# Design of an integrated evaluation index for recreational beaches

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## Abstract

An integrated index to evaluate recreational sand beaches (IBVI) was designed using descriptive beach indicators (BI), beach user's perception (KI) and indicators of beach economic value (MI). This index was applied in five urban sandy beaches with similar physiographic features, but economically and socio-culturally different (Ensenada, Rosarito and Mazatlan in México; Copacabana in Brazil; and Oceanside in Southern California in USA). According to the IBVI evaluation, Oceanside was the best beach, all values rating high, followed by Copacabana with high BI and KI but low MI. Mazatlan was rated medium, although user's perception was high. Poorly developed beaches, such as Ensenada, were rated medium for BI, KI and low for MI. The IBVI value at Rosarito was rated medium−low because both the BI and KI values were low. IBVI incorporates three visions for beach awards in one and can be useful to compare tourist sand beaches around the world.
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## 1. Introduction

Sand beaches are among the most valuable ecosystems used for outdoor recreation worldwide. Incorporated as parks and gardens in coastal cities, leisure and relaxed activities, such as watching wildlife and birds, walking or practicing water sports are common at beach areas [1]. As a natural resource of the coastal zone, sand beaches are perfect laboratories for the implementation of coastal zone management paradigms. Sand beaches are considered multifaceted study objects that can be managed by designing environmental management instruments with an integrated approach, meaning integrating physical, biological, socio-cultural and economic values [2].

Urban beaches play an important role in defining the development of large projects of tourist infrastructure that yield large economic inflow which benefits both local and international businesses. For example, California (USA) provides both direct and indirect services worth 27,000 million dollars, representing 3% of the state economic activity [3,4]. Houston

[5] established that for each dollar invested in beach maintenance in the USA, $600 return as taxes paid by national tourism and $20 by foreign tourists.

Nevertheless, and particularly in traditional beach countries, economic values have targeted a unidirectional development, largely dominated by mass tourism [6,7] which has caused beach development to drift from sustainability. Some environmental impacts reported are erosion, pollution, and landscape loss − the latter essentially being the main motive to start the development itself [7−13].

In the last 10 years, important attempts have been made to evaluate sand beaches to seek beach awards as a promotional tool [14]. Receiving national or international certifications such as Blue Flag [15], Blue Wave [16], National Healthy Beach Campaign [17] or Seaside Award (replaced by the Quality Coast Award in 2007 [18]) has motivated researchers, consultants and decision makers to design models, suggest sets of variables, select indicators and develop integrated schemes to collect beach data in comparable ways, which will identify the best beaches in a nation, a region or even worldwide.

Most sand beach evaluations are based on either simple or complex combinations of characteristics for beach classification and recommendations for common management. Chaverri [19] classified sand beaches of Costa Rica using a subjective

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evaluation technique based on more than 100 characteristics. Short [20] classified Australian sand beaches where surfing is common using risks indicators such as currents, tides, reefs, strong winds, and wave patterns. Williams et al. [21] proposed a classification scheme using 50 biophysical and socioeconomic characteristics. Williams and Morgan [22] and Morgan [23] later modified it by identifying the importance of beach users' preferences and priorities when choosing those characteristics. Leatherman [24] designed a quantitative scheme similar to that of Williams et al. [21] to compare and classify recreational sand beaches by using 50 criteria divided into biological and physical impacts and human use categories. These categories are scored from 1 (most negative) to 5 (most positive).

Beach evaluations are used for international certification [15–18] and are based on the fulfillment of specific criteria for sand beaches (26 in the case of blue flag). They are related to water quality, environmental information and education programs, compliance with environmental laws, and the presence of safety corps and other services. The certificate is reissued annually to ensure fulfillment of criteria [15].

These certification schemes provide a technical view that does not consider the ever-changing expectations of users (who also watch the landscape, sunbathe, eat, or rest after swimming). Besides, these schemes apply mainly to urban sand beaches, which have infrastructure and services such as restrooms, waste deposits, signs, and so on. Recently, new certification schemes have been developed for rural beaches with conservation objectives [18,25].The World Health Organization (WHO) [26], jointly with the United States Environmental Protection Agency (EPA) proposed a scheme that integrates microbiological measures, population, age demographics, riverine inputs, proximity to outfalls and flushing rates. Micallef and Williams [10,11,13] developed a scoring and classification system for swimming areas called *Bathing Area Classification System* (*BARE*). This system uses 45 different indicators for both rural and urban sand beaches. The indicators are grouped into safety categories, bathing water quality, infrastructure and cleanliness, beach influence area (hinterland), and trash quantification. These authors [10,13], and Pereira et al. [9], selected beach characteristics and ranked them in order of importance by distributing surveys among beach users. The two elements (descriptive beach features and users' perception) were then used to design management plans tailored for each beach.

Micallef and Williams [10] recommended considering economic characteristics to evaluate and classify sand beaches. Contingency values, hedonic prices, and travel costs have been published [27–32] but, in most beach evaluation literature, monetary values have been underestimated, given little weight, or not considered, e.g. the increase of real estate values in coastal zones [10]. Therefore, as in a previous exercise in seven Mexican beaches [33], in this work we used similar criteria to describe beaches and users' perception as they appear in the literature, but we added a monetary value by incorporating three economic indicators for urban beaches.

The index was applied to five urban beaches in America (Fig. 1) in order to identify the main factors affecting the integral quality of recreational beaches in different socioeconomic environments.

## 2. Study area

Five urban beaches with similar physiographic characteristics (sandy, wide, and extensive) but with marked differences in terms of socio-cultural and economic features were selected. Three sandy beaches of northwestern Mexico were included in the study, two in semiarid (Ensenada and Rosarito) and one in tropical climate (Mazatlan), a beach in tropical Rio de Janeiro, Brazil (Copacabana), and one in semiarid Southern California, USA (Oceanside).

## 3. Rosarito, México

Rosarito, in Baja California, Mexico, is one of the main tourist destinations of the state because of its strategic location only 15 km away from the Mexico–USA border with California, one of the richest states in the USA [34]. This has attracted tourism since 1920, which turned into the most important local activity; so important that it supports and encourages other activities such as commerce and real estate [7]. There are 11 km of sand beaches in Rosarito that represent the natural resource visited by tourists [35]. In 2002, the city had 2220 rooms in 31 hotels [36]. This sector employs more than 65% of the economically active population [37]. Tourists arrive mainly from the state of California, USA. This flow has been classified as cross-border tourism [38] by the World Tourism Organization (UNWTO) based on the length of time of their stay (24–72 h).

## 4. Ensenada, México

Ensenada, in Baja California, Mexico, depends on tourism as one of its main income sources, employing 54% of the economically active population [34]. Tourists come primarily from the USA (68%), especially from southern California. In 1998, the city had 70 hotels, with a total of 2769 rooms [39] and this has slowly grown until recently, when residential tourism is being promoted. Visitors, attracted by climate (27%), beach (15%), and shopping (14%), arrive in Ensenada mainly by land. However, an important segment does come in by sea either on cruises or in private boats [36].

## 5. Mazatlan, Mexico

Mazatlan, Sinaloa (Mexico) is a traditional beach destination in North America. Located on the coast of the Gulf of California, its tropical climate and 17 km of continuous sandy beaches are the main tourist attraction. Sport fishing, surfing, beach sports, jogging, swimming, sunbathing, sightseeing, eating, and drinking are the main recreational activities [40].

Tourism (62%), commerce, and fishing (CONAPO, 2006) [69] are the most important economic activities. The city has infrastructure of 139 hotels offering 9410 rooms in different categories [40]. In 2002, it received 1,225,800 visitors; 59%
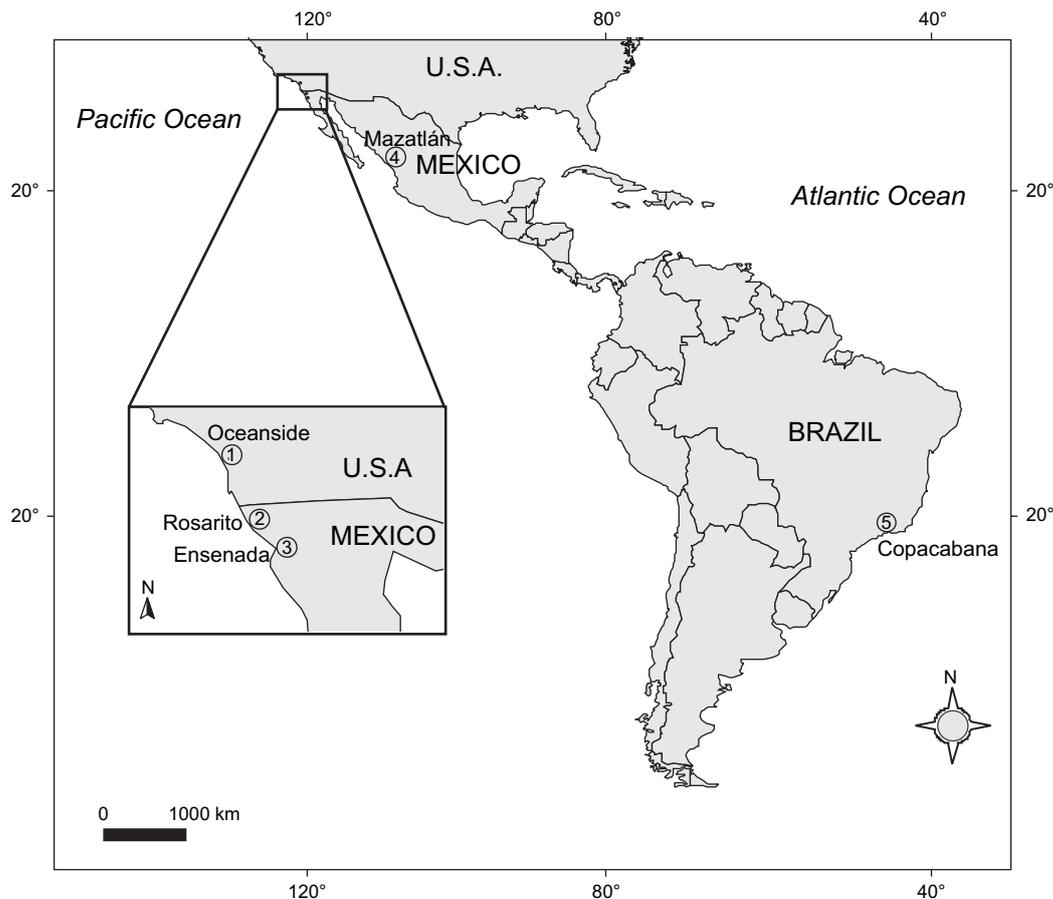
Fig. 1. Study area.

(722,400) as domestic tourists mainly from Guadalajara, Monterrey, and Mexico City; and 41% (503,400) foreigners from the USA and Canada, with 64% (322,000) of them coming in by cruise ships [40].

## 6. Oceanside, USA

Oceanside in southern California (USA) is 56 km north of San Diego and 137 km from Los Angeles. This city is located in one of the richest countries of California with a typically local style of living known as "Southern Californian" that dwells around the beach. It has historically been a tourist beach destination. During the last decade, the city received an average of 2.3 million tourists per year, 69% were Californian and the rest came from other states and foreign countries, and the main destination was the beach [3] (www.ci.oceanside. ca.us) [71]. Sunbathing, swimming, surfing, sport fishing, and nautical activities; wind sailing, kayaking, and riding jet skis are the most important recreational activities [3].

## 7. Copacabana, Brazil

Copacabana is located in Rio de Janeiro, Brazil. This beach is internationally recognized and receives a large amount of foreign and national tourists who are attracted by its fine sands, sea, and sun. Brazilians consider sand beaches as an extension of their home (IBOPE, 2005) [70]; hence, their culture is oriented towards the sea and its sand beaches [41]. The most important recreational activities at the beach are swimming, beach soccer and volleyball, sunbathing, eating, drinking, and enjoying the sights.

## 8. Methodology

Beach Index (BI) describes and evaluates the aptness of the beach for recreational purposes.

A descriptive matrix of each urban sandy beach was designed based on Fischer et al. [42], Cendrero and Fischer [43], Pereira et al. [9], Micallef and Williams [10], Villares et al. [12] Williams et al. [21], Leatherman [24] and Espejel et al. [33].

It considers 36 ecological indicators of biophysical features (sand color, texture, water temperature, etc.) and environmental issues (dirty sand and water, bad smells, trash, etc.); it also considers 38 socioeconomic indicators describing infrastructure and services (parking lots, restaurants, lifesavers, etc.). Each of these 74 descriptive records appraises the aptness of the beach for recreational activities using water and sand intensively (for instance motorized vehicles both terrestrial and aquatic), in addition to other activities such as sunbathing, walking, swimming, reading, etc. (Table 1).

One investigator (the same one) walked the four beaches and observed all attributes in the descriptive card, these were analyzed by qualifying them into three categories [44–46] assigning a value of 3 if it were favorable, 2 if indifferent, and 1 if unfavorable for recreational activities (BI) (Table 2).

## 9. Knowledge Index (KI; users' perception)

To determine the users' perception of these beaches, previous work by Pereira et al. [9] on the coast of Brazil , McLeod et al. [8] on rural Irish and Portuguese sand beaches , and Morgan et al. [47] in the United Kingdom was used as reference. The questionnaires used to establish user's perception were adapted and modified through a series of pilot tests thus generating a 36-question survey.

Chadwick [48] suggests that this piloting exercise must be done at a site similar to the study area. The municipal beach (Conalep in Ensenada, Mexico) was selected for this purpose [33]. The final questionnaire was prepared in Spanish and English versions to be randomly applied to beach users.

The questionnaire focused on three main aspects:

(1) The user profile, in which age, schooling, sex, marital status, occupation, and origin are determined.
(2) The user's attitude towards the beach, for example, favorite activities, preferred season to visit, reasons for attending, and their chosen company, among others.
(3) The user's opinion about the biotic and abiotic attributes of the beach and conditions of infrastructure and services.

Both attitude and opinion represent the user's perception and define the knowledge index (KI).

The minimum number of surveys for statistic significance was determined by the probabilistic expression of Snedecor and Cochran [49] proposed by Ibarra [50] for infinite universes ($N = 1000$) or finite non-accounted for the content of floating elements was used. The survey was applied to beach users during weekends and days off, when beaches receive the greatest number of visitors.

Repetitions in the answers to questionnaires were detected, thus isovariance curves were used to stop surveying. Cochran and Cox [51] and Solana-Sansores and Arreguín-Sánchez [52] suggest this method to check if the number of surveys is optimal.

The survey was analyzed as follows:

1. The frequency of response types was calculated. Frequency analysis allowed us to obtain a first picture of the users' opinion and attitude towards the beach.
2. Value ranks were defined. The answers were described in three categories (favorable: 3, regular: 2, and unfavorable: 1) which are commonly used among beach researchers [44–46]. Based on previous publications [10,11,21,24] a worldwide favorite beach for urban recreation and tourism development was described. This ''ideal'' beach has sand, it is not deep, the temperature of the water is pleasant, it lacks dangerous animals, sand and water are clean, no bad odors or discharges are present, it is not dangerous, and it has basic infrastructure and services (access, bathrooms, security, lifeguards, shade, and small shopping areas) (Table 2).

For Rio de Janeiro, a previous survey by the Brazilian Institute of Public Opinion and Statistics (IBOPE, 2005) at Copacabana beach was used as a reference to define user's perception.

## 10. Monetary Index (MI; economic value)

To assess the effect [33] of the beach on the economic indicators defined by both the market and private interests or by those established by public and institutional interests we selected the following parameters:

(1) Property tax per square meter.

Table 1
Example of the evaluation form to define the beach index (BI)

| | | | | | | Given value for recreational beach aptitude |
|---|---|---|---|---|---|---|
| *Biophysical and pollution indicators* | | | | | | |
| Beach width (m) | <5 | 5–10 | 10–30 | 50–80 | **>80** | **2** |
| Sediment color | Dark | Gray | Brown | **Light gold** | White | 3 |
| Morphodynamics | Reflective | | **Intermediate** | | Dissipative | 2 |
| Vegetation cover (%) | <10 | 10–20 | 20–30 | <30 | **Absent** | 2 |
| Dangerous animals | **Present** | | | | **Absent** | 1 |
| Trash | Too much | Moderate | **Few** | None | | 2 |
| Sewage outfalls | Present | | | | **Absent** | **3** |
| *Infrastructure and services indicators* | | | | | | |
| Beach use intensities | Saturated | | **Moderate** | | Low | 2 |
| Garbage collectors | None | 1–5 | 6–10 | **>10** | | 3 |
| Public restrooms | None | 1–3 | **3–5** | >5 | | 2 |
| Sport facilities | Absent | | | **Present** | | 3 |
| Car parking distance | >500 | 200–500 | **100–200** | <100 | | 2 |

Favorable (3), indifferent (2), unfavorable (1) attributes for active and passive recreation.
In bold some actual Copacabana beach features.

Table 2
Example of response classifications according to favorability analysis (KI)

| Index | Categories | Question | Answer | Favorability | Classes |
|---|---|---|---|---|---|
| Opinion | Beach conditions | Water temperature | Nice/normal pleasant | 3 | High |
| | | | Warm | 2 | Medium |
| | | | Cold | 1 | Low |
| | Beach public services | The public services (restrooms showers etc.) of this beach are: | Adequate | 3 | High |
| | | | Inadequate | 2 | Medium |
| | | | Nonexistent | 1 | Low |
| Attitude | Recreation habits | You prefer to come to the beach on | Weekends | 2 | Medium |
| | | | Both | 3 | High |
| | | | Weekdays | 1 | Low |

(2) Price per square meter of land in the real estate market.
(3) Three-star hotel room rates.

Spaces with and without beach front, at two blocks or 200 m distance inland or towards the urban areas from the physical limit of the sandy part of the beach. Each of these values was converted into US currency (USD) to compare values.

To compare indexes the numerical values were standardized using the Nijkamp and Rietveld [53] non-parametric statistic defining three classes: high, medium, and low. Finally, all the indexes (BI, KI, MI) were compiled in a matrix and beaches were arranged from the lowest to the highest value integrating the IBVI index (Table 6).

## 11. Results

### 11.1. Beach Index (BI)

Copacabana beach presented the highest values based on the quality of its physical attributes, zoning of beach activities and infrastructure and services offered by municipal and hotel areas (Table 3). Mazatlan and Oceanside were medium rated beaches. Although in Mazatlan the physical conditions of the beach are reasonably good, public services are insufficient. On the contrary, in Oceanside physical conditions are poor (cold water and chronic beach erosion) but beach infrastructure is fairly good. Ensenada and Rosarito were rated the lowest because beach activities are chaotic: vehicles, horses, salespeople and drunkards mix in with peaceful families and tourists, and beach infrastructure is incipient or inexistent.

### 11.2. Knowledge Index (KI)

Sand beaches are mainly used by married couples, usually employees, aged between 25 and 49 years. Oceanside visitors have higher education (56%) while in Rio de Janeiro the study level reaches high school (37%) and in Rosarito, Ensenada and

Mazatlan (37, 36, 32%, respectively) visitors have only had elementary schooling (Fig. 2).

Mazatlan and Oceanside had high ranking, while Ensenada and Rosarito were only given medium and low value, respectively (Table 4). In spite of the chronic erosion and cold water mentioned in the BI description of Oceanside, most users agree that it classifies within the concept of the "ideal beach". Paying little attention to sewage runoff odors and the lack of services, Mazatlan users attached importance to the physical conditions such as warm water and tropical climate. Ensenada and Rosarito cannot be classified as tourist beaches yet, though they are appreciated by local residents for some of their favorable physical attributes; especially for walking or resting rather than for swimming. Beach users mentioned the absence of infrastructure and pointed out danger caused by the presence of trash, by some users' behavior and other uncontrolled activities.

### 11.3. Monetary index (MI; economic value)

In Oceanside, monetary value is ranked high (Table 5) because all values except hotel room rates were high. On the other hand, Mazatlan, Ensenada and Rosarito ranked medium in MI value. Copacabana shows a low value in two of the three monetary indicators.

### 11.4. Integrated beach value index (IBVI)

The index is: IBVI = BI, KI, MI,
where,

IBVI = integrated beach value index.
BI = beach index: expresses the recreational capacity of the beach according to its biophysical and environmental attributes and its infrastructure and services.
KI = knowledge index: evaluates opinion and the attitude of the users on the beach.
MI = monetary ndex: estimates the economic value of the beach in monetary terms.

Table 3
Beach Index (BI)

| Index/beach | Ensenada | | Rosarito | | Mazatlán | | Copacabana | | Oceanside | |
|---|---|---|---|---|---|---|---|---|---|---|
| Recreational aptitude of the beach (BI) | Medium | 0.38 | Low | 0 | Medium | 0.88 | High | 1 | Medium | 0.70 |

Describes the urban sandy beaches by 29 of biophysical, 38 infrastructure and services and 7 environmental quality attributes. Numbers are standardized values in three ranks (0–0.18 = low, 0.19–0.88 = medium; 0.89–1 = high).
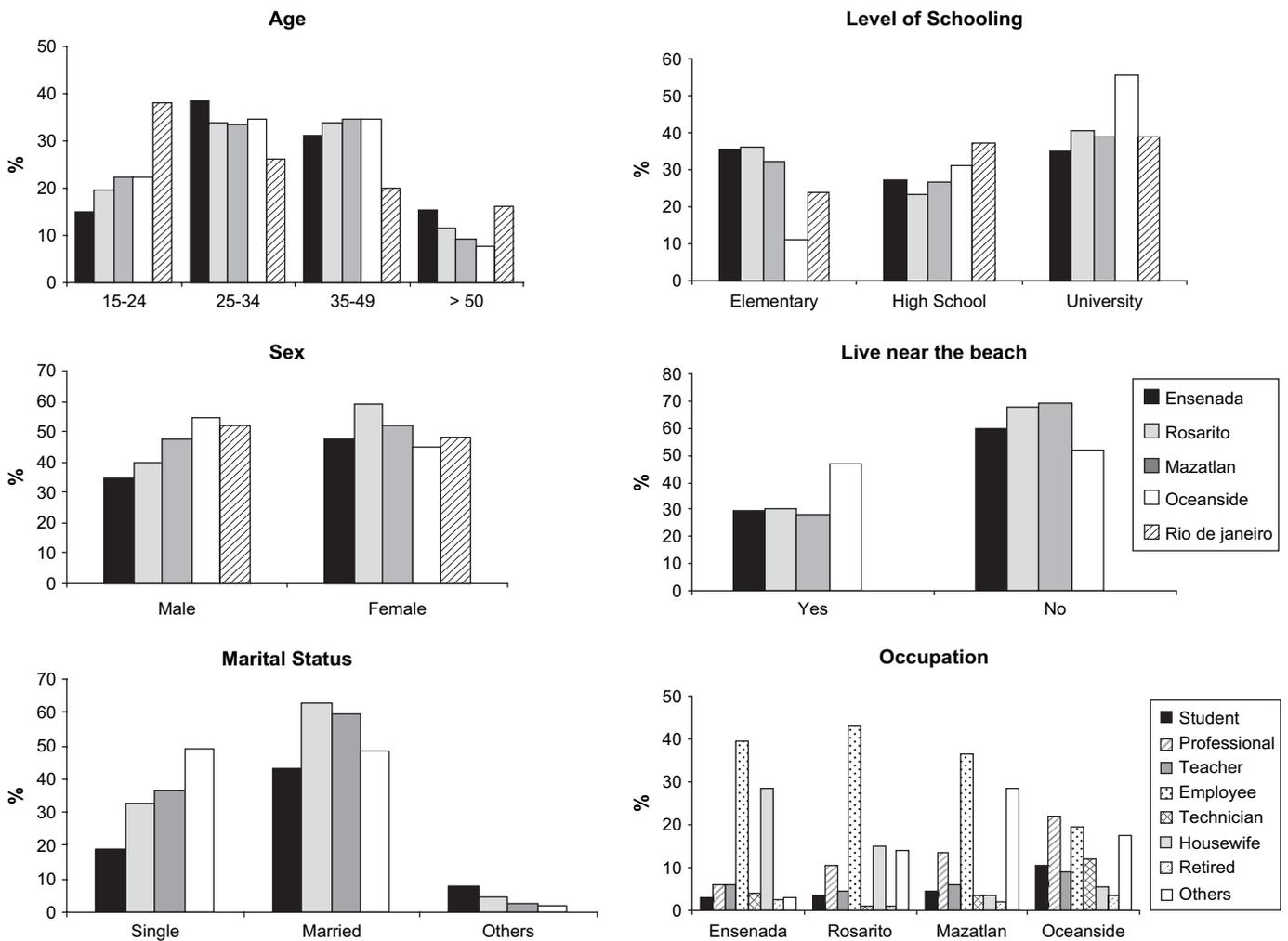
Fig. 2. Users' profile (%) of the studied sand beaches.

Results are described in Table 6. Oceanside shows the highest rank in all indexes, followed by Copacabana where, despite the high value obtained, the monetary value is medium. None of the beaches ranked low in all indexes, however, all Mexican beaches received a medium value because, except for the users' perception of Mazatlan, all other indexes ranked as medium or low.

## 12. Discussion

The index proposed in this work allowed to integrate three types of parameters of different origin that had never been put together before. Although similar beach descriptions (equivalent to BI) have been presented by Fischer et al. [42], Cendrero and Fischer [43], Pereira et al. [9], Micallef and Williams [11],

Villares et al. [12], Williams et al. [21] and Leatherman [24] and the user's perception (equivalent to KI) reported by Pereira et al. [9], McLeod et al. [8] and Morgan et al. [47], none of these had incorporated the economic value in monetary terms as previously suggested by Micallef and Williams [10,11]. Understanding the three indexes BI, KI, and MI, the integrated beach value turned out to be meaningful.

## 13. Beach Index (BI)

Copacabana offered the highest quality (Table 3) for recreational use because it has favorable requirements for sand and water activities and beach managers have spatially separated recreational activities. In contrast, Oceanside is similar to

Table 4
Knowledge Index (KI) expresses beach user's perception

| Index/beach | Rosarito | | Ensenada | | Mazatlán | | Oceanside | |
|---|---|---|---|---|---|---|---|---|
| Opinion | Low | 0 | Low | 0 | Medium | 0.8 | High | 1 |
| Attitude | Low | 0 | Medium | 0.5 | High | 1 | Medium | 0.5 |
| User's perceptions | Low | | Medium | | High | | High | |

Numbers are standardized values and ranks were defined according to the curve's inflection (0–0.5 = low, 0.6–0.8 = medium, 0.9–1 = high).

Table 5
Monetary Index (MI) reflects the economic value of the beach

|  | Copacabana |  | Ensenada |  | Mazatlán |  | Rosarito |  | Oceanside |  |
|---|---|---|---|---|---|---|---|---|---|---|
| Property tax | Low | 0.11 | Medium | 0.22 | Low | 0 | High | 1 | High | 0.76 |
| Real Estate | Low | 0.05 | Low | 0 | Medium | 0.27 | Medium | 0.54 | High | 1 |
| Room rates | Medium | 0.44 | High | 0.5 | High | 1 | Low | 0 | Low | 0.16 |
| Rank (MI) | Low | 0.6 | Low | 0.72 | Medium | 1.27 | Medium | 1.54 | High | 1.92 |

Numbers are standardized values, the class rank is given by the curves inflexion points (for MI it is 0.6–0.72 = low, 0.73–1.54 = medium, 1.55–1.96 = high).

Copacabana in terms of the spatial distribution of activities but the quality for recreation was ranked medium because the seawater is polluted and the beach is being eroded due to the construction of the adjacent navy base and dams [3,54] (www.spl.usace.army.mil) [73]. Besides, the San Luis Rey River, which acts as natural drainage of the highly urbanized area [55], diminishes water quality, which in turn limits beach activities, especially during the rainy season [56]. In agreement with Hanemann et al. [57], these authors report that the main problem in the San Diego County and southern California sand beaches is the bad quality of the water used by swimmers.

Mazatlan was ranked medium because, although it is a favorite beach for Mexican tourists, services are not well organized and almost no infrastructure for recreational support is present. Ensenada also ranked medium. It was registered as having cold water, which is due to the presence of the cold California Current. Therefore, the beach is preferred by residents for walking and for the "ocean view" rather than for swimming and sunbathing. Besides, it has litter [58] and deforested sand dunes. The lowest value for BI was recorded in Rosarito because, although physical features are fairly good, lack of infrastructure and services and polluted water and sand are important descriptors for the evaluation of recreational sandy beaches [16–18,59].

If, in the near future, beaches are monitored with the method presented in this work, the evaluations for Ensenada and Rosarito will radically change since huge ocean-view urbanization plans are coming up in the next 5–10 years.

This index can be compared to others that are found in literature, mostly checklists like Leatherman [24], Pereira et al. [9], Williams et al. [21], Villares et al. [12], but the BI is a more similar index to those presented by Fischer et al. [42], Cendrero and Fischer [43] and Micallef and Williams [10,11] in which all descriptors are evaluated. These authors have evaluated coastal areas for conservation (rural beaches for others) and developed areas. In Mexico, Enriquez [59] determined beach recreational capacities by comparing the specific requirements of an activity and the existing attributes on

the used beaches in a similar format as the one used in this research.

Nevertheless, our proposal can be considered advantageous because it allows to define the recreational aptitude of any type of beach, be it in a mass tourist area or in a wild isolated site. The index allows to detect the attributes that do or do not favor the recreational aptitude of any beach. It is possible to directly identify the missing elements make it an ideal beach and to design strategies or actions directed to recover or improve those elements which, if compiled, would bring about an increase in the recreational offerings and attractiveness of the beach.

## 14. Knowledge Index (KI)

According to IBOPE (2005), an opinion as well as an attitude gives a high value to Copacabana. This survey, in accordance with Fessler et al. [41] and Gomes [60], refers to the culture and sense of belonging to this beach, which was interpreted as of high value. The survey mentions that walking, running, swimming, sunbathing, and sports like football, volleyball, and frescobol (a kind of beach tennis) are the main activities in Copacabana beach. Similarly, Mazatlan and Oceanside were highly ranked by users but for different reasons. The user's perception of Oceanside beach considers the beach as part of the "social imaginary" and "California lifestyle" [3,55,57]. The user's perception of the beach at Mazatlan corresponds with an idea of a worldwide favorite beach for urban recreational and tourism development [38,61]. Visitors are attracted by climate, carnival and some nationwide sports events [40].

KI has seldom been used or included as part of beach evaluations and classification schemes [14] because it is difficult to define. Currently, effective international schemes with great influence on beach certification like *Blue Flag*, *Blue Wave*, and *Seaside Award* focus only on fulfilling technical characteristics as the BI presented above, but are limited in user's perception aspects. Fischer et al. [42], Chaverri [19], Cendrero and Fischer [43] and Leatherman [24] raised other issues to describe and evaluate beaches, but it is only recently that Pereira et al. [9] in Brazil and Micallef et al. [11,13] in Malta and Croatia, elaborated new schemes incorporating ecological and perceptional aspects in only one instrument to classify and evaluate sand beaches in an integrated way. In these schemes, the selection and order of importance of the characteristics were determined from previous surveys of beach users.

This lack of information about beach users' perception has led to the discovery that users of certified sites with a Blue Flag scheme do not know the difference between a certified

Table 6
Beach rating based on the Integrated beach value index (IBVI)

| Index | Ensenada | Rosarito | Mazatlán | Copacabana | Oceanside |
|---|---|---|---|---|---|
| Beach index (BI) | Medium | Low | Medium | High | High |
| Knowledge index (KI) | Medium | Low | High | High | High |
| Monetary index (MI) | Medium | Medium | Medium | Medium | High |
| Integrated beach value index (IBVI) | Medium | Medium | High | Medium | High |

beach and an uncertified one [14]. Some even interpret the physical presence of the blue flag as a sign of risk or danger [14]. Other results showed that people's opinion on beach certification was not key for the decision to use it [14].

In the present comparative study we found that the user's profile is homogenous at all sites despite the different socio-cultural patterns, as Pereira et al. [9] mention. Schooling does reflect the economic asymmetries in the three countries, where the USA appears over Brazil and Mexico (Fig. 2). Over-all, users at all sites liked the sand and agreed that the seawater and the sand beaches were clean. This agrees with Dinius [62] and Smith et al. [63] who mention that user's perception re-garding cleanliness or pollution is influenced by visual factors; the user associates absence of litter with clean water. They also state that evidence of a drain or discharge is related to questionable water quality. At all studied sites there are dis-charges in the beach, however, they are not visible and thus users do not relate them to water quality.

Answers to surveys in low-ranked beaches (see opinion in-dex in Table 4) indicated that users are sensitive to the lack of restrooms, showers, security, and cleaning services which seem to be a common deficiency in sand beaches around the world [8,9,47,57,64,65].

Oceanside, a well-known and much visited beach in south-ern California, with a million visitors every year and high in-come from tourism [3,4,55] (www.ci.oceanside.ca.us) [71] is the beach with greatest infrastructure and with highest service demands from the users in this research. BI results indicate that this beach is well equipped and has good infrastructure, much of which does not exist in other sand beaches, and users are aware of it. Nevertheless, users expressed that the beach requires more and better services.

## 15. Monetary Index (MI; economic value)

Oceanside has the highest MI despite the low room rates. This is because Oceanside is more of a residential, not so much a tourist, urban beach, and this is reflected in the high values of real estate and property tax. This may change, as in other regional beaches (Ensenada and Rosarito among them), because there are plans for hotel and commercial devel-opment in the near future.

Rosarito and Mazatlan rank with a medium MI because each of the three indicators has a different value. In Rosarito, high local property taxes are related to high demand for hous-ing, mainly by US citizens from California, and not because of the beach itself. Living near the seashore is highly regarded by Southern Californians, but the soaring real estate values and taxes in California (1% of the sale price [29]) (www.sdcounty.ca.gov/ttc) [74] raise the value of property to a much higher level than in Mexico. This has turned the Baja California coast, especially the Tijuana−Rosarito−Ense-nada tourist corridor, into one of the best areas to acquire real estate with an ocean view [38]. It is on this strip of land where real estate areas have been defined as particularly high since they offer better infrastructure and services than other areas

of the Rosarito municipality [7]. In addition, there is the pos-sibility of acquiring properties with exclusive and private sand beaches, which strongly influences their value and conse-quently that of real estate.

In the case of Mazatlan, although one of its main attractions is the beach, this is not considered when defining and assess-ing valuable zones. This assessment only contemplates avail-able services and socioeconomic value of the site. Hotel rates reflect the economic value of the beach and its importance as part of the traditional tourist attraction [66,67] (Table 5).

Both Ensenada and Copacabana ranked low in MI and real state value. The city of Ensenada is an example where the beach is not considered part of the tourist offering, nor is it considered a recreational space of the city and for that reason it does not influence in real state values. This situation will probably change due to a municipal program that is being ap-plied to the development of commercial and residential areas on the beachfront.

In Copacabana, real estate values are low (Table 5) because Rio de Janeiro does not show demand for oceanfront real es-tate. In addition, Brazilian laws stipulate limitless access to sand beaches (www.rio.rj.gov.br) [72] and do not permit the establishment of exclusive or private zones.

The resulting score for each beach allowed to assess the beach effect on private and public economic indicators at each site [29,68]. This is clearly shown by each of the eco-nomic indicators selected to establish the economic index (MI) of a beach, which agree with other indicators.

## 16. Final considerations

The low value of the presently analyzed Mexican beaches reflects a lack of interest in beaches as a natural resource when there is no tourism development. This is interpreted as the result of a lack of sense of belonging to the beach in En-senada, Rosarito and Mazatlan, which contrasts with the strong sense of belonging and beach value in Copacabana and Oceanside.

Most international beach certification processes compare beaches around the world without taking into account physiog-nomic, social or economic differences. Therefore, this evalua-tion index was purposefully used on sand beaches with particular cultural and socioeconomic features that would make them seem not very comparable. In conclusion, this method allows to compare rather different beaches and obtain results that may be applied worldwide.

If Copacabana and Oceanside are regarded as the best ur-ban beaches for recreational activities, Mexican beach man-agers could apply this information to improve the three Mexican beaches analyzed in this paper.

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