4	B5	B6	Papers	B1	B2	B3	B4	B5	B6
Elias et al. (2000)					X		Tanner et al. (2014)					X	*
Corradi et al. (2004)						X	Victoria et al. (2014)		*			X	
Iskander et al. (2007)					X	X	Windle & Rolfe (2014)		*	X	X	*	X
Patterson (2007)					X	X	Ewing (2015)		*		*	X	
Turner & Anderson (2007)							Zhang et al. (2015)	*	X	*	X		*
Cervantes et al. (2008)	X	X	X	X	X		Angnuureng et al. (2016)						X
Cohen et al. (2008)					X	*	Lee et al. (2016)		X		*		X
Silva-Cavalcanti et al. (2009)	*	X	*	*	X		Sarafraz et al. (2016)					X	
Costa et al. (2010)					X		Todd & Bowa (2016)		X	X	X	X	*
Noble et al. (2010)					X		Yu et al. (2016)	*	X	X	X	X	X
Widmer & Hennemann (2010)		*			X		Kacar & Omuzbuken (2017)		*			X	
Kweon et al. (2011)					X		Usher & Gomez (2017)		X		X		
Phillips et al. (2011)					X		Vaz et al. (2017)	*	*	*	*	*	
Tomlinson et al. (2011)		*		*	X	*	Arshad & Farooq (2018)		*	*		X	
Brignone et al. (2012)					X	*	Dominguez-Tejo et al. (2018)	*	*	*	X	*	*
Cooper & Lemckert (2012)		*	*	*	X	*	Li & Zhu (2018)						X
Enns et al. (2012)					*		Searcy et al. (2018)			*		*	
Botero et al. (2013a)	X	X	*	X	*	*	Silva-Cavalcanti et al. (2018)	*	X	X	X	X	
Botero et al. (2013b)		*	*	X	*		Talpur et al. (2018)	X	X	*	X	*	
Isla (2013)	*	*	*	*	X	X	Bagheri et al. (2019)					*	
Kim et al. (2013)	*	*	*		X	X	Besley & Birch (2019a)					X	
Pirez et al. (2013)					X		Besley & Birch (2019b)					X	
Rollnic & Medeiros (2013)					*	X	He et al. (2019)					X	
Suzuki et al. (2013)					X		Kim et al. (2019)		*				X
Hubbard et al. (2014)		*			X	*	Pinheiro et al. (2019)		*		*	X	*
Mallmann & Pereira (2014)					X	X	Wu et al. (2020)		*			X	
Marshall et al. (2014)	*	X	*	*	X	*							

B1: Accessibility from the city; **B2:** Social practices; **B3:** Users representations.
B4: Facilities and equipment; **B5:** Beach ecology and environmental quality; **B6:** Sediment dynamics.

items (Cervantes et al., 2008). Table 6 reveals the six papers addressing the three components of the beach system don't give the same importance to the city influence on the beach. Three of them study several items (Todd and Bowa, 2016; Yu et al., 2016; Silva-Cavalcanti et al., 2018) whereas the three others focus more specifically on the influence of the city on the biophysical dimension of the beach (Tomlinson et al., 2011; Cooper and Lemckert, 2012; Isla, 2013).

The beach's influence on the city (category C in Table 3) is much less studied (Table 7). 20 papers do not investigate or quote any of the three items listed in this category and only nine papers deal with at least one of these items. The items most quoted are C1 (n = 18) and C3 (n = 19), but they are rarely the main focus of the articles.

Only three papers jointly study C1, C2 and C3 items. They are part of the six papers that investigate the three components of the beach system as promoted by James (2000a). In the first article, these three items are related to coastal hazards and the perspective of sea level rise (Cooper and Lemckert, 2012). The second one analyses the influence of the beach and beach tourism on urban development in the immediate suburbs of Mar del Plata, Argentina (Isla, 2013). Finally, the third one consists of a comparison between two beach management models, and the authors define whether these models consider the different influences of the beach on the city (Yu et al., 2016).

The number of papers where two items referring to the beach influence on the city are studied is also low (n = 5). One deals with coastal land use in Kuala Terengganu, Malaysia, in relation to coastal risks (Bagheri et al., 2019). From the perspective of sustainable coastal occupation, authors are interested in C1 and C2 in relation to the attractiveness of the coast. Another paper analyses the influence of the beach on the city of San Francisco (Ewing, 2015) and discusses C1 and C2 in terms of coastal risks on the shore. A third one focusing on the perception of beach users looks at the influence of beach tourism on C1 and C3 in four cities: Enseneda, Mazatlan and Rosarito and Oceanside, particularly through the services offered on and near the beaches (Cervantes et al., 2008). A fourth one deals both with C1 and C3 while creating a system of ecosystemic indicators for southeast Florida's beaches (Marshall et al., 2014). The last one integrates C1 and C3 as part of its typology of beaches in the Lisbon metropolitan area (Vaz et al., 2017).

3.5. *An emerging but still rare promotion of collaboration between authorities and of public participation in beach management design*

In addition to the finding that few papers adopt an integrated approach of beach management in large coastal cities, our results show that very few of them propose or mention management models that integrate interactions between different local authorities and/or public participation (Table 8). Most of the papers simply do not address the issue of interactions between local authorities responsible for beach management (D1 item), nor do they discuss public participation (D2 item). Only one paper addresses both D1 and D2, showing that the absence of interaction between stakeholders contributes to conflicts and slows down management mechanisms (Yu et al., 2016). These authors also point out that public participation in management systems is one of the key principles of ICZM and favor a greater understanding and acceptance of public beach policies.

Five papers deal with only one of the two items. One article, dealing with the reintroduction of seagrass in Adelaide highlights the importance of D1 in order to improve the protection of natural beach resources (Tanner et al., 2014). The authors also show that D2 offers an opportunity to increase users' awareness of these types of environmental issues. The benefits of D1 are demonstrated in the article concerning the management of Barcelona beaches (Tomlinson et al., 2011). Through their "Systems Approach Framework", the authors show that interactions between services and stakeholders lead to more efficient management models.

Regarding D2, the article by Cervantes et al. (2008) on users' perceptions and representations suggests that relying more on users when designing beach management models would be beneficial as these models would comply more with beach users' expectations and practices. This is in line with the article on the quality of Gold Coast beaches (Todd and Bowa, 2016), where the authors also seek to measure civil participation in management policies in order to construct their index.

Table 7
Items related to the beach influence on the city.

Papers	C1	C2	C3	Papers	C1	C2	C3
Elias et al. (2000)				Tanner et al. (2014)			
Corradi et al. (2004)	*			Victoria et al. (2014)	*		*
Iskander et al. (2007)			*	Windle & Rolfe (2014)	*		*
Patterson (2007)		*		Ewing (2015)	**X**	**X**	*
Turner & Anderson (2007)				Zhang et al. (2015)	*	*	**X**
Cervantes et al. (2008)	**X**	*	**X**	Angnuureng et al. (2016)	*		
Cohen et al. (2008)				Lee et al. (2016)			*
Silva-Cavalcanti et al. (2009)			*	Sarafraz et al. (2016)	*		
Costa et al. (2010)			*	Todd & Bowa (2016)	*		*
Noble et al. (2010)				Yu et al. (2016)	**X**	**X**	**X**
Widmer & Hennemann (2010)	*		*	Kacar & Omuzbuken (2017)	*		*
Kweon et al. (2011)				Usher & Gomez (2017)	*	*	*
Phillips et al. (2011)				Vaz et al. (2017)	**X**	**X**	*
Tomlinson et al. (2011)	*	*	*	Arshad & Farooq (2018)	*		
Brignone et al. (2012)				Dominguez-Tejo et al. (2018)			
Cooper & Lemckert (2012)	**X**	**X**	**X**	Li & Zhu (2018)			
Enns et al. (2012)				Searcy et al. (2018)			
Botero et al. (2013a)			*	Silva-Cavalcanti et al. (2018)			
Botero et al. (2013b)			*	Talpur et al. (2018)	*	*	*
Isla (2013)	**X**	**X**	**X**	Bagheri et al. (2019)	**X**	**X**	*
Kim et al. (2013)	*	*	*	Besley & Birch (2019a)			
Pirez et al. (2013)				Besley & Birch (2019b)			
Rollnic & Medeiros (2013)				He et al. (2019)			
Suzuki et al. (2013)				Kim et al. (2019)	*		
Hubbard et al. (2014)	*	*		Pinheiro et al. (2019)			
Mallmann & Pereira (2014)	*			Wu et al. (2020)	*		*
Marshall et al. (2014)	**X**	**X**	*				

C1: City development and urban projects; **C2:** City infrastructures; **C3:** Tourism development.

Finally, the article on the prevention of risks associated with rip currents shows that risk reduction requires the implementation of communication strategies (Silva-Cavalcanti et al., 2018).

4. Discussion

Some findings of our literature review are rather surprising and call for some discussion. First, it is necessary to better understand why the number of papers dealing with integrated beach management in large cities is so little. This requires to look for possible bias in our methodology. Second, on the basis of our findings, it is worth discussing the surprising lack of consideration to the assessment of integrated beach management in large cities. This leads to explore the possible political and technical obstacles to such an approach of the beach in these cities. Third, we propose some thinking on how other studies could be developed in order to offer a more complete view on integrated beach management in large towns, taking advantage of some studies already existing for little and medium size cities.

Table 8
Items related to public participation and interactions among local authorities in beach management.

Papers	D1	D2	Papers	D1	D2
Elias et al. (2000)			Tanner et al. (2014)	**X**	*
Corradi et al. (2004)			Victoria et al. (2014)		
Iskander et al. (2007)			Windle & Rolfe (2014)		
Patterson (2007)			Ewing (2015)		
Turner & Anderson (2007)		*	Zhang et al. (2015)	*	
Cervantes et al. (2008)			Angnuureng et al. (2016)		
Cohen et al. (2008)			Lee et al. (2016)		
Silva-Cavalcanti et al. (2009)			Sarafraz et al. (2016)		
Costa et al. (2010)			Todd & Bowa (2016)	*	**X**
Noble et al. (2010)			Yu et al. (2016)	**X**	**X**
Widmer & Hennemann (2010)	*		Kacar & Omuzbuken (2017)		
Kweon et al. (2011)			Usher & Gomez (2017)		
Phillips et al. (2011)			Vaz et al. (2017)		
Tomlinson et al. (2011)	**X**		Arshad & Farooq (2018)		
Brignone et al. (2012)			Dominguez-Tejo et al. (2018)	**X**	*
Cooper & Lemckert (2012)			Li & Zhu (2018)		
Enns et al. (2012)			Searcy et al. (2018)		
Botero et al. (2013a)			Silva-Cavalcanti et al. (2018)		**X**
Botero et al. (2013b)			Talpur et al. (2018)		
Isla (2013)		*	Bagheri et al. (2019)		
Kim et al. (2013)			Besley & Birch (2019a)		
Pirez et al. (2013)			Besley & Birch (2019b)		
Rollnic & Medeiros (2013)			He et al. (2019)		
Suzuki et al. (2013)			Kim et al. (2019)		
Hubbard et al. (2014)			Pinheiro et al. (2019)		
Mallmann & Pereira (2014)			Wu et al. (2020)		*
Marshall et al. (2014)					

D1: Interaction among local authorities; **D2**: Public participation.

4.1. Possible methodological bias in detecting papers on integrated beach management in large cities

Because beach management is a rather old and wide area of research and because coastal cities are places facing various challenges in terms of coastal management, the total number of articles we extracted from the WoS may be seen as under evaluated. Therefore, we looked for possible bias and explanations to validate our results.

First, we questioned the threshold of 500,000 inhabitants that was defined in order to select the papers. Indeed, if this threshold had been lower, other articles related to our topic would have been included. For instance, Lucrezi et al. (2015), who cross-referenced users' and managers' representations regarding the Blue Flag on beaches in several South African municipalities, including Cape Town, would have been considered. Another example is the work of Ribeiro et al. (2011) on beach users' perceptions of mass attendance, conducted in Cascais, within the Lisbon Metropolitan Area. Other works dedicated to the beach influence on real estate market in Pensacola, United-States (Hamilton and Morgan, 2010) or more cultural approaches, such as the one developed by Bank (2015) to assess beach territoriality in the post-apartheid era in East London, South Africa, could have been interesting papers to consider in the frame of our analysis. But the study areas of these papers are cities with populations between 200,000 and 400,000, which exclude them from our "large city" category.

Second, our decision to only select papers written in English also led us to exclude other papers relevant to our topic. For example, a paper in Spanish comparing Montevideo, Uruguay, and Balneario-Camboriu, Brazil, dedicated to urban beach governance (Bombana et al., 2016) or another one written in Portuguese dedicated to the scenic value of the beaches in Florianopolis, Brazil, regarding the level of urbanization (De Oliveira et al., 2016) are part of our DataSet 1 but were excluded from DataSet 2.

Third, we searched for a possible "Web of Science effect" on our results. Though this tool is powerful and can be seen as a reference in terms of indexation of scientific publications, we indeed tried to randomly check whether papers we identified by other means were in our results from the WoS. We could notice that one paper was not in DataSet 1 whereas "beach management" do appear in its abstract and keywords (Lucrezi et al., 2016). This is the only example we found, but it shows that the completeness must always be questioned. Knowing this limit, we made a new search on the WoS applying the same protocol several months after our initial work, to verify the strength and stability of the system to extract DataSet 1 and DataSet 2. Surprisingly, the result we obtained was different from the initial one (481 items for DataSet 1 while we had 446). These differences are linked to a recent evolution of the WoS which now makes some book chapters appear in the results, even when the query is made on papers only. Though our decision to only consider papers and not books or book chapters can be discussed, the fact that our second search on the WoS gives similar results (except regarding Lucrezi et al., 2018) shows that the system is highly reliable. Regarding the possible input that books and book chapters could have given, we had a look at the results obtained from the second search on the WoS. Except one book chapter where Cape Town, which is a little less than half a million inhabitants, is the case study (Lucrezi et al., 2018), we noticed that beaches studied are always located in medium cities. Also, other books that we found from other sources than the WoS, such as Botero et al. (2018) or Williams and Micallef (2009), offer interesting developments on integrated management since both the social, biophysical and governance components of the beaches are assessed. But mostly, these works do not focus on large coastal cities.

4.2. Obstacles to the elaboration of an integrated management model for beaches located in large cities

Despite the numerous challenges coastal cities and their beaches are facing today and the age of ICZM, our results reveal that this framework is still little used regarding beaches in large cities. The different issues related to beach management are mainly addressed in an isolated way, whereas the ICZM principles underline the need of global approaches to manage complex systems such as beaches (Chua, 1993; Kenchington and Crawford, 1993; Cicin-Sain and Knecht, 1998). Knowing that one of the hindrances to achieving integrated management is the lack of crossover between the ecological, economic and socio-cultural spheres (Klinger, 2004), the low number of cross-sectoral papers is rather surprising. This finding questions the possible political and technical obstacles which underlie this lack of studies. This observation may be related to a lack of coordination between different stakeholders. While working on integrated management models in small or medium-sized cities, some authors highlighted that this fragmentation makes it harder to implement integrated management models at the beach level (Sarda et al., 2015; Palazón et al., 2016). The difficulties related to the division of competences between stakeholders were recently highlighted by Sauer et al. (2021) in an article on adaptation to climate change in the Barcelona Metropolitan Area. Their work reveals the complexity of coastal governance within large urban areas and confirm previous observations made by Bombana et al. (2016) regarding beach management governance in Montevideo and Balneario Camboriu. This observation calls for further research on the coordination of stakeholders involved in coastal management in large cities. These difficulties also require an evaluation of the efficiency of these public policies. In this respect, Ehler (2003) has developed a series of indicators to assess the progress of public policies towards integrated management. This approach, developed in his work to evaluate the management of marine protected areas, could be transposed to public policies for beach management in large cities adapting some of the criteria. In a similar way, Pickaver et al. (2004) developed a model to assess the progression toward integrated management over time through different phases which go from sectoral approaches to fully completed ICZM. Though the models they studied apprehend integrated management both at the national and the local scale, it could be really interesting to implement these models to evaluate beaches integrated management in large cities.

4.3. Applying to large city integrated management tools created for smaller cities?

The relatively small number of papers dealing with integrated beach management in large cities calls for some thinking regarding a possible city size effect on research projects. Indeed, studying beach management in large metropolis may be related to the difficulty to handle such an issue in large, complex and densely populated places, where it is not easy to interact with all stakeholders. In smaller municipalities, such an approach seems easier. For example, several authors succeeded to develop a systemic approach to evaluate current management methods or to propose new, more integrated management models. Among these works, an evaluation of the management systems implemented on the Catalan coast, Spain, through a selection of criteria representative of the beach system (Ariza et al., 2008a) or by creating a beach quality index (Ariza et al., 2010) can be noticed. Some other works were an investigation on the management systems implemented through a questionnaire distributed to local stakeholders (Ariza et al., 2008b, Palazón et al., 2016) or directly to the users (Lozoya et al., 2014). Some authors also developed new integrated management models, such as the Ecosystem Based Management System (EBMS), and show how it could improve the standard management systems (Sarda et al., 2015; Sarda and Lozoya, 2018). They underline the added-value of considering a beach as a social-ecological system when conceiving management models. With no doubt, studying beach management in a small or medium size city is possible.

As Sarda et al. (2015) highlight, it is important to consider the influence of urban planning policies on beaches, which clearly makes sense in large cities. This is also what comes out of the work of Semeoshenkova et al. (2017), whose calculations to produce a beach quality index are weighted according to the degree of urbanisation of the place where beaches are located.

However, these models are often limited to the sole beach or its immediate surroundings whereas an important challenge lies in the various city-beach interactions in large cities. Indeed, the beach has a strong relationship with the waterfront, whether it be its influence on the urban fabrics structuration (Cartlidge, 2011) or on the prices of the touristic facilities (Rigall-I-Torrent et al., 2011). Also, the link between the beach and the whole city has been shown on various aspects, in terms of accessibility (Kim and Nicholls, 2016) or in terms of major urban projects related to the seashore (Prytherch and Boira-Maiques, 2009). While our review reveals that no article explores the equity of access to beaches, several authors have shown that this is a major issue in coastal cities, through studies on accessibility (Micallef and Williams, 2002; Oh et al., 2008; Dixon et al., 2012; Kim et al., 2019) or on real estate prices in neighborhoods near beaches (Chica-Olmo et al., 2020). In this sense, beaches in large cities ought to be considered as public urban spaces which are part of the city in terms of attendance, practices, and planning. From these observations, the integrated management models designed from small or medium-sized municipalities could be implemented through adjustments. Indeed, large cities specificities in terms of practices, infrastructures or public transportation ought to be taken into account in these models. For instance, it could be interesting to adapt and implement these models to different large cities and to assess their progression toward integrated management despite the institutional context and their specificities.

In line with this idea, some cities are already proposing innovative responses. For instance, Barcelona developed a strategic plan called Pla lito*ral, pla estratègic dels espais litorals de la ciutat* (Strategic plan of the city coastal areas) (2019), which may correspond to this acceptance of an integrated multilevel beach management. Indeed, while considering both the ecological and social dimensions of the beach, local managers

considered the different city-beach interactions and made it possible for various stakeholders of the coast to commit during the design of this document.

5. Conclusion

Though large coastal cities are places with a lot of ecological, economic and social challenges in relation to the seashore, this review sheds light on the relatively weak number of studies concerning beach management in such a geographical context. Also, despite the design of integrated beach management models in the early 2000 (James, 2000a; Micallef and Williams, 2002), our analysis reveals that few papers dedicated to beach management in large cities are in line with these systemic approaches. On the contrary, we highlight the preponderance of papers adopting a sectoral approach. In particular, most of the papers only focus on the biophysical component of the beach and only a few are dedicated to its social component. As a result, the number of articles where the beach is studied as a social and ecological system is very low. Moreover, the analysis reveals a lack of theoretical papers on beach management in large coastal cities. Most often, management issue is quoted only to give sense to the methodological protocol implemented or to provide some recommendations to the local stakeholders in the discussion or conclusion sections. Also, most of the papers indicate that the results obtained are likely to be an aid for management decisions, but beach management is not the real subject of these studies.

Another interesting finding is that very few papers consider the mutual influences existing between the beach and the city, which appear surprising considering the obvious links between them. Due to the predominance of sectoral approaches, papers only analyse beach-city interactions in relation to a specific issue, such as bathing water quality or social practices. This reveals that beach-city interactions are not considered as a research topic in most of the papers identified. The lack of theoretical approach regarding beach management also appears when it comes to public participation or interactions among local authorities. Very few papers recall the necessity to involve beach users or to implement better coordination between the local management bodies, and most often it comes as a quick recommendation at the end of the paper.

Finally, the main output of this review is that beach management in large coastal cities deserves more attention from researchers. Located at the interface of dense, large, and sometimes old urban areas, these beaches are facing many challenges that requires specific management models. This need for further research is especially acute as large cities and their beaches are being threatened by rising sea levels due to climate change (Nicholls, 1995; Nicholls, 2003). Furthermore, the global health crisis induced by Covid-19 has set out the expectations of urban dwellers for access to open spaces in contact with nature and refers to the issue of socio-environmental justice (Olszewska-Guizzo et al., 2021; Poortinga et al., 2021; Ugolini et al., 2021). In this sense, Botero (2020) shows how the covid-19 epidemic has highlighted the environmental, social, and economic value of beaches, using the cases of Santa Marta and Cartagena. Finally, the Sustainable Development Goals introduced in 2017 by the United Nations remind us that cities and the oceans are a critical issue for sustainability.

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