

ALMA MATER STUDIORUM  
UNIVERSITY OF BOLOGNA

SCHOOL OF SCIENCE

Laurea Magistrale in Analisi e Gestione dell'Ambiente  
Curriculum in Water and Coastal Management

**DEVELOPING A MANAGEMENT-BASED RANKING OF BEACHES  
FROM A WORLDWIDE PERSPECTIVE**

Thesis in: Environmental assessment

Supervisor  
Alice Newton

Co-supervisor  
Camilo Botero

Presented by:  
Elaine Oliveira

Unique session Academic year 2022

## **Abstract**

The research aimed to develop a robust and objective framework, based on management effectiveness, to rank beaches worldwide by the integration of indicators and the assessment of the socio-ecological system quality. The methodology involved a critical analysis of web-based rankings to collect the information on how they are made and the indicators used. In addition, a survey was conducted in the Science Direct database to identify the indicators used in beach quality assessments by the scientific literature. The indicators identified were evaluated according to their usefulness for beach management following the SMART criteria. The indicators that passed the evaluation were grouped into domains and categories following the official classification by the literature. Moreover, a measurement technique and a 5-point rating score for each indicator was suggested based on these same articles. Weights were calculated for different beach types using analytical hierarchical process and focus group. The quality value of each beach was calculated through equations after normalization, and the results were output in graphs inspired by CS and OHI. The results show that web-based rankings are mostly subjective and that beaches on these lists are not directly compared to one another. Moreover, they are exploring the visual appealing aspect, which is clear by the importance of indicators (color of water/sand are the most recurrent). The scientific literature, on the other hand, despite incorporating a wider set of indicators, are also focusing on recreation and user satisfaction. The indicators chosen to compose the framework are distributed into four domains (recreation, protection, conservation and sanitary) that cover main functions of a beach and aim to see it from a holistic view. The allocation of weights allowed respecting the differences provoked by distinct urbanization levels, granting the safeguard of the characteristics of every beach type, while the rating score helped to reduce the subjectivity by ensuring that the scale of comparison is always the same. The application of the framework on Portuguese beaches validated the methodology and showed the framework fulfills its purpose of ranking and pointing out the strengths and weakness of every beach.

**Keywords:** beach ranking; beach quality; indicators; beach management

## Table of Contents

<b>LIST OF ILLUSTRATIONS</b> .....	<b>5</b>
<b>LIST OF TABLES</b> .....	<b>6</b>
<b>GLOSSARY AND ACRONYMS</b> .....	<b>7</b>
<b>ACKNOWLEDGMENTS</b> .....	<b>8</b>
<b>CHAPTER 1. INTRODUCTION</b> .....	<b>9</b>
1.1. <i>CONTEXT</i> .....	9
1.2. <i>SCOPE</i> .....	10
1.2.1. <i>Hypothesis</i> .....	10
1.2.2. <i>Aim</i> .....	10
1.2.3. <i>Objectives</i> .....	10
1.2.4. <i>Research Questions</i> .....	11
<b>CHAPTER 2. LITERATURE REVIEW</b> .....	<b>12</b>
2.1. <i>BEACH</i> .....	12
2.2. <i>BEACH PREFERENCES</i> .....	13
2.3. <i>BEACH MANAGEMENT</i> .....	15
2.4. <i>BEACH QUALITY</i> .....	16
2.5. <i>RANKING X AWARENESS</i> .....	17
2.6. <i>INDICATORS</i> .....	18
2.7. <i>SES FRAMEWORKS</i> .....	19
<b>CHAPTER 3. METHODOLOGY</b> .....	<b>21</b>
3.1. <i>INDICATORS SURVEY</i> .....	21
3.1.1. <i>Analysis of Rankings</i> .....	21
3.1.2. <i>Evaluation &amp; Aggregation</i> .....	22
3.2. <i>FRAMEWORK FORMULATION</i> .....	22
3.2.1. <i>Rating Score</i> .....	22
3.2.2. <i>Weighting</i> .....	23
3.2.3. <i>Index calculation</i> .....	23
3.3. <i>APPLICATION OF FRAMEWORK</i> .....	24
3.3.1. <i>Study Area Description</i> .....	24
<b>CHAPTER 4. RESULTS</b> .....	<b>26</b>
4.1. <i>RANKING ANALYSIS</i> .....	26
4.2. <i>BEACH QUALITY INDICES</i> .....	30
4.3. <i>SCIENTIFIC INDICATORS</i> .....	34
4.4. <i>FRAMEWORK</i> .....	35
4.4.1. <i>Beach Ranking Framework</i> .....	35
4.4.2. <i>Rating Score</i> .....	39
4.4.3. <i>Weights</i> .....	50
4.5. <i>APPLICATION</i> .....	53

<b>CHAPTER 5. DISCUSSION .....</b>	<b>57</b>
<b>CHAPTER 6. CONCLUSION .....</b>	<b>61</b>
6.1. <i>DISSEMINATION &amp; EXPLOITATION .....</i>	62
<b>CHAPTER 7. REFERENCES.....</b>	<b>64</b>
<b>CHAPTER 8. APPENDIX .....</b>	<b>72</b>
8.1. <i>APPENDIX 1: TEMPLATE TO CALCULATE THE WEIGHTS BY AHP .....</i>	72
8.2. <i>APPENDIX 2: FOCUS GROUP.....</i>	73
8.3. <i>APPENDIX 3: LIST OF WEBSITES .....</i>	74
8.4. <i>APPENDIX 4: SCORE ASSESSMENT FOR THE STUDY AREA.....</i>	76
8.5. <i>APPENDIX 5: FRAMEWORK FOR MANAGERS ON GOOGLE FORMS .....</i>	79

## List of Illustrations

Figure 1: Example of rating adapted from Williams & Micallef (2009) .....	17
Figure 2: Example of ranking adapted from Williams & Micallef (2009) .....	17
Figure 3: Example of classification adapted from Williams & Micallef (2009) .....	18
Figure 4: Left: Output for Circles of Sustainability (Source: <a href="https://www.circlesofsustainability.com/">https://www.circlesofsustainability.com/</a> ); Right: Scoring graph for Ocean Health Index (Source: <a href="http://ohi-science.org/ohi-global/">http://ohi-science.org/ohi-global/</a> ) .....	20
Figure 5: Methodology applied for ranking framework.....	21
Figure 6: Study Area in Algarve, Portugal .....	25
Figure 7: Ranking methods used by websites to rank the 'best' beaches (n=70 websites) .....	27
Figure 8: Number of websites that consider each indicator.....	28
Figure 9: Division of indicators by thematic area (websites).....	29
Figure 10: Location of the beaches classified as the best (#1) in the world by different websites .....	30
Figure 11: Number of articles that consider each indicator .....	34
Figure 12: Division of indicators by thematic area (scientific) .....	35
Figure 13: Ranking Framework structure .....	36
Figure 15: Graphic output of the normalized values for rural and urban beaches .....	54
Figure 16: Graphic output of the normalized values for village beaches. ....	55
Figure 14: Performance of beaches in each domain. ....	55
Figure 17: Ranking of the beaches in Algarve using the beach ranking framework ..	56

## List of Tables

Table 1: List of Awards and Coverage .....	18
Table 2: Explanation of each ranking method .....	27
Table 3: List of Beach Quality Assessments. ....	32
Table 4: Set of Categories and Indicators that compose the Protection domain. The indicators were chosen based on the source described at the last column.....	37
Table 5: Set of Categories and Indicators that compose the Sanitary domain. The indicators were chosen based on the source described at the last column.....	37
Table 6: Set of Categories and Indicators that compose the Recreational domain. The indicators were chosen based on the source described at the last column.....	38
Table 7: Set of Categories and Indicators that compose the Conservation domain. The indicators were chosen based on the source described at the last column.....	39
Table 8: Proposed rating Score for each indicator composing the Beach Ranking Framework. ....	40
Table 9: Weights assigned for domains and categories for Urban Beaches. The columns show the values applied by each scholar, the mean value between them all and the standard deviation ( $\sigma$ ).....	50
Table 10: Weights assigned for domains and categories for Village Beaches. ....	51
Table 11: Weights assigned for domains and categories for Rural Beaches. ....	52
Table 12: Normalized scores for the beaches at Algarve, Portugal .....	53
Table 13: Options of products that could be used to disseminate the results of the framework.....	62

## **Glossary and Acronyms**

AHP – Analytic Hierarchy Process  
AMPIC – Marine Protected Area of Community Interest  
APA – Environmental Portuguese Agency  
BARE – Bathing Area Registration and Evaluation  
BQV – Beach Quality Value  
BEQ – Beach Environmental Quality  
EU – European Union  
CCDR – Regional Coordination and Development Commission  
CCMAR – Sea Science Center  
CS – Circles of Sustainability  
Cm –Municipal Council  
DGAM – General Directorate of Maritime Authority  
EEA – European Environment Agency  
ERSAR – Regulatory Entity for Water and Waste Services  
EUNIS – European Nature Information System  
EUROSTAT – European statistics  
ICNF – Institute of Nature Conservation and Forests  
INE – National Statistics Institute  
INR – National Institute for Rehabilitation  
IPMA – Portuguese Institute for Sea and Atmosphere  
OHI – Ocean Health Index  
PROT – Regional Land Management Plan  
SDG – Sustainable Development Goals  
SES – Socio-Ecological Systems  
SLR – Sea Level Rise  
SMART – Specific, Measurable, Achievable/Appropriate, Relevant/Realistic, Timely  
UAlg – University of Algarve  
UCA – University of Cádiz  
UniBo – University of Bologna  
WACOMA – Water and Coastal Management

## **Acknowledgments**

During these last two years, I have had so much help that is difficult to keep track. It is hard to remember and write to each one. Therefore, I want to thank all those who have passed through my life during this period: my family, friends, teachers, the thoughtful strangers in my emails and all the others who have been part, even if indirectly, of this work. However, some special acknowledgments must be done.

First, I would like to thank the Erasmus Mundus Program for the funding, the Water & Coastal Management Program for the opportunity to come abroad and study with such an amazing academic group, and all the WACOMA coordinators and collaborators who provided the support during this time. I thank the host institutions, University of Bologna, University of Cadiz and University of Algarve, for the infrastructure and effort during the classes.

I thank my supervisors Alice Newton and Camilo Botero, who guided me through the making of this thesis and for their support and advice. I would also like to thank Eduardo Barbosa, who supported my decision to come here.

To the Proplayas Network and the Group Sistemas Costeros (Playascol Corporación Ltda.) who welcomed me during my internship and helped me in some of the steps of the methodology. To Brianna Bombana, Chris Houser, Gerardo Perillo and Flavia Lins de Barros, who accepted the invitation to help me weighting the categories and share their expertise.

I would also like to thank my Wacomates, who accompanied me on this journey and made life easier. I will miss you guys! It has been a pleasure working with you. Finally, to Filipe who has been by my side even from a distance, supporting me, reading my work and programming with me this whole time.

## Chapter 1. Introduction

This thesis document is in partial fulfillment of the requirements of the *Erasmus Mundus* Master in Water and Coastal Management. It focuses on assessing beach 'quality' in order to support the management of beaches in the context of coastal tourism sector of the Blue Economy.

### 1.1. Context

Sun, beautiful beaches, and warm ocean waters have become standard vacation requirements for many tourists (Miller & Hadley, 2019). According to Picken (2017), beaches became a desirable space of pleasure from the beginning of the 19<sup>th</sup> century, when the feelings of danger and strangeness of the sea were defeated. The gradual reinvention of the beach as a coastal resort has made it one of the most successful forms of tourism (Picken, 2017).

In order to attract the attention of users, who are the driving force and the ultimate receptor of beach tourism (Rangel-Buitrago *et al.*, 2019), the coastal tourism industry applies a variety of aesthetic scales, rating recreational areas to inform the public where the 'best beaches' are located (Williams & Micallef, 2009). Beach ratings, according to Cagilaba & Rennie (2005) are the ranking of beaches according to their performance against a checklist of different criteria, based on physical, biological, and human use attributes. The evaluation results is an ordered list with the 'best' beach at the top. An example of a famous ranking scheme is one used by *TripAdvisor*, a platform that provides a list of the best beaches based on the preferences of the tourists.

Nevertheless, the information provided on how these rankings are performed is often unclear or missing. This lack of information raises some questions. What is the 'best' beach based on? How was the ranking made? Can these rankings be considered reliable and objective? Tourists are attracted by these rankings and use them to choose their destination. The proliferation of subjective and inaccurate ranking schemes, therefore, can intensify the pressure of tourism on a system by increasing the number of visitors at beaches that are not prepared for a huge flux of visitors. Moreover, pristine areas, that were initially unknown, could be jeopardized by the worldwide, careless and limitless divulgation.

Assessing threats, weakness and strengths and identifying the causes of 'poor/good' beaches are key elements of management (Williams & Micallef, 2009).

Hence, the creation of an objective and integrated methodology to rank beaches can help to achieve these elements by highlighting the characteristics and classifying the quality of each beach. Botero *et al.* (2018) affirms that beach managers need fast and simple tools to face daily situations. A structured and objective beach ranking can constitute one of those tools since it will assess the health status of a beach and guide the response and actions towards the main issues identified.

Coastal tourism is a sector of the Blue Economy (EC, 2021) and one of the goals of the Ocean Health Index; therefore, efforts to improve the use and conservation of resources are justifiable. Furthermore, the framework cannot only support the sustainable development and conservation of coasts, but also be used as a reliable source of information for users when choosing a destination to visit, eliminating the subjectivity embedded on the existing rankings.

## 1.2. Scope

### 1.2.1. Hypothesis

Integrating a wide set of indicators in beach ranking assessment can help to reduce the subjectivity of '*best beaches*' lists and support beach and tourism management by highlighting the weakness and strengths of each area.

### 1.2.2. Aim

Develop a robust, effective and objective framework to rank beaches worldwide by the integration of indicators, reducing the subjectivity of the existing assessments and supporting beach management.

### 1.2.3. Objectives

- Analyze existing beach rankings and quality assessments worldwide, identifying the indicators used to rank the beaches;
- Evaluate the indicators according its usefulness for beach management;
- Define the set of indicators considering a beach as a SES
- Propose a new ranking scheme based on beach management effectiveness;
- Apply the new ranking in Portuguese beaches

#### 1.2.4. *Research Questions*

1. Which indicators are used to rank beaches on the web-based rankings?
2. Is there a scientific approach to rank beaches? Which indicators are used?
3. Is it possible to create a framework that will reduce the subjectivity and support beach and tourism management?

## Chapter 2. Literature Review

### 2.1. Beach

A beach can be defined as a wave deposited accumulation of unconsolidated sediment, ranging in size from very fine sand up to boulders, deposited between the upper swash limit and wave base (Bird, 2008; Short & Jackson, 2013). Beaches can also be considered socio-ecological systems (SES) that play a key role in coastal environments since they provide multiple functions, such as coastal protection, natural reservoirs, leisure, identity, economy and culture (Sardá *et al.*, 2015; Botero *et al.*, 2018). The same beach can be categorized in different names depending on the dimension that is adopted (shape, physical, anthropogenic, and morphodynamic regime):

**Shape:** Williams & Micallef (2009) categorized the beaches based on their shape as pocket (small beaches enclosed by headlands, which have onshore-offshore sediment movement and little longshore movement) or linear (long straight beaches with a pronounced longshore drift).

**Physical dimension:** Wright & Short (1984) categorized the beaches based on the surf scaling parameter ( $\xi$ ) and dimensionless fall velocity ( $\Omega$ ) as reflexive, intermediate and dissipative.

*Reflexive* ( $\xi < 2.5$ ;  $\Omega < 1$ ) are steep beaches with a small subaqueous sand storage, minimum wave energy dissipation (waves reach the beach face without breaking and surge up the beach or collapse over the step), normally composed of coarser material.

*Intermediate* stages ( $1 < \Omega < 6$ ;  $2.5 < \xi < 20$ ) possess coexisting dissipative and reflective elements and exhibit the most complex morphologies and process. Are divided into four: low tide terrace, transverse bar rip, rhythmic bar beach, and longshore bar trough.

*Dissipative* ( $\xi > 20$ ;  $\Omega > 6$ ) are flat shallow beaches with a wide breaking zone and a large subaqueous sand storage.

**Morphodynamic regime:** Short (1999), classified the beaches considering the relative tidal range (RTR) into wave dominant (RTR  $< 3$ ), tide modified (RTR 3 to 10) and tide dominant (RTR  $> 10$ ). RTR expresses the relationship between the tidal range (TR) and the wave height ( $H_b$ ) by the equation  $RTR = TR/H_b$ .

**Anthropogenic dimension:** Williams & Micallef (2009) categorized the beach in the anthropogenic dimension as remote, rural, village, urban and resort.

*Remote* beaches are areas largely defined by difficulty of access (not supported by public transportation and with very limited temporary summer housing).

*Rural* is described as the beach located outside the urban/village environment and not readily accessible by public transport. These beaches have little or no beachfront development or facilities and are valued by their quietness and natural qualities.

*Village* is a beach located outside the main urban environment, reached by public or private transport and associated with a small and permanent population, with access to organized and small-scale community services.

*Urban* beaches are generally open to the public, have well-established public services (e.g. banks, cafes, internet, markets) and commercial activities in the proximity (fishing, harbors and marinas).

*Resort* beach is a self-contained entity that fulfills all recreational needs of beach users to different degrees. It can be private or open to the public for day use for a fee.

Other nominations include the terms “tourist”, “popular”, “semi-natural” and “natural”. Botero *et al.* (2018) defined *tourist* beaches as socio-ecological resources located mainly on coastal destinations, which are developed and managed for the primary purpose of attracting tourists interested in sun, sea and sand activities. *Popular* are beaches visited by local residents of the city or village in which the beach is located and used just for recreational purposes. Some authors include the term “recreational” to describe beaches that are managed for recreation purpose. Peña-Alonso *et al.* (2018) use the term “*Semi-natural*” to define the beach located in medium or low population density areas, with reduced accessibility, moderate attendance and limited number of facilities; and “*natural*” for the ones that have high preservation value, are located far from urbanized areas, with reduced access (made by private transport) and usually no facilities.

## 2.2. *Beach Preferences*

The preferences of users have been studied intensively for several authors around the world. The studies focused on identifying the most important parameter of

a high quality beach, and the influence of beach type and user profile on these preferences. Cleanliness/water quality is the most important criterion for beach users according to Brentont *et al.* (1996), Marin *et al.* (2009), Vousdoukas *et al.* (2009), Botero *et al.* (2013), Rodella *et al.* (2017), Peña-Alonso *et al.* (2018), Roca & Villares (2018) and Lucrezi *et al.* (2018). Safety has also a high priority for users' worldwide (Hecock, 1970; Brentont *et al.*, 1996; Rodella *et al.*, 2017; Lucrezi *et al.*, 2018).

Regarding the type of beach, the preferences change between semi-natural and urban beaches. In urban, the facilities are the main attraction while in semi-natural beaches the reason to visit is the landscape (Hecock, 1970; Roca & Villares, 2008; Roca *et al.*, 2008; Cabezas-Rabadán *et al.*, 2017). Concerning the influence of the profile, Bimonte & Faralla (2012) supports that beach users' preferences are influenced by their interests, opinions, lifestyle and motivation. Phillips and House (2009) discovered that diverse user groups rank the same beaches differently due to the prioritization of indicators: surfers favor physical, conservationists favor biological and families favor human indicators.

Age is one of the most important characteristics that influences the perception of the user. Hecock (1970) states that teenagers and college students seem to express a strong positive reaction to crowding and are attracted to food facilities. According to Brentont *et al.* (1996) age also plays a role in the activities (young people prefer swimming whereas elderly enjoy walking) and in the attractiveness (younger tourists are more attracted by the presence of specific facilities for sports or exercises). Peña-Alonso *et al.* (2018) state that the older the user, the greater the importance attributed to quietness, access and parking.

Concerning education level, Peña-Alonso *et al.* (2018) declare that the higher the education, the lower the importance to characteristics related to comfort, services and facilities. According to Lucrezi *et al.* (2018), users with lower education levels choose a beach by its attractiveness and for social bounding. The socioeconomic status is another aspect that can affect preferences. Second Hecock (1970), aesthetics seems to be more important for the higher class: dunes with spectacular surf or broad expanses of glistening white sand attract visitors with high socio-economic attributes (especially highly paid; highly educated or professional-technical occupation). Santos *et al.* (2005) discovered that litter generation, fate and disposal depends on the socio-economic characteristics of beach users (the lower the status, the greater the amount of litter).

Roca *et al.* (2009) notice that locals tend to be more demanding and are more concerned about the environment and its conservation. This demanding group is composed of young people living in the municipality or in the vicinities, with strong attachment to the region and looking for peace and quiet areas. In contrast, the satisfied group, composed of foreign adults and elders who are staying for a short period, is attracted by the scenic value and the provision of facilities.

### 2.3. *Beach Management*

A management system, according to Sardá *et al.* (2015), is a systematic framework of policies, procedures and practices used to ensure that an organization can fulfill the tasks required to achieve its objectives. When these objectives are related to natural environments, like a beach, the management needs to consider the entire ecosystem, including humans, to maintain its health, productivity and resilience.

Some definitions of beach management have been provided along the years. According to Simm (1996), beach management is the process of managing a beach in a way that reflects an acceptable compromise, according the available finance, between the various coastal defense, nature conservation, public amenity and industrial objectives. Bird (1996) affirms that beach management seeks to maintain or improve a beach as a recreational resource and a means of coast protection, while providing facilities that meet the needs and aspirations of those who use the beach. James (2000) affirms that the concept must acknowledge beaches as multidimensional environmental systems, recognizing the roles of the natural and social sciences in management. Williams (2009) describes beach management as a tightrope that balances conflict via a multi-faceted, multi-jurisdiction management approach from many disciplines, leading to effective utilization of the valuable national resources.

According to García & Veneciano (2011), beach management is best understood as the actions implemented by a competent organism to maintain the balance between the existing coastal ecosystem and the pressure exerted by human activity. Beach management aims to achieve the sustainable physical use and development of the resources that form the natural environment of the beach, whilst satisfying the uses and needs that the ecosystem services of the beach offer to society (Camarsa *et al.*, 2012). Botero *et al.* (2015) affirms that beach management should provide a sustainable, optimum usage of natural, socioeconomic and cultural

resources, while providing in certain localities increased recreation, in others conservation.

Williams & Micallef (2009) provide one of the most spread definitions. According to the authors, beach management seeks to achieve optimal physical usage and development of beach resources that respects the natural physical elements of a beach environment while satisfying basic social needs within the environment. It is the management of humans and the way they interact with the beach environment, in order to avoid, remediate or mitigate adverse interactions.

An overview of the term shows that the definition varies slightly according to the author, but with a general agreement on the sustainable use of resources. A point to highlight is the fact that some authors describe beach management as a type of coastal management although the majority of ICZM strategies and tools are not suitable to a micro-local scale of beaches (Botero *et al.*, 2018).

#### 2.4. *Beach Quality*

Quality is often defined as a degree of excellence. According to Harvey (2006), in the sense of excellence, quality is described as either distinctiveness (special) or the exceeding/achievement of standards. However, quality could also be defined in terms of 'fitness for purpose' (extent to which the product or service fits a stated purpose), 'perfection' (zero defects) or 'transformation' (process of change) (Harvey, 2006). Harvey & Green (1993) state that quality is a relative concept as it will have different meanings for different people or even different conceptualizations by the same person at different moments. In agreement, Shewfelt (1999) affirms that quality depends on the perspective of the viewer: for the products' perspective, quality is the attributes selected based on accuracy, whereas for the consumers quality is related with satisfaction and acceptability.

This work is adopting the definition of quality as beach environmental quality. Beach environmental quality is defined by Botero *et al.* (2019) as the state of the beach as a socio-natural system in a certain time, concerning its ecosystem functionality and satisfaction of human needs.

## 2.5. *Ranking x Awareness*

Beach quality assessment can be described as the act of judging or deciding the quality of a beach (Botero *et al.*, 2019). The assessment of a beach quality can take the form of awards (certification schemes), ratings, rankings or classifications. According to Botero (2019), the separation between the assessment process (rating schemes) and the recognition of a desired level of quality (certification schemes) is not clearly differentiated in the scientific or technical literature. Additionally, rating and ranking, despite being two different response formats (Harzing *et al.*, 2009), are mistakenly used as synonyms. A clear definition of these terms is, therefore, essential:

*Rating schemes* are the most ubiquitous form of performance judgment (Land & Farr, 1980), where respondents rate their level of agreement or the level of importance of a series of statements on a predefined number of scale points (Harzing *et al.*, 2009). An example of rating is shown in figure 1.

How would you describe the state of  
this beach with regards to litter pollution?  
Tick **one box** only

(A) Very Good	(C) Fair
(B) Good	(D) Poor

Figure 1: Example of rating adapted from Williams & Micallef (2009)

*Ranking*, on the other hand, is an arrangement in hierarchical order, where different items are compared directly to one another (e.g., “Rank by order of importance or preference”). Harzing *et al.* (2009) affirm that respondents are unable to reliably distinguish among a large set of values, thus, this response format could generate unstable results. An example of ranking is shown in figure 2.

Please rank the most important reasons for selecting a beach to visit.  
1 being the **most important** followed by 2, 3, etc.  
\*Place a **different** number in **each** box

[ ] Views and Landscape	[ ] Accessibility
[ ] Toilet facilities	[ ] Parking
[ ] Cleanliness	[ ] Safety

Figure 2: Example of ranking adapted from Williams & Micallef (2009)

*Classification* is the process of cluster or group beaches according to their types and characteristics. The process returns groups of beaches that have at least one element in common (e.g. urban beaches, dog friendly). An example of classification is shown in figure 3.

Classification of bathing environment	
5 star	'A' score rating awarded to water quality, scenery and litter
4 star	'A' score awarded to water quality and litter, 'B' to scenery
3 star	'B' score awarded to water quality and litter, 'C' to scenery
2 star	'C' score rating awarded to water quality, scenery and litter
1 star	Where any parameter is awarded a 'D' score rating

Figure 3: Example of classification adapted from Williams & Micallef (2009)

*Awards* are a set of administrative and operational elements that, through a process of systematic evaluation of pre-established requirements, recognizes the effort of standard achievement (Bartram & Rees, 1999; Cagilaba & Rennie, 2005; Botero, 2019). The result of an award is a title/ flag that confirms the specific beach has fulfilled all the technical criteria required. Table 1 shows a list of existing awards and their coverage. There are also books that rate and certify beaches, like *Guida Blue* in Italy, *Good Beach Guide* in the United Kingdom and *Beach Safety* in Australia.

Table 1: List of Awards and Coverage

Award	Coverage
Bandera Azul ecológica	Costa Rica
Bandera Ecoplayas	Spain
Blue Flag	Worldwide
Blue Wave& Clean Beaches	USA
Green Coast Award	Ireland & Wales
Playas y Balnearios de Calidad	Argentina
Premio Ecoplayas	Peru
Quality Coast Award	Worldwide
Scotland's Beach Awards	Scotland
Seaside Award	United Kingdom
Sostenibilidad para destinos turísticos de playa	Colombia
Sustentabilidad de Calidad de Playas	Mexico

## 2.6. Indicators

Indicators are a quantitative measure of the health status of the environment, indicating the pressures, the evolving state and the appropriateness of policy measures and that can be used to reflect the provision of a service and how it is changing over time (Niemeijer & Groot, 2008; Elliott, 2011; Hattam *et al.*, 2015).

According to Aubry & Elliott (2006), indicators have three basic functions: simplify the characteristics of the ecosystem status; quantify the changes compared to the expected conditions; and communicate the information with stakeholders and policy makers. Atkins *et al.* (2015) state that indicators need to relate to the components, processes and benefits as identified within the ecosystem services in order to capture the diversity and complexity of the coastal and marine systems.

In order to be effective for management, indicators must follow the five SMART characteristics: **S**pecific, **M**easurable, **A**chievable/ **A**ppropriate/ **A**ttainable; **R**ealist/ **R**elevant/ **R**esults focused; **T**ime-bounded/**T**imely (Dorian, 1981; Elliott, 2011). Other requirements include anticipatory; biologically important; broadly applicable; continuous and integrative over time and space; cost-effective; interpretable; sensitive to change; socially relevant; provide responsive feedback to management; scientifically sound; politic relevant; and support environmental legislation (Elliott, 2011; Maes *et al.* 2013).

## 2.7. *SES frameworks*

Social-ecological systems (SES) are defined as complex systems composed of biophysical and social components, embedded in a network of relationships among smaller and larger components (Janssen & Ostrom, 2006; Becker, 2012). According to Cinner & Barnes (2019), the SES concept explicitly recognizes that people and nature are intricately connected: human activities alter the structure and function of ecosystems, which in turn provide people with ecosystem goods and services that contribute to human well-being.

According to Virapongse *et al.* (2016), SES can bring the concepts of transdisciplinary science and resilience together by the development of conceptual and empirically based models and frameworks. Moreover, the authors affirm that an effective SES environmental management approach offers great potential for more sustainable outcomes of interventions, can assist managers to address complex systems holistically, and also help reduce knowledge compartmentalization by including diverse stakeholders in decision making. Two examples of frameworks that use the SES theory are the *Circles of Sustainability* (CS) and the *Ocean Health Index* (OHI).

*Circles of Sustainability* (James, 2015) is an assessment framework to measure urban sustainability through a holistic approach by assigning scores to categories divided into four domains: ecology, politics, culture and economics. The graphical output of scores (Fig. 4) provides a simple view of the sustainability of a particular site, making it easier to communicate a large set of information to stakeholders.

The *Ocean Health Index* (Halpern *et al.*, 2012) is a systematic approach that measures the overall condition of the marine ecosystem by a standardized, quantitative, transparent and scalable measure. The framework includes ten goals and accounts for the current status and likely future condition of each one. According to Halpern *et al.* (2012), OHI is an analytical approach to guide how to improve overall ocean health at the same time that allows clear and rapid communication of vast quantities of information (Fig. 4).

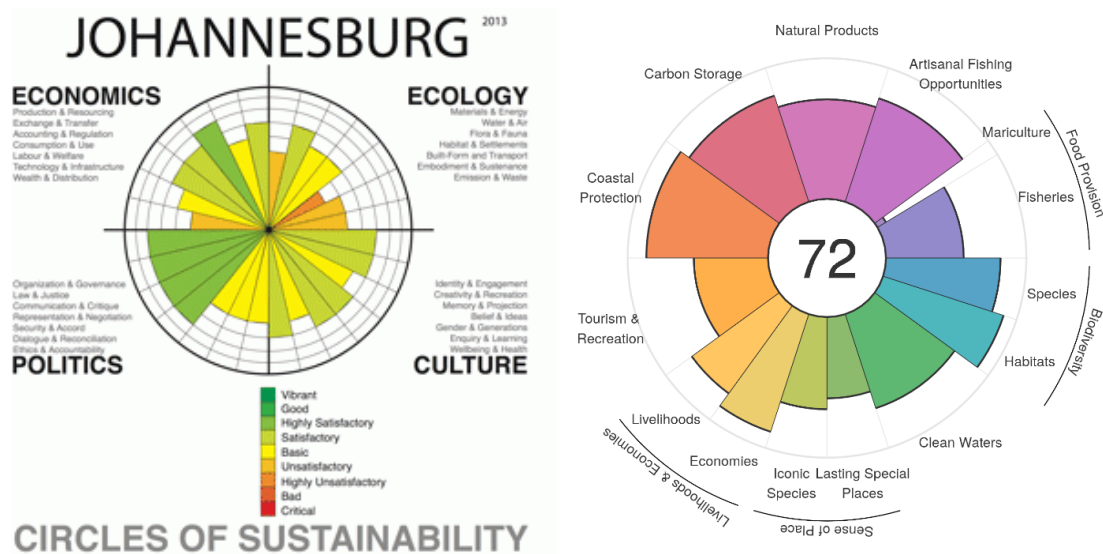


Figure 4: Left: Output for Circles of Sustainability (Source: <https://www.circlesofsustainability.com/>); Right: Scoring graph for Ocean Health Index (Source: <http://ohi-science.org/ohi-global/>)

## Chapter 3. Methodology

This chapter exhibits the formulation of the ranking (Fig. 5), starting with the investigation of ‘best beaches’ lists and beach quality assessments for the extraction of relevant indicators, followed by the analysis and division of indicators and the formulation of scores and equations. Finally, the methodology was applied in Portuguese beaches for validation.

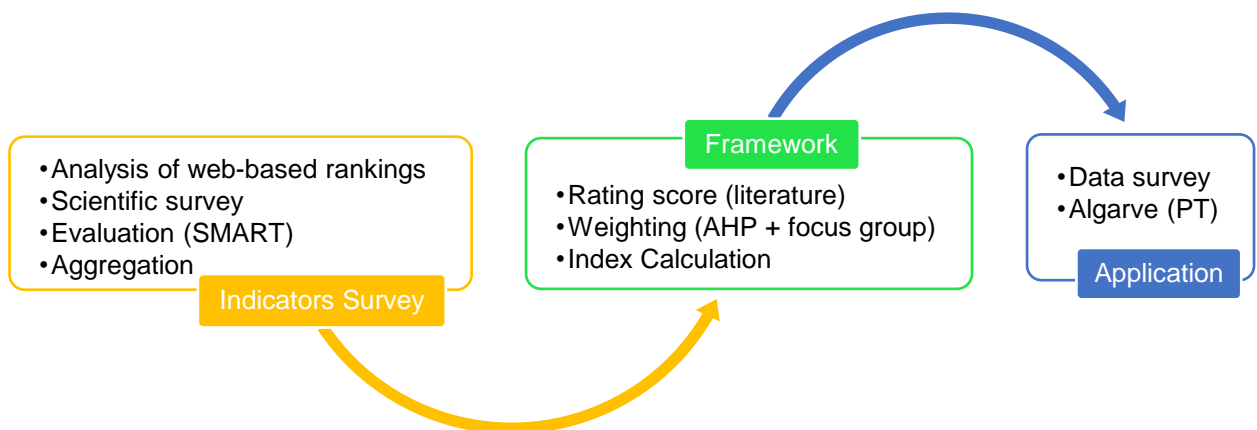


Figure 5: Methodology applied for ranking framework

### 3.1. Indicators Survey

#### 3.1.1. Analysis of Rankings

To identify the rankings, the first 100 websites were checked based on the following criteria (i) focused on beaches; (ii) more than five beaches; (iii) original content (websites that merely replicate other rankings were discarded). The survey was conducted using the term ‘best beaches’ in several languages (English, French, Portuguese, Spanish and Italian) in order to amplify the range of websites. In each site it was extracted the indicators used (if applicable), the person responsible for the ranking (personal experience, editorial board, users, etc.) and the name of the beaches in the list. The information collected was registered on a table for further analysis.

The selected data was analyzed and summarized based on the indicators (if they are mentioned or not, the frequency of appearance and the average of indicators considered by site). It was also noted if the beaches were disposed by an increasing order. In this case, the top one beach of the world was plotted into a map using *Google Earth* and *QGis*. In addition, *Google Earth* was used to characterize the beaches at the first position of each ranking to extract elements in common.

In order to compare the results of the general websites with the scientific literature, and to collect the indicators used in beach quality assessments, a search

was conducted in Google Scholar and Science Direct databases with the terms 'beach', 'indicators', 'quality' and 'index'. Articles that propose an index to evaluate quality considering the beach through a holistic approach were selected and examined. From each index, the domains, the list of indicators and the methodology for scoring and weighting them, were extracted and recorded in a spreadsheet.

### 3.1.2. *Evaluation & Aggregation*

To begin with, the potential indicators identified previously were analyzed to remove the ones with similar meaning. The remaining were evaluated according to its relevance for management based on the *S.M.A.R.T.* criteria (Elliott, 2011). Indicators that did not fulfill those requirements were discarded. In addition to them, indicators derived from a technical report of the European Commission (Maes *et al.*, 2013) and from ecosystem indicators literature (Atkins *et al.*, 2015; Hattam *et al.*, 2015), were revised during the framework composition. The final set of indicators were selected based on (i) the frequency of occurrence in the rankings and indices analyzed; (ii) the main issues that demand management; (iii) the appropriateness for describing the beach function.; (iv) the availability of data to support them; and (v) the communicability of the information.

The indicators considered relevant and appropriate were divided into domains (recreation, protection, conservation and sanitary) and categories according (i) their classification by the scientific literature and by the government agencies and (ii) on their suitability for each domain. The choice of dividing the framework into domains and categories was adapted from James *et al.* (2015). The domains have equal relevance in order to assess the beach by a holistic approach. The variable number of indicators in the categories aims to include all aspects considered relevant. It does not represent a higher importance and does not affect the weighting.

## 3.2. *Framework formulation*

### 3.2.1. *Rating Score*

For each indicator, a measurement technique was proposed following the literature, the beach quality indices analyzed and established regulations. A 5-point Likert-type scale was also suggested based on those same references. The choices were made based on (i) feasibility to be measured; (ii) effectiveness as indicator; (iii)

clear division of scores. Preferences were given for the ratings of indices that incorporate stakeholders in their methodology.

### 3.2.2. *Weighting*

According to Semeoshenkova *et al.* (2016), weighting regulates the importance of different indicators and components and allows the differentiation of beach types. The weights were established using the Analytic Hierarchy Process, following the procedure explained by Saaty (2008). AHP is a general theory of measurement that facilitates decision making by organizing judgments into a nonlinear framework using pairwise comparisons (Saaty, 1987; 1994). The method was applied for different beach types in order to respect different management strategies. The beach types included were Urban, Village and Rural, following the anthropogenic classification of Williams & Micallef (2009). Weights were assigned for each category ( $r, p, c, s$ ) and for each domain ( $w$ ).

Focus group was used to reduce subjectivity and bias. An online meeting was organized on June 2, where coastal management experts from *Proplayas Network* were asked to compare the domains and indicators, using a spreadsheet (Appendix 1), according to their importance within each beach typology by using the pairwise comparison scale. The experts were chosen based on (i) Member of *Proplayas Network*; (ii) PhD owner; (iii) H index (Appendix 2). The responses obtained were average and the final weight values and standard deviation were calculated for each beach type.

### 3.2.3. *Index calculation*

After each indicator was scored, they were normalized. The normalization was done by dividing the sum of the scores allocated to each indicator in a category by the total maximum score for each category. For example, the category 'Habitat' is composed of two indicators: ecosystem connectivity and ecosystem condition. The sum attributed for each indicator was summed (e.g.  $4 + 5 = 9$ ) and divided by the maximum score for the category ( $5 + 5 = 10$ ) resulting in a normalized score ( $9 / 10 = 0.9$ ). The normalization is crucial for the standardization of the indicators allowing comparison. After the normalization of all the categories, the final Beach Quality Value was calculated using linear aggregation based on the following equations:

Equation 1: Equation for calculating the Individual Beach Quality Value (BQV).

$$\begin{aligned}RD &= [(r_1 \times AP) + (r_2 \times CC) + (r_3 \times FS) + (r_4 \times SV) + (r_5 \times Saf)] \\PD &= [(p_1 \times SB) + (p_2 \times SS) + (p_3 \times IC) + (p_4 \times SbD) + (p_5 \times RV)] \\CD &= [(c_1 \times EQ) + (c_2 \times GA) + (c_3 \times Hb) + (c_4 \times SP) + (c_5 \times Her)] \\SD &= [(s_1 \times WQ) + (s_2 \times SQ) + (s_3 \times EP) + (s_4 \times SF) + (s_5 \times LW)] \\BQV &= (w_1 \times RD) + (w_2 \times PD) + (w_3 \times CD) + (w_4 \times SD)\end{aligned}$$

Where; AP = Access & Parking; CC = Carrying Capacity; FS = Facilities & Services; SV = Scenic Value; Saf = Safety ; SB = Storm Buffer; SS = Shoreline Stability; IC = Induced Changes; SbD = Subaerial Dissipation; RV = Risk & Vulnerability; EQ = Environmental Quality; GA = Governmental Acts; Hb = Habitat; SP = Species; Her = Heritage WQ = Water Quality; SQ = Sand Quality; EP = Episodic Pollution; SF = Sanitary Facilities & Services; LW = Litter & Waste; RD = Recreation domain; PD = Protection domain; CD = Conservation Domain; SD = Sanitary domain.

The  $r$ ,  $p$ ,  $c$  and  $s$  coefficients adjust the importance of the categories for each domain, while the  $w$  coefficient adjusts the importance of domains for each beach typology. The ranking is the decreasing order of beaches based on the BQV.

### 3.3. Application of framework

In order to validate the methodology proposed, the framework was applied by the author in the region of Algarve, in the South of Portugal. The data for each indicator was scored based on the scientific framework created using information provided by the literature, public databases, *Google Earth* and official government/environmental sites. Researchers from Algarve were consulted by email to clarify some parameters. Fieldwork was also carried out in April and May of 2022 for visual inspection. The Quality Value for each beach and the final ranking was calculated using a spreadsheet developed by the author. The individual performance of each beach was represented in a graph inspired by the visual output of CS and OHI. The graph is an attempt to facilitate the visualization of data by users and managers.

#### 3.3.1. Study Area Description

The Algarve, located at the Southern coast of Portugal, extends from the Odeceixe estuary on the West coast, to the Guadiana river mouth at the South coast, totalizing 210 km (Moura *et al.*, 2019). The shore is marked by a high geodiversity,

having vertical cliffs segments associated with estuarine-lagoon systems (Teixeira, 2009).

Regarding the hydrodynamic regime, the tide is semi-diurnal, with amplitude of 2m (Teixeira, 2009); the average waves are 1m height, with period of 4.7 seconds and W-SW prevailing direction; the winds approach the coast with angles of 40° and 60° (Costa *et al.*, 2001; Teixeira, 2009). The average temperature is 14° in winter and 24° in summer (Semeoshenkova & Williams, 2011). The beaches are composed of median to coarse sand and have intermediate to reflective morphodynamic state (Loureiro *et al.*, 2013).

The area selected to apply the framework comprises eight beaches (Fig. 6) at Faro district in Algarve region: three in the municipality of Lagos (Luz, Camilo and Dona Ana), one in Portimão city (Rocha Beach), two in Lagoa (Benagil and Marinha Beach), one in Albufeira (Falésia Beach) and one in the municipality of Faro (Faro Beach). Following the anthropic classification of Williams & Micallef (2009), Rocha and Dona Ana are urban beaches; Faro and Luz are village beaches; and Falésia, Marinha, Benagil and Camilo are rural beaches. The beaches were chosen due to their frequent mention on worldwide rankings.

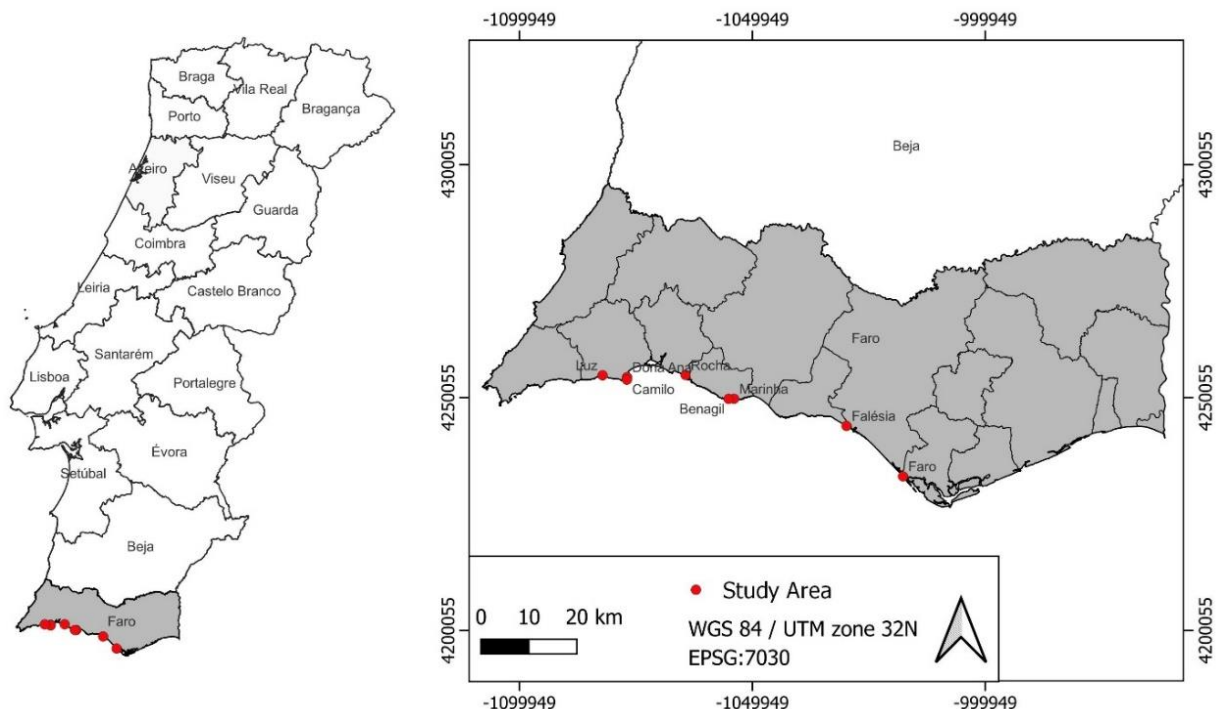


Figure 6: Study Area in Algarve, Portugal

## Chapter 4. Results

### 4.1. Ranking analysis

The exploratory survey returned 70 websites containing some type of 'best beaches' ranking. The majority presented a list of 'best beaches of the world', but some of them exhibited the best beaches of a country (Portugal, Spain, Mexico, Colombia, and Brazil) or a region (Algarve, Sardegna, Europe, and The Caribbean). Appendix 3 shows the name and link of each site. Of the 70 websites analyzed, 47 (67%) ordered the beaches according to their position on the list. The others presented just a list with the beaches that satisfied their checklist. Since a ranking scheme needs to have some order, sites that do not present the beaches by an increasing order cannot be considered as a 'ranking'.

Only 30% (28 sites) considered indicators in their assessment, as shown in figure 7. The rest are the opinion of the editorial board (21 sites), personal experience (14), users' perception (11) and opinion of travel specialists (5). The category others include Instagram popularity (2), certification and awareness schemes (1) and the results of previous scores (1). Finally, 11 sites did not specify what information was used. Some rankings used more than one approach in the process. The different approaches are explained in table 2. Those categories were defined based on 1) the creator responsible for the content (e.g. blogger, editorial board); 2) on the criteria specified in the webpage; 3) by the methodology used for the ranking (if specified).

The '*Users' perception*' is normally based on popular vote (like US News) or evaluation of beaches (like *TripAdvisor*); however, other options are pursued, for example, *Kiwi.com* promotes a world championship to decide the best beach. The process involves duels, with the result decided by votes on Instagram. *Money.co* delivers the best beach according to the amount of Instagram posts per meter. *World Beach Award* collects popular votes to reward the best beach destination.

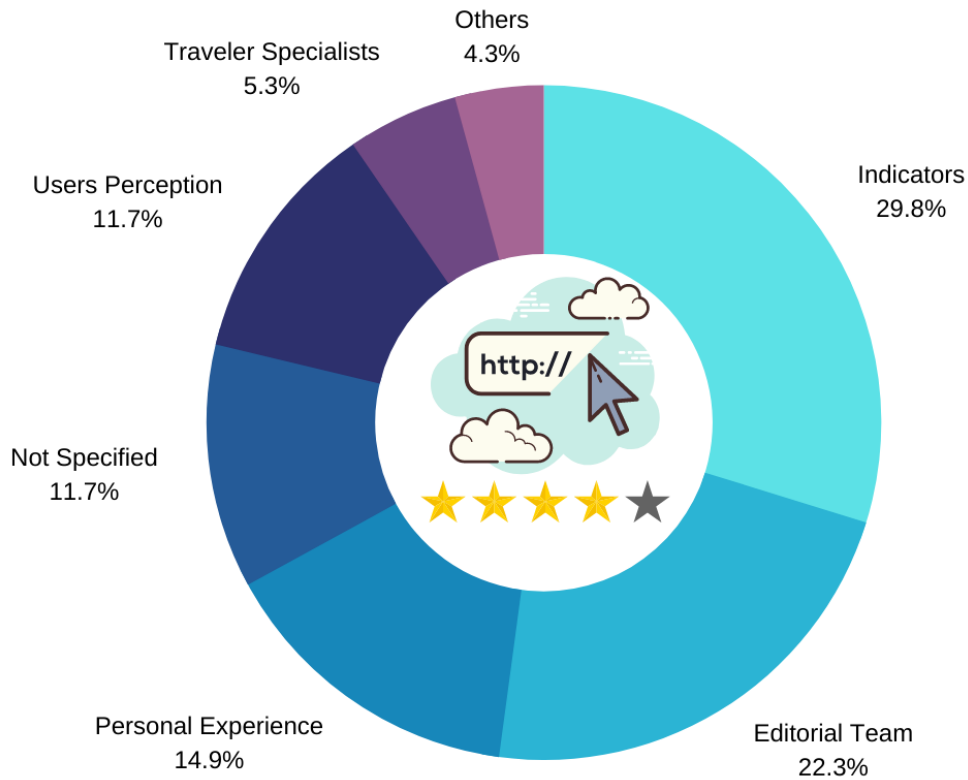


Figure 7: Ranking methods used by websites to rank the 'best' beaches (n=70 websites)

Table 2: Explanation of each ranking method

Ranking method	Explanation
Indicators	Use of characteristics, such as the color of the water, to rank the beaches
Editorial team	Judgment of the group responsible for dictating the subject of a specific website.
Personal experience	Content done by a singular individual that owns a blog
User's perception	General public opinion collected through surveys or online evaluation
Specialists	Websites that consider the opinion of traveler specialists, such as journalists, bloggers, editors and traveling agencies, rather than just from the owners of the webpage
Instagram	Websites that are interested in the popularity numbers of this social media
Previous scores	Previous critic reviews and former beach winners from other media results are incorporated into the ranking to avoid repetitions
Certification/Awareness	The consideration of official recognition, such as Blue Flag, granted to a location
Not specified	Websites where the assessment could not be identified

Concerning '*indicators*', the total number considered by site ranged between 2 and 17 with an average of 8. Whereas the indicators of some sites are explicit, in others the indicators were extracted from the text, (e.g. beaches with turquoise waters). A total of 49 indicators were found. The most cited indicator was the color of water

(considered by 21 out of 28 sites), followed by the color of the sand (20). Scenic value (15), well-kept vegetation (13), access (13), and turbidity (11) were also highlighted. Figure 8 shows that many of the indicators (75%) are cited by less than 5 websites and 22% appear just at one webpage.

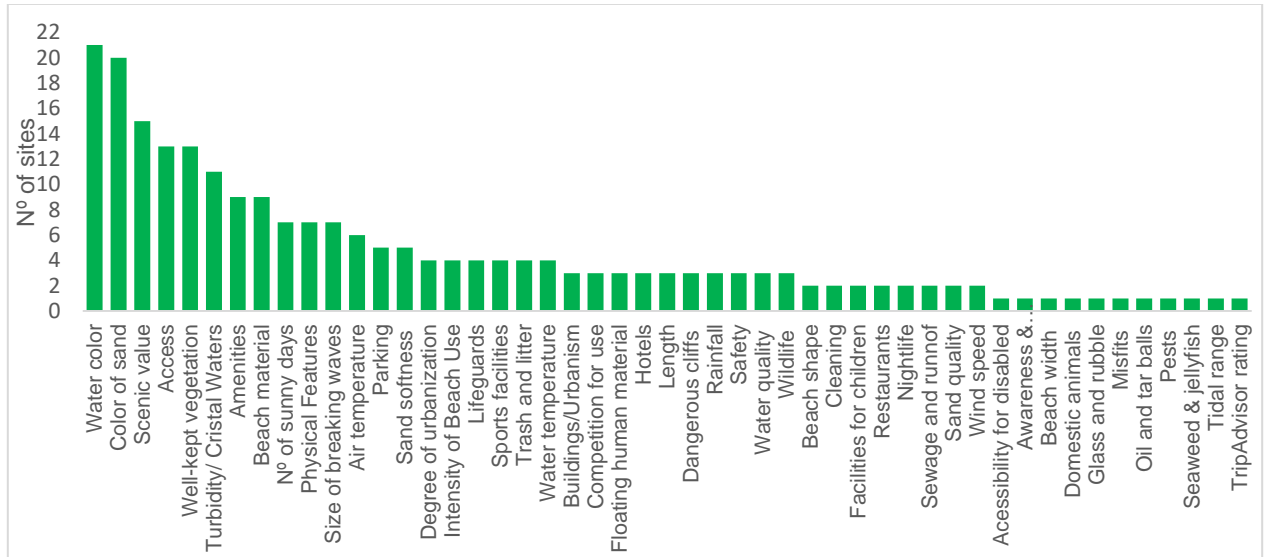


Figure 8: Number of websites that consider each indicator

Grouping the indicators (Fig. 9), we can see that 31% are related to recreation attributes, 23% to sanitary and human health, 20% to physical characteristics of the beach, 16% to environmental features, and 10% to climate conditions.

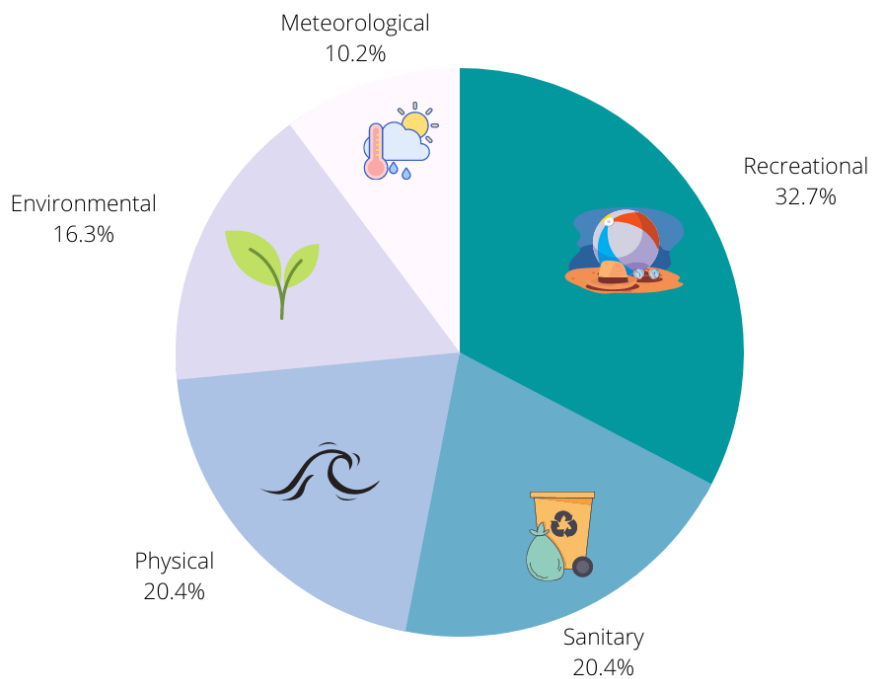


Figure 9: Division of indicators by thematic area (websites)

From the 47 websites that assessed the beaches, 21 were worldwide lists. The top-ranked beach of each site was plotted onto a map (Fig. 10). Beaches on Bora Bora, Zakynthos (Greece), and Seychelles won the first position in more than one site. La Digue Island, in Seychelles, was the front-runner in 5 cases. Looking into the distribution and characteristics of the winners it is possible to find some similarities. First, all of them are located on islands or archipelagos, have turquoise or emerald waters and very white sand. They are also surrounded by vegetation, that can be either a dense forest or jungle (majority of the cases) or a well-preserved dune or coastal vegetation. Promontories, cliffs, or mountains fence the top beaches, giving them a pocket-protected shape. Facilities are not mandatory and, when present, they are scattered and well-distributed.

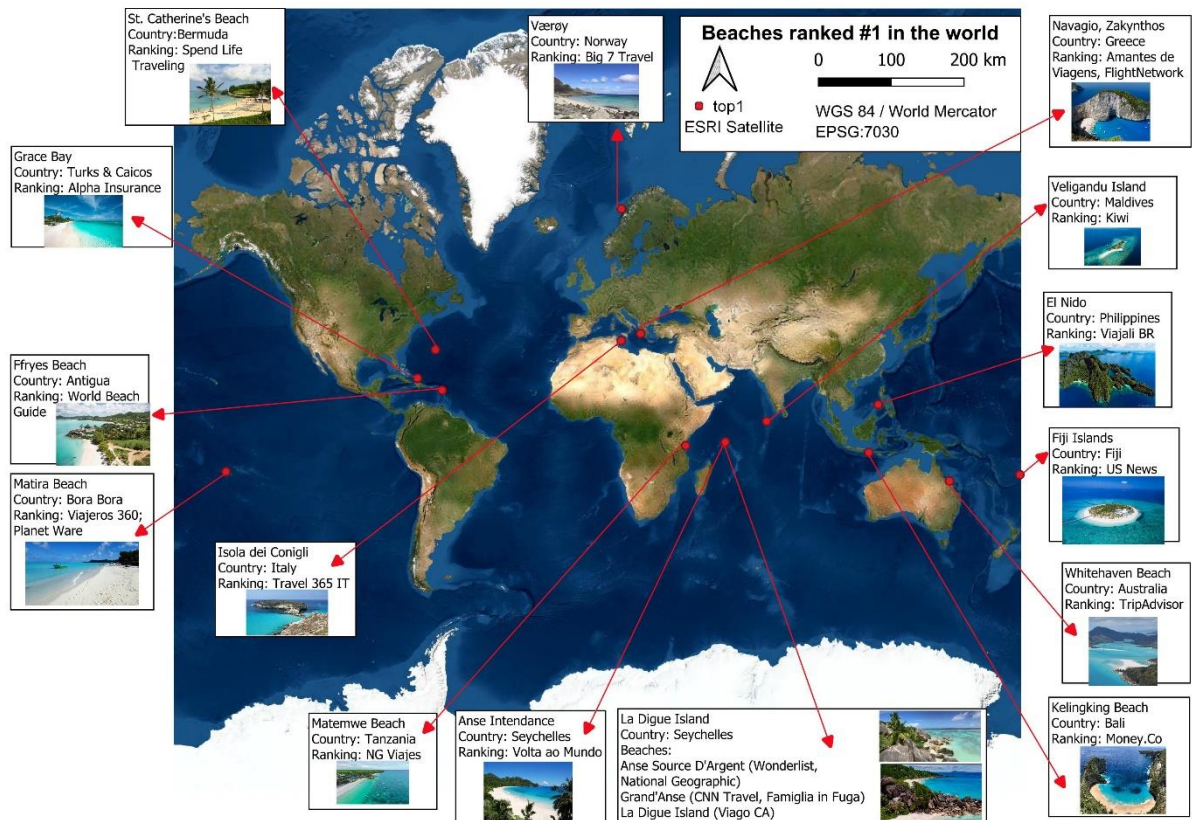


Figure 10: Location of the beaches classified as the best (#1) in the world by different websites

## 4.2. Beach Quality Indices

A beach index describes and evaluates the beach, allowing the detection of attributes that can identify the aptitude of the beach towards recreation or conservation (Cendrero & Fischer, 1997; McLachlan *et al.*, 2013; Cervantes & Espejel, 2008). It can be used as a tool to classify, assess and compare management programs through time and space (Araújo & Costa, 2008). Table 3 shows beach indices applied by diverse authors. The analysis of the indices shows that beach quality assessments were applied all over the world, in beaches with different stages of development. Weights were assigned in almost all assessments through the evaluation of experts or users. The involvement of stakeholders, mostly beach experts and users, is recurrent on the methodologies.

The authors adopted different approaches for the definition of scores during the rating of indicators. Cendrero & Fischer (1997) and Botero *et al.* (2015) created their rating based on the opinion of coastal experts. Ariza *et al.* (2010) and Peña-Alonso *et al.* (2018) generated the rating based on a combination of opinions (from

experts, users, and government), directives and literature. The majority of indices, however, evaluate the indicators based on previous scores established in the literature.

There is also a differentiation on the indices division names. Ariza *et al.* (2010) divides the index first into components (based on beach function), then into partial indices which are composed by a set of parameters or indicators. Botero *et al.* (2015) divide the index into indicators and then into parameters. Bombana & Ariza (2019) divides the index into sub-indices, which are composed of a range of variables. Peña-Alonso *et al.* (2018) divide into partial indices that are composed of variables. Semeoshenkova *et al.* (2016) divide into components and then into indicators. Independent of the name, the indices are generally divided into physical characteristics of the beach, environmental quality and human aspects, such as socioeconomic and recreation. The present study divides the index first into domains, then into categories that are measured by a set of indicators.

Some limitations have also been identified. Cendrero & Fischer (1997) states that there is an inequality between socio-economic and ecological indicators due the absence of baseline data for ecological components, which can be a potential source of uncertainty. Bombana & Ariza (2018) affirms that it is clear that beach user satisfaction is at the forefront of those indices and even when other aspects are included, such as environmental and physical characteristics, they aim to promote recreation as well. In addition, the authors affirm that most of the indices are neglecting the complexity of socio-ecological systems due to the lack of transdisciplinary approaches. Palazón *et al.* (2019) sustains that the aesthetic and hygienic assessment by visual inspection is still subjective and that indices are static and not up to date. According to Espínola & Marques Júnior (2021), indices are created to help the management of beaches but not to rank the best ones or help the tourist to decide their destination.

Table 3: List of Beach Quality Assessments.

Index	Authors	Sub-Indices	Score definition	Weight	Stakeholder	Type of beach	Application
<b>Environmental Quality of Coastal Areas</b>	Cendrero & Fischer (1997)	Resources; Hazards; Occupancy	Coastal researches and coastal planners	Delphi Method	Planning and management officials; coastal researchers	Different coastal environments, including beaches	Spain
<b>Beach Rating Scale</b>	Leatherman (1997)	Physical; Biological; Human use and impacts	Authors opinion	-	-	Urban to pristine	USA
<b>User-based Rating system</b>	Morgan (1999)	Physical; Biological; Human uses	Literature	User survey	Users	Tourist beaches	UK
<b>Bathing Area Registration &amp; Evaluation</b>	Micallef <i>et al.</i> (2004)	Safety; Water quality; Facilities; Scenery; Litter	Literature	-	-	Urban, resort, village, rural and remote	Croatia
<b>Coastal Scenic Assessment</b>	Ergin <i>et al.</i> (2014)	Physical; Human	Users survey	User survey, Fuzzy Logic	Users	Urban, resort, village, rural and remote	Turkey, UK and Malta
<b>Environmental Beach Quality</b>	Sealeum <i>et al.</i> (2007)	Physical; Social; Pollution; Biological	Literature	Scale from 1 to 4 according priority	Specialists (environmental / tourism); Users	Recreational beach	Thailand
<b>Environmental Quality Indicators</b>	Araújo & Costa (2008)	Natural; Socioeconomic	Literature	Scale from 1 to 3 according importance	-	Overdeveloped, developed and underdeveloped	Brazil
<b>Integrated Beach Value Index</b>	Cervantes & Espejel (2008)	Ecological; Socioeconomic; Users' Perception; Monetary	Literature	-	Users	Urban	USA, Mexico and Brazil
<b>Beach Quality index (BQI)</b>	Ariza <i>et al.</i> (2010)	Recreational; Natural; Protective	Experts, users, directives, literature,	Linear combination; multi-criteria	Beach experts; Users	Urban and urbanized	Spain

Index	Authors	Sub-Indices	Score definition	Weight	Stakeholder	Type of beach	Application
<b>Environmental Function Analysis</b>	Amyot & Grant (2014)	Ecological; Socio-economic	Authors opinion	Normalization	Provincial planners	Beaches with protected status	Canada
<b>Environmental Quality of Tourist Beaches</b>	Botero <i>et al</i> (2015)	Sanitary; Ecological; Recreational	Experts	Average rating of experts	Experts	Tourist beaches	Colombia
<b>Multi-criteria evaluation structure</b>	Chen & Bau (2016)	Cleanliness; Safety; Protection & management; Facilities & services	Order of importance	AHP	Beach management experts	Urban	Taiwan
<b>Beach Evaluation Index (BEI)</b>	Lucrezi <i>et al.</i> (2016)	Beach Description; Human Dimension; Monetary	Literature	-	Users	Urban	South Africa
<b>Integrated Beach Quality Index (IBQI)</b>	Semeoshenkova <i>et al.</i> (2016)	Environmental quality; Human welfare & health	Order of excellence	AHP	Beach experts	Urban, semi-urban and semi-rural	Italy
<b>Beach Health Index (BHI)</b>	Todd & Bowa (2016)	Beach health goals	-	Based on literature	-	Urban, semi-urban	Australia
<b>Multi-dimensional recreational quality</b>	Peña-Alonso <i>et al.</i> (2018)	Accessibility; Water; Environmental; Comfort; Scenic; Human activity & infrastructure; Safety; Facilities;	Experts, users, directives, literature,	Derived from questionnaire survey	Experts and users	Urban, semi-urban and natural	Spain
<b>Double-Looped Beach Quality Index</b>	Bombana & Ariza (2019)	Economics; Morphodynamics; Recreational; Ecology & natural heritage;	Multi-stakeholders	-	Multi stakeholders	Urban, semi-urban and natural	Spain

### 4.3. Scientific Indicators

The survey for beach quality assessment returned 18 articles (Tab. 3) and 231 indicators. Indicators that are cited by just 1 or 2 articles comprise 50% of total. Indicators cited by at least 9 articles (50%) comprise just 10%. The most cited indicator was Access (considered by 15 out of 18), followed by Parking (14) and Beach width (12). Color of water, the most cited indicator on websites, was considered by 9 articles. Figure 11 shows the indicators that are cited by 5 or more articles.

Grouping the indicators (Fig. 12), we can see that 26% are related to recreation attributes, 25% with physical characteristics of the beach, 23% with environmental features, 14% with sanitary and human health, 6% with management, 3% with economic situation, and 3% with climate conditions. The main differences with the websites are the inclusion of management and economic indicators, the increasing importance of environment and the decreasing of sanitary and meteorological.

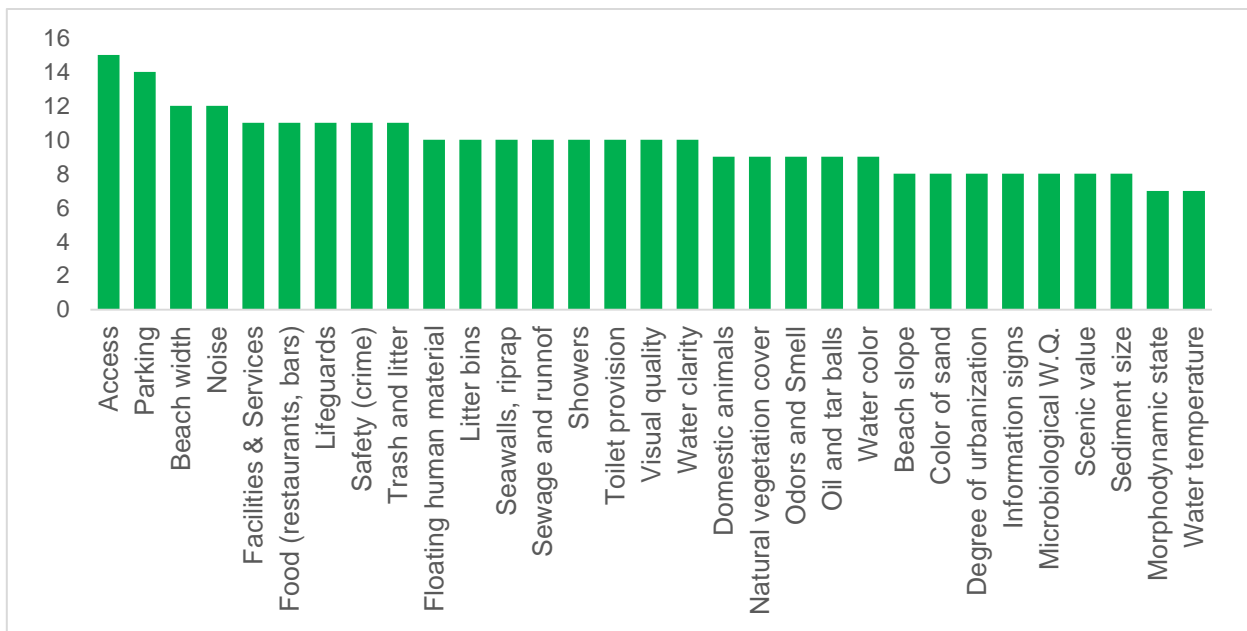


Figure 11: Number of articles that consider each indicator

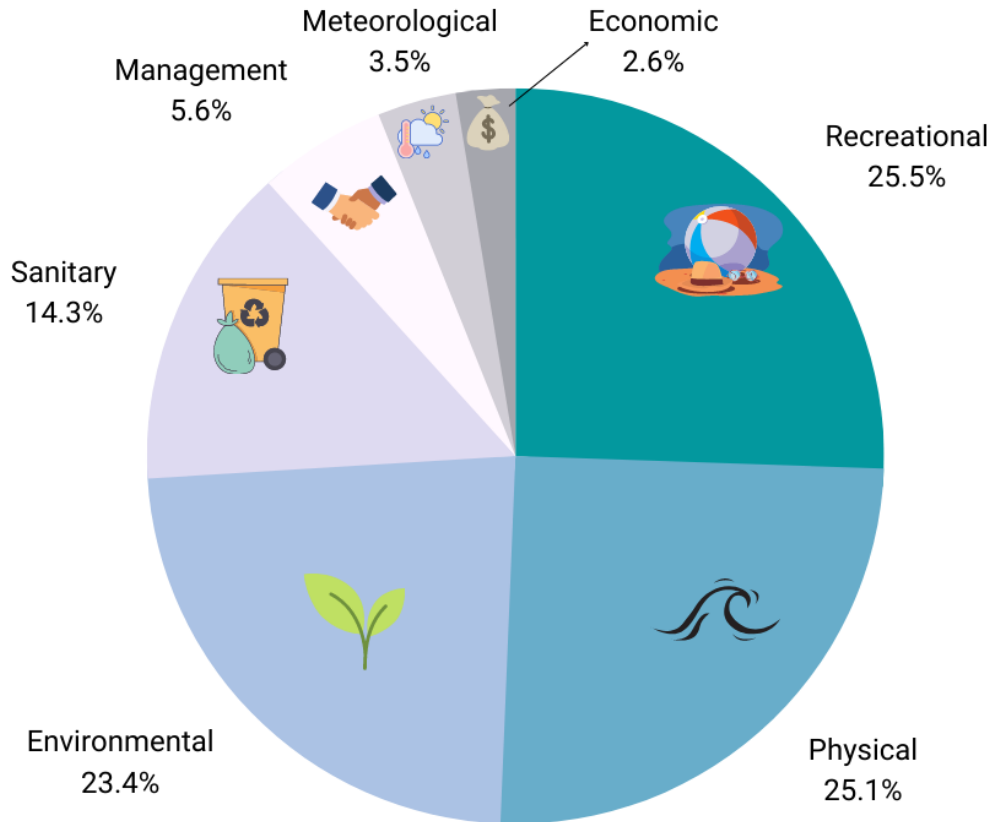


Figure 12: Division of indicators by thematic area (scientific)

#### 4.4. Framework

##### 4.4.1. Beach Ranking Framework

The Beach Ranking Framework is divided into four domains that embrace the functions of a beach: Protection, Recreation, Sanitary and Conservation. The recreational domain (RD) refers to the provision of services and infrastructure that enable beach users to relax, have fun and be entertained. The protection domain (PD) includes indicators that are going to evaluate the beach potential to dissipate energy and defend the city against possible harmful events. Conservation (CD) refers to the preservation of the environment, including indicators to measure biodiversity, environmental quality and management conservation actions. Finally, the fourth domain is dedicated to sanitary (SD) issues that aims to identify the presence and impacts of litter and pollution. Each domain is composed of five categories, which are measured by indicators that embrace the characteristics necessary to describe the domain (Fig. 13). The description of categories and indicators included in each domain are exhibited in tables 4 to 7.

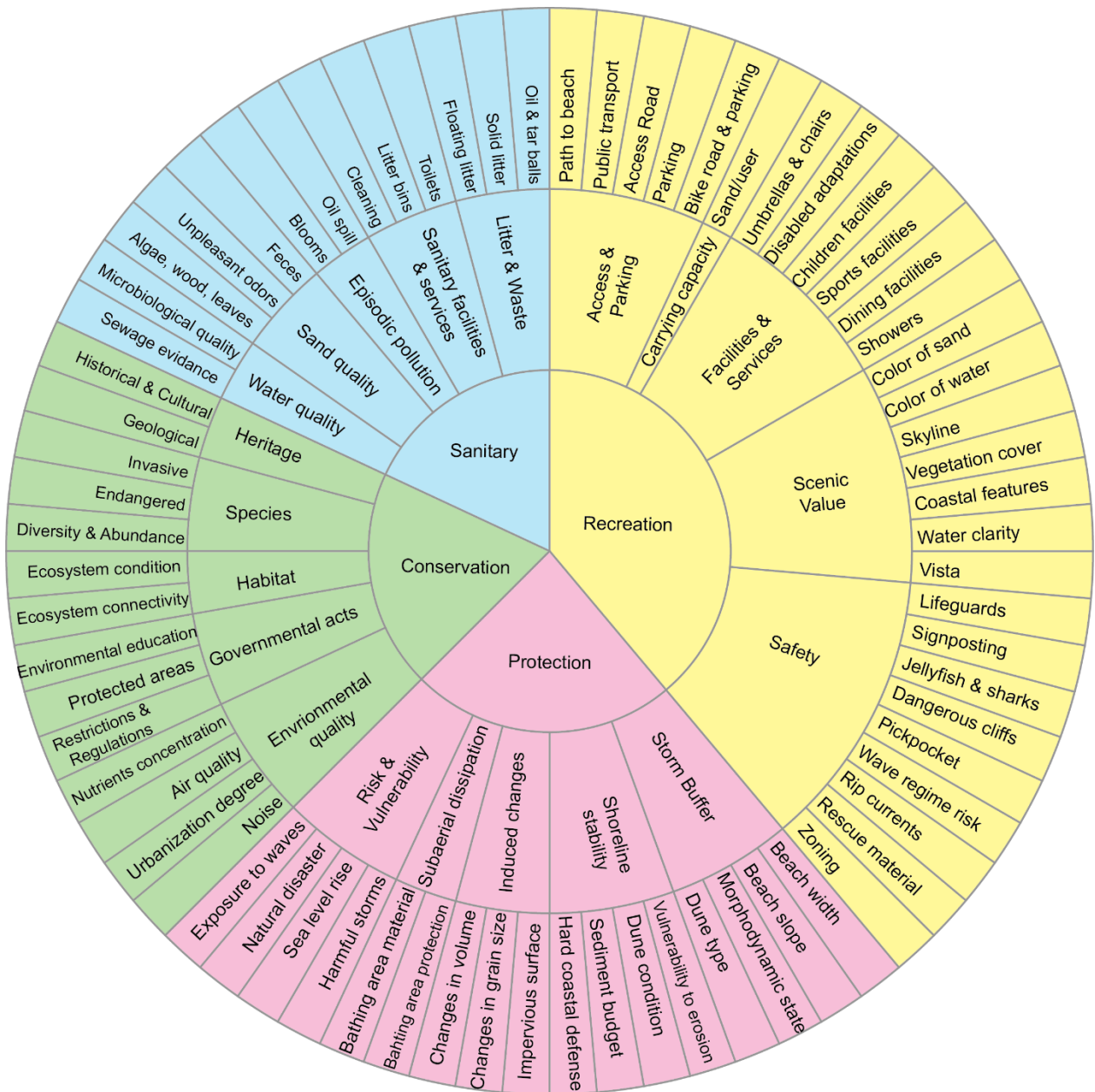


Figure 13: Ranking Framework structure

**Protection Domain:**

Table 4: Set of Categories and Indicators that compose the Protection domain. The indicators were chosen based on the source described at the last column.

Category	Description	Indicators	Source
Storm Buffer	Evaluates the capacity of beach to defend and resist against storms and includes aerial beach elements	<ol style="list-style-type: none"> <li>1. Beach width</li> <li>2. Beach slope</li> <li>3. Dune type</li> <li>4. Morphodynamic state</li> </ol>	Ariza <i>et al.</i> (2010)
Shoreline Stability	Refers to the position of the shoreline along the time.	<ol style="list-style-type: none"> <li>1. Vulnerability to erosion</li> <li>2. Dune condition</li> <li>3. Sediment budget</li> <li>4. Hard coastal defense</li> </ol>	Leatherman (1997); Cendrero & Fischer (1997); Semeoshenkova <i>et al.</i> (2016);
Induced Changes	Evaluates the human modifications on the beach and surroundings	<ol style="list-style-type: none"> <li>1. Impervious surface</li> <li>2. Changes in grain size</li> <li>3. Changes in volume</li> </ol>	Ariza <i>et al.</i> (2010); Bombana & Ariza (2019)
Subaerial Dissipation	Identifies the presence of subaerial features (e.g. saltmarshes, mangroves) that absorb wave energy	<ol style="list-style-type: none"> <li>1. Bathing area protection</li> <li>2. Bathing area material</li> </ol>	Araújo & Costa (2008); Atkins <i>et al.</i> (2015); Lucrezi <i>et al.</i> (2016)
Risk & Vulnerability	Evaluates the occurrence and frequency of events (e.g. hurricanes, sea level rise) that can generate impacts at a site	<ol style="list-style-type: none"> <li>1. Harmful storms</li> <li>2. Sea level rise</li> <li>3. Natural disaster</li> <li>4. Exposure to waves</li> </ol>	Cendrero & Fischer (1997); Bombana & Ariza (2019); Araújo & Costa (2008); Maes (2018)

### Sanitary Domain:

Table 5: Set of Categories and Indicators that compose the Sanitary domain. The indicators were chosen based on the source described at the last column.

Category	Description	Indicators	Source
Water Quality	Evaluates the overall quality of the bathing waters	<ol style="list-style-type: none"> <li>1. Sewage discharge evidence</li> <li>2. Microbiological water quality</li> </ol>	Cendrero & Fischer (1997); Cervantes & Espejel (2008)
Sand Quality	Aims to identify the comfort and cleanliness of sediments	<ol style="list-style-type: none"> <li>1. Accumulation of wood/algae</li> <li>2. Unpleasant odors</li> <li>3. Feces on the sand</li> </ol>	Botero <i>et al.</i> (2015);
Episodic Pollution	Evaluates the occurrence and frequency of potential pollution sources	<ol style="list-style-type: none"> <li>1. Algae blooms</li> <li>2. Oil spills</li> </ol>	Botero <i>et al.</i> (2015); Peña-Alonso <i>et al.</i> (2018)
Litter & Waste	Examines the presence of different types of litter	<ol style="list-style-type: none"> <li>1. Floating litter</li> <li>2. Solid human waste</li> <li>3. Oil patches</li> </ol>	Leatherman (1997); Araújo & Costa (2008)
Sanitary facilities & Services	Investigates the provision of sanitary amenities	<ol style="list-style-type: none"> <li>1. Cleaning of the beach</li> <li>2. Litter bins</li> <li>3. Toilet provision</li> </ol>	Peña-Alonso <i>et al.</i> (2018)

## Recreational Domain:

Table 6: Set of Categories and Indicators that compose the Recreational domain. The indicators were chosen based on the source described at the last column.

Category	Description	Indicators	Source
Access & Parking	Aims to identify the type of entrance and the availability of parking on the surroundings	<ol style="list-style-type: none"> <li>1. Path to the beach</li> <li>2. Public transport</li> <li>3. Access road</li> <li>4. Car parking</li> <li>5. Bicycle parking</li> </ol>	Araújo & Costa (2008); Ariza <i>et al.</i> (2010);
Carrying Capacity	Public crowding perception	<ol style="list-style-type: none"> <li>1. Availability of sand by user</li> </ol>	Micallef <i>et al.</i> (2004)
Facilities & Services	Evaluates the offer of amenities and adaptations for disabled users.	<ol style="list-style-type: none"> <li>1. Umbrellas and chairs</li> <li>2. Dining facilities</li> <li>3. Adaptations for disabled users</li> <li>4. Facilities for children</li> <li>5. Sports facilities</li> <li>6. Showers</li> </ol>	Morgan (1999); Araújo & Costa (2008); Ariza <i>et al.</i> (2010);
Scenic Value	Measures the coastal scenery of a specific site	<ol style="list-style-type: none"> <li>1. Color of sand</li> <li>2. Color of water</li> <li>3. Skyline</li> <li>4. Vegetation cover</li> <li>5. Coastal features</li> <li>6. Water clarity</li> <li>7. Vista</li> </ol>	Scenic Evaluation (Ergin <i>et al.</i> , 2004)
Safety	Includes the aspects related with security in the beach including currents, rescuing and dangerous situations	<ol style="list-style-type: none"> <li>1. Lifeguards</li> <li>2. Signposting</li> <li>3. Dangerous animals</li> <li>4. Dangerous cliffs</li> <li>5. Pickpockets &amp; crime</li> <li>6. Wave regime risk</li> <li>7. Rip currents</li> <li>8. Rescue material</li> <li>9. Zoning of activities</li> </ol>	Leatherman (1997); Morgan (1999); Araújo & Costa (2008); Peña-Alonso <i>et al.</i> (2018)

## Conservation Domain:

Table 7: Set of Categories and Indicators that compose the Conservation domain. The indicators were chosen based on the source described at the last column.

Category	Description	Indicators	Source
Environmental Quality	Evaluates the overall quality of the environment of a beach, identifying noise, air pollution and eutrophication	<ol style="list-style-type: none"> <li>Noise</li> <li>Degree of urbanization</li> <li>Air quality</li> <li>Concentration of nutrients</li> </ol>	Atkins <i>et al.</i> (2015); Maes (2018);
Governmental acts	Refers to instruments and public regulations of use and conservation of a beach	<ol style="list-style-type: none"> <li>Restrictions &amp; regulations</li> <li>Protected areas</li> <li>Environmental education</li> </ol>	Atkins <i>et al.</i> (2015); Lucrezi <i>et al.</i> (2016); Maes (2018)
Habitat	Evaluates the presence and condition of beach habitats present at the beach	<ol style="list-style-type: none"> <li>Ecosystem connectivity</li> <li>Ecosystem condition</li> </ol>	Araújo & Costa (2008); Maes (2018)
Species	Examines the richness and abundance of species in an area and identify the presence of endangered and invasive species	<ol style="list-style-type: none"> <li>Diversity &amp; abundance</li> <li>Endangered and iconic</li> <li>Invasive species</li> </ol>	Atkins <i>et al.</i> (2015); Maes (2018);
Heritage	Evaluates sites with specific conservation interest	<ol style="list-style-type: none"> <li>Geological interest</li> <li>Historic, archeological, cultural and scientific interest</li> </ol>	Cendrero & Fischer (1997); Atkins <i>et al.</i> (2015)

### 4.4.2. Rating Score

The rating score, exhibited on table 8, aims to reduce the subjectivity during the evaluation process. The use of 'Bad' to 'Good' scale gives space to personal interpretation since what can be seen as good for a person can be faced as regular by another one with more restrictive criteria. The standardization of scores, with a clear definition of what is good or bad for each indicator is, therefore, essential. The proposed rating score was based on the scientific literature about beach quality. Priority was given for articles that incorporated the opinion of beach experts (managers, planners, investigators) and beach users through the realization of workshops and questionnaires. The scores selected were adapted to a 5-point scale.

Table 8: Proposed rating Score for each indicator composing the Beach Ranking Framework.

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Path to the beach	Presence of Stairs or Steps	Presence of stairs	Path with steps > 20 cm	Path with steps between 10 and 20 cm	Main access clear; presence of stairs or steps in the middle	Clear path to beach	Araújo & Costa (2008); Morgan (1999); Ariza <i>et al.</i> (2010)
Public transport	Frequency (hours) and variety	Access only by private transport	Bus stop far from the beach(>2km) ; Scarce (≤3 bus/day)	Bus stop far from the beach; Bike roads not existent	Bus every 1 to 2 h; Bike roads available	Diverse (bus, train, bike) with high frequency (<1 h/day)	Peña-Alonso <i>et al.</i> (2018); Roca <i>et al.</i> (2009)
Access Road	Width, Sign & Conditions of Roads	Non existent	Narrow and not asphalted	Narrow and asphalted, but with irregularities	Wide and asphalted, but not well signposted	Well signposted, wide, well asphalted	Morgan (1999); Ariza <i>et al.</i> (2010)
Parking	Abundance; Distance from the beach; fee	Non existent	Limited (1); Only Private; ≥ 300 m	Moderate; private/public; 200 to 300 m	Abundant; Public available; 200 to 300 m	Very abundant ; public options available; <200m	Amyot & Grant (2014); Ariza <i>et al.</i> (2010)
Bicycle parking	Distance from the beach; Capacity	Absent	>300m	200 to 300 m; <5 bikes	Between 100 to 200 m; 5 - 10 bikes	≤ 100 m; >10 bikes	Peña-Alonso <i>et al.</i> (2018)
Availability of sand by user	Nº of visitors; beach length; social perception	Overcrowded; [< 4m²/user]; Small beach with very high number of visitors	Crowded [4-8 m²/user]; Small to median beach	Crowded [4-8 m²/user]; Large beach	Satisfactory [4-8m²/user]; small to median beach	Optimal conditions [>8m²/user]; Large beach	Ariza <i>et al.</i> (2010)

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Umbrellas and chairs	% of occupancy of beach surface	Concentrated (>50%)	-	Between 30% and 50%	-	Scarce (<30%) or inexistent;	Ariza <i>et al.</i> (2010)
Dining facilities	Concentration and distribution of restaurants, bars, etc.	Absent	Scarce (<5 options) along the year	Seasonal facilities	Good variation of options well maintained	Wide selection well maintained, well-distributed and with minimum impacts	Morgan (1999); Ariza <i>et al.</i> (2010)
Adaptations for disabled users	Presence of braille panels, adapted access to bathing area, dog allowed, adapted facilities	Absent	-	Partially adapted ( $\leq 2$ adaptations)	-	Adapted (>2 adaptations)	Peña-Alonso <i>et al.</i> (2018); INR (Praia acessível)
Facilities for children	Presence, size, maintenance, distance	Nonexistent if Urban	-	Existing and well maintained; >150 m from the beach	Existing and well maintained; small, at the beach	Existing and well maintained; medium/large, at the beach	Ariza <i>et al.</i> (2010)
Showers/feet showers	Distance; Number	Absent	$\geq 250$ m; only 1	Between 150 and 250 m; 2	-	<150 m; >2	Morgan (1999); Ariza <i>et al.</i> (2010)
Sports facilities	Presence of facilities; options available (fixed, renting)	Nonexistent if Urban	-	Rent equipment during summer	-	Rent equipment; presence of facilities on the surroundings	Ariza <i>et al.</i> (2010)
Color of Sand (Beach Face)	Scenic Evaluation	Absent	Dark	Dark tan	Light tan	White/gold	Ergin <i>et al.</i> (2004)
Color of Water	Scenic Evaluation	Brown or gray	Milk blue or green	Green, gray or blue	Light or dark Blue	Turquoise	Ergin <i>et al.</i> (2004)

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Skyline	Scenic Evaluation	Very unattractive	-	Sensitively designed	Very sensitively designed	Natural/historic features	Ergin <i>et al.</i> (2004)
Vegetation cover	Scenic Evaluation	Absent	Bare (<10%)	Scattered	High natural cover	Very high natural cover	Ergin <i>et al.</i> (2004); Araújo & Costa (2008);
Coastal Features	Presence of: rock ridges, lagoons, peninsulas, caves, headlands, reefs, arches, deltas, waterfalls, estuaries, etc.	Absent	1	2	3	>3	Ergin <i>et al.</i> (2004)
Water clarity	Scenic Evaluation	Muddy	Opaque	-	Clear	Very clear	Ergin <i>et al.</i> (2004)
Vista	Scenic Evaluation	Open on one side	Open on two sides	-	Open on three sides	Open on four sides	Ergin <i>et al.</i> (2004)
Lifeguards	Distribution along the year	Absent	Occasional	Peak season weekends	Seasonal	Permanent	Morgan (1999); Peña-Alonso <i>et al.</i> (2018)
Signposting	Presence and visibility	Absent	-	Present, but not well-located/clear	-	Visible and clear	Araújo & Costa (2008);
Dangerous animals (jellyfish, sharks)	Frequency of shark attacks; jellyfish report	Frequent (>5/y) jellyfish and shark attacks	Frequent (>5/y) jellyfish; occasional shark attacks (<5/y)	Occasional (1-5/y) jellyfish and shark attacks	Rare (<1/y) jellyfish and no history of shark attacks	Absent	Araújo & Costa (2008); Morgan (1999)

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Dangerous cliffs	Unstable cliffs, stone fall danger	Dangerous, loose cliffs directly above beach	-	Unfenced cliffs, negligible, stone fall danger	-	None directly above beach	Morgan (1999)
Pickpockets & crime	Frequency of crimes and surveillance	Common; no police surveillance	Common; Occasional surveillance	Rare; Occasional surveillance	Rare; Surveillance during high season	Rare; Permanent surveillance	Leatherman (1997); Peña-Alonso <i>et al.</i> (2018)
Wave regime risk	Size and type of breaking; Sea state warning flags	Dangerous (Wave >1,5m; surging and plunging waves)	Presence of Sea state warning flags; Wave >1,5m	Presence of Sea state warning flags; Moderate energy (0.5 to 1.5 m)	Safe; Moderate energy (0.5 to 1.5 m)	Safe; Low energy: (<0.5m); Spilling breaking wave	Leatherman (1997); Peña-Alonso <i>et al.</i> (2018)
Rip Currents	Presence and frequency	Frequent; Not well marked; without information	-	Occasional; well-marked; information provided	-	Absent	Araújo & Costa (2008);
Rescue material	Distribution along the year	Absent	Occasional	Peak season weekends	Seasonal	Permanent	Morgan (1999); Peña-Alonso <i>et al.</i> (2018)
Zoning of activities (bathing, surfing, etc.)	Allocation of space for each activity	Competition for use of space	-	Allocation of space for boats or sports (only sea)	-	Allocation of space for each activity, marked with buoys or flags, including on land	Araújo & Costa (2008); Leatherman (1997)
Beach Width	Beach width (m)	Narrow (<10 m)	10-30 m	30-60 m	60-100 m	wide >100 m	Leatherman (1997)

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Beach slope	Beach slope (°)	Very Steep (>20°)	15°-20°	10-15°	5-10°	Gentle (<5°)	Araújo & Costa (2008); Morgan (1999);
Dune type	Stage of dunes	Absent	Incipient	Foredune ridge only	Secondary ridge	Several, fixed dunes	Ergin <i>et al.</i> (2004); Bombana & Ariza (2019)
Vulnerability to erosion	Rate of erosion (m/y)	Very High (>1m/year)	High	Moderate	Low	Very Low (0 m/year)	Cendrero & Fischer (1997); Araújo & Costa (2008);
Dune condition	Dunes condition	Absent, replaced by hard engineering	Severely disturbed and limited in extent	Disturbed but largely intact	well developed, little disturbance	Pristine and extensive	McLachlan <i>et al.</i> (2013)
Sediment budget	[Sources - Sinks]	Erosional	-	Stable	-	Depositional	Leatherman (1997)
Hard coastal defense	Presence and quantity of seawalls, groins, etc.	>3	3	2	1	None	Ergin <i>et al.</i> (2004)
Impervious surface	Cover area (%)	>60%	40-60%	20-40%	5-20%	<5%	Ariza <i>et al.</i> (2010)
Changes in grain size	(%) of beach area affected	Severe (>30%)	-	Moderate (<30%)	-	No alterations	Ariza <i>et al.</i> (2010)
Changes in volume (nourishment)	(%) of beach area affected; Number of interventions	Severe (>30%); >3 interventions	Severe (>30%); <3 interventions	Moderate (<30%); 2 interventions	Moderate (<30%); 1 intervention	No alterations	Ariza <i>et al.</i> (2010)
Bathing area protection	Distribution of reefs, saltmarshes	Absent	-	Low protection/coverage	-	High protection; high coverage	Araújo & Costa (2008);

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Bathing area material	Predominant material	Rocky	Mixed rock and coarse sand	Coarse sand	Mixed coarse sand and fine sand	Fine or medium sand	Araújo & Costa (2008);
Morpho-dynamic state	Morphodynamic state	Very reflective	Mostly reflective	Intermediate	Mostly dissipative	Dissipative	Amyot & Grant (2014)
Harmful storms	Nº events/century; Vulnerability	Frequent (>50); High vulnerability	Recurrent (26-49); High vulnerability	Occasional (11 - 25); Medium vulnerability	Scarce (1-10); Low vulnerability	Rare (<1); Low vulnerability	Cendrero & Fischer (1997); Araújo & Costa (2008);
Sea level rise	Rate of sea level rise (mm/y)	>20 mm/year	-	0.5 to 20 mm/y	-	<0.5 mm/year	Cendrero & Fischer (1997);
Natural disaster	Probability of occurrence; Vulnerability	Very High (Return Period <100 years); High vulnerability	Moderate (Return Period: 100 and 1000 y); High vulnerability	Moderate (Return Period: 100 and 1000 y); Low vulnerability	Little (Return Period > 1000 years); Very low vulnerability	Absent	Lucrezi <i>et al.</i> (2016)
Exposure to waves	Beach shape (pocket, linear)	Exposed	-	Half-sheltered	-	Sheltered	Araújo & Costa (2008);
Noise	Scenic Evaluation	Intolerable	Tolerable	-	Little	None	Ergin <i>et al.</i> (2004)
Degree of urbanization	Area of construction (%)	>75%	75-50	25-50	1 to 25	0	Peña-Alonso <i>et al.</i> (2018)

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Air quality (air pollutants)	Emission of pollutants (PM <sub>2.5</sub> , PM <sub>10</sub> , O <sub>3</sub> , NO <sub>2</sub> , SO <sub>2</sub> ); Directives	Bad PM <sub>10</sub> >101; PM <sub>2.5</sub> >51; NO <sub>2</sub> >401; O <sub>3</sub> >241; SO <sub>2</sub> >501	Weak (PM <sub>10</sub> 51-100; PM <sub>2.5</sub> 26-50; NO <sub>2</sub> 201-400; O <sub>3</sub> 181-240; SO <sub>2</sub> 351-500)	Regular (PM <sub>10</sub> 36-50; PM <sub>2.5</sub> 21-25; NO <sub>2</sub> 101-200; O <sub>3</sub> 101-180; SO <sub>2</sub> 201-350)	Good (PM <sub>10</sub> 21-35; PM <sub>2.5</sub> 11-20; NO <sub>2</sub> 41-100; O <sub>3</sub> 81-100; SO <sub>2</sub> 101-200)	Very Good (PM <sub>10</sub> <20; PM <sub>2.5</sub> <10; NO <sub>2</sub> <40; O <sub>3</sub> <80; SO <sub>2</sub> <100)	APA PT
Concentration of Nutrients	Concentration of Nitrogen according Directives; Changes on the environment	>50 mgNO <sub>3</sub> /l; Severe alteration with high impacts	>50 mgNO <sub>3</sub> /l; Little alteration or impacts	<50 mgNO <sub>3</sub> /l; Alteration on the state of habitat without significant impact	<25 mgNO <sub>3</sub> /l; Alteration on the state of habitat without significant impact	<25 mgNO <sub>3</sub> /l; No alterations on the state of habitat	Directives 91/676/EEC ; 75/440/EEC
Restrictions & Regulations	Legal instruments; Communications at the beach	Absent	One restriction (e.g. dogs)	Moderate (two restrictions visible)	-	Many (e.g. dogs, drinks, dunes, parking)	Lucrezi <i>et al.</i> (2016)
Protected areas (%)	(%) area under conservation	0%	<10%	10 - 30%	30 - 50%	>50%	Cendrero & Fischer (1997)
Environmental Educational	Number of initiatives and engagement with society	Absent	Few activities	Moderate	Many activities	Many activities, high engagement	Lucrezi <i>et al.</i> (2016)
Ecosystem connectivity	Number (n° habitats/ha), size and connectivity of ecosystems	Absent	Few (1-5), medium, disconnected	Many (5), small, connected	Many (5-10) medium-large, connected	Numerous (>10), medium-large, connected	Amyot & Grant (2014); Lucrezi <i>et al.</i> (2016); Cendrero & Fischer (1997);

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Ecosystem condition	Conservation status of habitats; % of area changed	Very badly preserved (>75%)	Badly preserved (50-75%)	Moderately preserved (20-50%)	Well preserved (5-20%)	Very well preserved; <5%	Araújo & Costa (2008); Atkins <i>et al.</i> (2015)
Diversity & Abundance	Number and size of populations; level of conservation	Low abundance; high modification; missing the majority of communities	Intermediate; high modification; missing some expected communities	Intermediate; moderate modification; missing some communities	Species rich and abundant; little modification; missing some communities	Species rich and abundant; pristine; all expected communities present	McLachlan <i>et al.</i> (2013); Directive 2000/60/EC
Endangered and iconic	Number of species; nesting	Absent	-	Present in low numbers, not nesting	-	Nesting/spawning present in large numbers	McLachlan <i>et al.</i> (2013)
Invasive species	Establishment; Invasive potential; Commercial Value	Well-established, impacts reported; No commercial value	Well-established; medium/high potential; low commercial value	Species established; medium/low invasive potential; high commercial value	Species introduced; low invasive potential; Very high commercial value	No reported/Absent	Keller <i>et al.</i> (2011)
Geological interest	Geological diversity	Absent	-	-	-	Present	Bombana & Ariza (2019)
Historic, archaeological cultural & scientific interest	n° of units; conservation	Absent	Few; bad conservation	Moderate n° and conservation	High (>5); Bad/fair conservation	High (>5); Good conservation	Cendrero & Fisher (1997); Lucrezi <i>et al.</i> (2016)

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Sewage discharge evidence	Items per linear meter on strand line	Clear evidence (>3 items)	-	Some evidence (1-3 items)	-	No evidence	Ergin <i>et al.</i> (2004); Araújo & Costa (2008);
Microbiological water quality	Accordance of directives/standards; (ufc/100ml)	Not suitable (frequent)/Without analysis	Enterococcus intestinalis >185; Escherichia coli >500	Enterococcus intestinalis 185; Escherichia coli 500	Enterococcus intestinalis 200; Escherichia coli 500	Enterococcus intestinalis 100; Escherichia coli 250	DIRECTIVE 2006/7/EC
Accumulation of wood, leaves, macroalgae	Items per linear meter on strand line	Heavily contaminated (>10); Unpleasant walking	-	Some accumulations (5-10)	Traces (0-5)	Absent	Araújo & Costa (2008);
Unpleasant Odors	Complaining reports; Field observations	Strong	-	Detectable	-	Absent	Araújo & Costa (2008);
Feces on the sand	Items per linear meter on strand line	Frequent	-	Some	-	Absent	Lucrezi <i>et al.</i> (2016)
Blooms	Nº of events/year; impacts	>5/year; toxicity detected; economic and environmental impacts	>5/year; toxicity not detected; only economic impacts	2-5/year; toxicity detected; only economic impacts	2-5/year; toxicity not detected; without impacts	<2/year; without any effects	Peña-Alonso <i>et al.</i> (2018)
Oil spills	Nº of events/year	>2/y	-	>1/y	-	Absent	Lucrezi <i>et al.</i> (2016)
Cleaning of the beach	Method applied	Absent	Mechanic (heavy) -high frequency (>3/week)	Mechanic (heavy) - low frequency	Mixed (mostly manual)	Manual / Not necessary	Peña-Alonso <i>et al.</i> (2018); Lucrezi <i>et al.</i> (2016)

Indicator	Measurement	Score					Source
		1	2	3	4	5	
Litter bins	Distribution and maintenance	Absent	Scarce, rarely emptied	Existing, but poorly managed	Regularly emptied, without separation	Regularly emptied and with litter segregation	Williams & Micallef (2009)
Toilet provision	Distribution and maintenance	Absent	Poorly managed at the beach and surroundings	Poorly managed on the beach; no gender specification	Clean, limited to private places	Clean; public toilet at the beach; gender specific	Williams & Micallef (2009)
Floating debris/litter	Accumulation by strand line	Continuous accumulations	Full strand line	Single accumulation	Few scattered	Visually absent	Ergin <i>et al.</i> (2004)
Solid human waste	Accumulation by area	High along all the beach	High next to the access point	Some in specific points	Few scattered	Visually absent	Ergin <i>et al.</i> (2004)
Oil & tar balls	Items per linear meter on strand line	Many patches evident	-	Traces	-	Absent	Morgan (1999)

#### 4.4.3. Weights

The weights attributed for each beach can be seen in the tables 9 to 11. The mean values for the domains and categories varied according to the type of beach. For urban beaches, recreation and sanitary have higher weight, while for rural, the conservation domain is more important. Meanwhile, for village beaches, all the domains have similar weights. This differentiation of importance goes in agreement with the expectations for each beach type: urban beaches are known for their development and offer of services and amenities, while rural ones are known for their naturalness. Since village beaches are the transition between the two, it is expected to have a mixture of elements.

Table 9: Weights assigned for domains and categories for Urban Beaches. The columns show the values applied by each scholar, the mean value between them all and the standard deviation ( $\sigma$ ).

<b>URBAN</b>		<b>Gerardo</b>	<b>Flavia</b>	<b>Briana</b>	<b>Camilo</b>	<b>Chris</b>	<b>Final mean value</b>	<b><math>\sigma</math></b>
Domains	Recreation	0.52	0.4	0.25	0.39	0.29	0.37	0.08
	Conservation	0.17	0.11	0.25	0.08	0.08	0.14	0.06
	Protection	0.2	0.25	0.25	0.19	0.08	0.19	0.05
	Sanitary	0.07	0.22	0.25	0.31	0.52	0.27	0.11
Recreation	Access & Parking	0.13	0.15	0.13	0.19	0.25	0.17	0.04
	Carrying Capacity	0.14	0.28	0.22	0.1	0.07	0.16	0.07
	Facilities & Services	0.14	0.15	0.14	0.2	0.23	0.17	0.03
	Safety	0.19	0.19	0.25	0.42	0.25	0.26	0.06
	Scenic Value	0.4	0.14	0.25	0.04	0.12	0.19	0.11
Protection	Subaerial dissipation	0.22	0.17	0.19	0.07	0.24	0.18	0.05
	Risk & Vulnerability	0.11	0.17	0.14	0.47	0.25	0.23	0.11
	Induced changes	0.08	0.31	0.41	0.16	0.13	0.22	0.11
	Shoreline stability	0.3	0.18	0.1	0.21	0.13	0.18	0.06
	Storm buffer	0.25	0.17	0.14	0.05	0.25	0.17	0.06
Conservation	Environmental quality	0.25	0.29	0.11	0.41	0.28	0.27	0.07
	Governmental acts	0.12	0.29	0.17	0.22	0.11	0.18	0.06
	Habitat	0.25	0.14	0.32	0.1	0.27	0.22	0.08
	Species	0.26	0.14	0.17	0.06	0.27	0.18	0.07
	Heritage	0.12	0.14	0.21	0.2	0.06	0.15	0.05
Sanitary	Water quality	0.26	0.22	0.17	0.09	0.32	0.21	0.07
	Sand quality	0.26	0.22	0.18	0.05	0.21	0.18	0.06
	Episodic pollution	0.13	0.21	0.31	0.45	0.19	0.26	0.10
	Facilities & services	0.14	0.13	0.17	0.14	0.1	0.14	0.02
	Litter & Waste	0.14	0.21	0.17	0.27	0.2	0.20	0.03

The weights for the categories also changed between beach types. Regarding recreation, scenic value and carrying capacity have higher priority for rural and village beaches, while safety was considered the most important for urban. Concerning conservation, environmental quality is the most important category for urban beaches and habitat for rural beaches. Village beaches show an average distribution between all the categories. The sanitary facilities and services have the lowest weight for all beach types in the sanitary domain. Finally, the protection domain did not show any relevant variation of priorities between the categories.

Table 10: Weights assigned for domains and categories for Village Beaches.

VILLAGE		Gerardo	Flavia	Briana	Camilo	Chris	Final mean value	$\sigma$
Domains	Recreation	0.51	0.15	0.11	0.22	0.29	0.26	0.12
	Conservation	0.23	0.29	0.54	0.23	0.08	0.27	0.11
	Protection	0.12	0.27	0.21	0.44	0.08	0.22	0.10
	Sanitary	0.13	0.29	0.13	0.11	0.52	0.24	0.14
Recreation	Access & Parking	0.05	0.1	0.08	0.14	0.25	0.12	0.06
	Carrying Capacity	0.27	0.31	0.28	0.19	0.07	0.22	0.08
	Facilities & Services	0.13	0.12	0.08	0.09	0.23	0.13	0.04
	Safety	0.17	0.22	0.16	0.07	0.25	0.17	0.05
	Scenic Value	0.36	0.29	0.4	0.46	0.12	0.33	0.10
Protection	Subaerial dissipation	0.2	0.2	0.29	0.2	0.24	0.23	0.03
	Risk & vulnerability	0.1	0.2	0.07	0.07	0.25	0.14	0.07
	Induced changes	0.16	0.2	0.5	0.1	0.13	0.22	0.11
	Shoreline stability	0.29	0.2	0.06	0.19	0.13	0.17	0.06
	Storm buffer	0.24	0.2	0.07	0.38	0.25	0.23	0.07
Conservation	Environmental quality	0.31	0.2	0.07	0.06	0.28	0.18	0.10
	Governmental acts	0.11	0.2	0.33	0.26	0.11	0.20	0.07
	Habitat	0.19	0.2	0.26	0.17	0.27	0.22	0.04
	Species	0.24	0.2	0.17	0.09	0.27	0.19	0.05
	Heritage	0.12	0.2	0.17	0.41	0.06	0.19	0.09
Sanitary	Water quality	0.35	0.26	0.21	0.2	0.32	0.27	0.05
	Sand quality	0.11	0.26	0.16	0.07	0.21	0.16	0.06
	Episodic pollution	0.13	0.26	0.34	0.1	0.19	0.20	0.08
	S. facilities & services	0.13	0.09	0.05	0.14	0.1	0.10	0.03
	Litter & Waste	0.24	0.13	0.21	0.44	0.2	0.24	0.08

The standard deviation shows the variability of weights between the scholars. Regarding the domains, urban beaches show the lowest values of variability. Rural beaches have higher inconsistency for conservation and protection, and village beaches have higher values for the sanitary domain. All beach types presented high variability for scenic value and induced changes. In the sanitary domain, urban beaches showed stronger disagreement on episodic pollution. Finally, rural beaches had a higher variability for the categories 'habitat' and 'environmental quality' on the conservation domain, while village beaches had higher disagreement on environmental quality and heritage.

Table 11: Weights assigned for domains and categories for Rural Beaches.

<b>RURAL</b>		<b>Gerardo</b>	<b>Flavia</b>	<b>Briana</b>	<b>Camilo</b>	<b>Chris</b>	<b>Final mean value</b>	<b><math>\sigma</math></b>
Domains	Recreation	0.081	0.080	0.070	0.110	0.180	0.104	0.03
	Conservation	0.128	0.390	0.640	0.540	0.370	0.414	0.14
	Protection	0.402	0.130	0.160	0.240	0.370	0.260	0.10
	Sanitary	0.201	0.390	0.130	0.110	0.080	0.182	0.09
Recreation	Access & Parking	0.051	0.060	0.060	0.280	0.180	0.126	0.08
	Carrying Capacity	0.062	0.340	0.410	0.180	0.220	0.242	0.11
	Facilities & Services	0.219	0.070	0.050	0.090	0.180	0.122	0.06
	Safety	0.219	0.170	0.060	0.380	0.150	0.196	0.08
	Scenic Value	0.404	0.350	0.410	0.020	0.240	0.285	0.12
Protection	Subaerial dissipation	0.043	0.200	0.290	0.080	0.270	0.177	0.09
	Risk & vulnerability	0.048	0.200	0.100	0.320	0.330	0.200	0.10
	Induced changes	0.071	0.200	0.410	0.230	0.070	0.196	0.10
	Shoreline stability	0.408	0.200	0.080	0.260	0.070	0.204	0.10
	Storm buffer	0.34	0.200	0.110	0.120	0.210	0.196	0.06
Conservation	Environmental quality	0.317	0.200	0.040	0.060	0.230	0.169	0.10
	Governmental acts	0.081	0.200	0.130	0.120	0.090	0.124	0.03
	Habitat	0.158	0.200	0.370	0.420	0.190	0.268	0.10
	Species	0.19	0.200	0.190	0.290	0.190	0.212	0.03
	Heritage	0.233	0.200	0.270	0.080	0.230	0.203	0.05
Sanitary	Water quality	0.272	0.250	0.120	0.110	0.240	0.198	0.07
	Sand quality	0.198	0.250	0.120	0.450	0.240	0.252	0.08
	Episodic pollution	0.091	0.250	0.350	0.170	0.220	0.216	0.07
	S. facilities & services	0.175	0.080	0.040	0.040	0.060	0.079	0.04
	Litter & Waste	0.217	0.180	0.350	0.220	0.220	0.237	0.05

## 4.5. Application

The rating score of each indicator can be seen in Appendix 4 and the normalized scores in table 12. The normalized score for each category is also shown at the graphs exhibited in figures 14 and 15. The axis of the graphs varies from 0 to 1, being one the greatest value at the outside border (the more filled the slice, the better the performance of the beach in this particular category). The colors are representing the domains: yellow for recreation, pink for protection, green for conservation, blue for sanitary. The individual BQV is shown in the center of the graph.

Table 12: Normalized scores for the beaches at Algarve, Portugal

	Sub-Index	Faro	Falésia	Marinha	Benagil	Rocha	D. Ana	Camilo	Luz
Recreation	Access & Parking	0.80	0.76	0.56	0.52	0.80	0.60	0.52	0.76
	Carrying capacity	0.60	1.00	0.60	0.20	0.60	0.40	0.20	0.40
	Facilities & Services	0.90	0.57	0.40	0.47	0.93	0.50	0.30	0.90
	Scenic Value	0.71	0.83	0.91	0.83	0.74	0.83	0.86	0.74
	Safety	0.84	0.82	0.73	0.64	0.89	0.80	0.76	0.84
Protection	Storm Buffer	0.65	0.50	0.50	0.50	0.75	0.50	0.45	0.60
	Shoreline Stability	0.55	0.75	0.50	0.50	0.60	0.65	0.65	0.65
	Induced Changes	0.80	0.93	1.00	0.87	0.47	0.67	1.00	0.80
	Subaerial dissipation	0.40	0.40	0.70	0.70	0.60	0.50	0.50	0.50
	Risk & Vulnerability	0.50	0.60	0.80	0.80	0.55	0.80	0.75	0.65
Conservation	Environmental quality	0.75	0.90	0.95	0.85	0.60	0.80	0.95	0.90
	Governmental acts	0.73	0.53	0.73	0.73	0.73	0.80	0.80	0.80
	Habitat	0.80	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Species	0.87	0.53	0.87	0.73	0.40	0.53	0.60	0.73
	Heritage	0.20	0.30	0.50	0.30	0.50	0.20	0.60	1.00
Sanitary	Water quality	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00
	Sand quality	0.73	0.93	0.93	1.00	1.00	1.00	0.93	1.00
	Episodic pollution	0.90	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Sanitary facilities & Services	0.93	0.93	0.93	1.00	0.93	0.87	0.87	0.93
	Litter & Waste	0.93	0.93	0.93	1.00	0.93	0.93	0.93	0.93

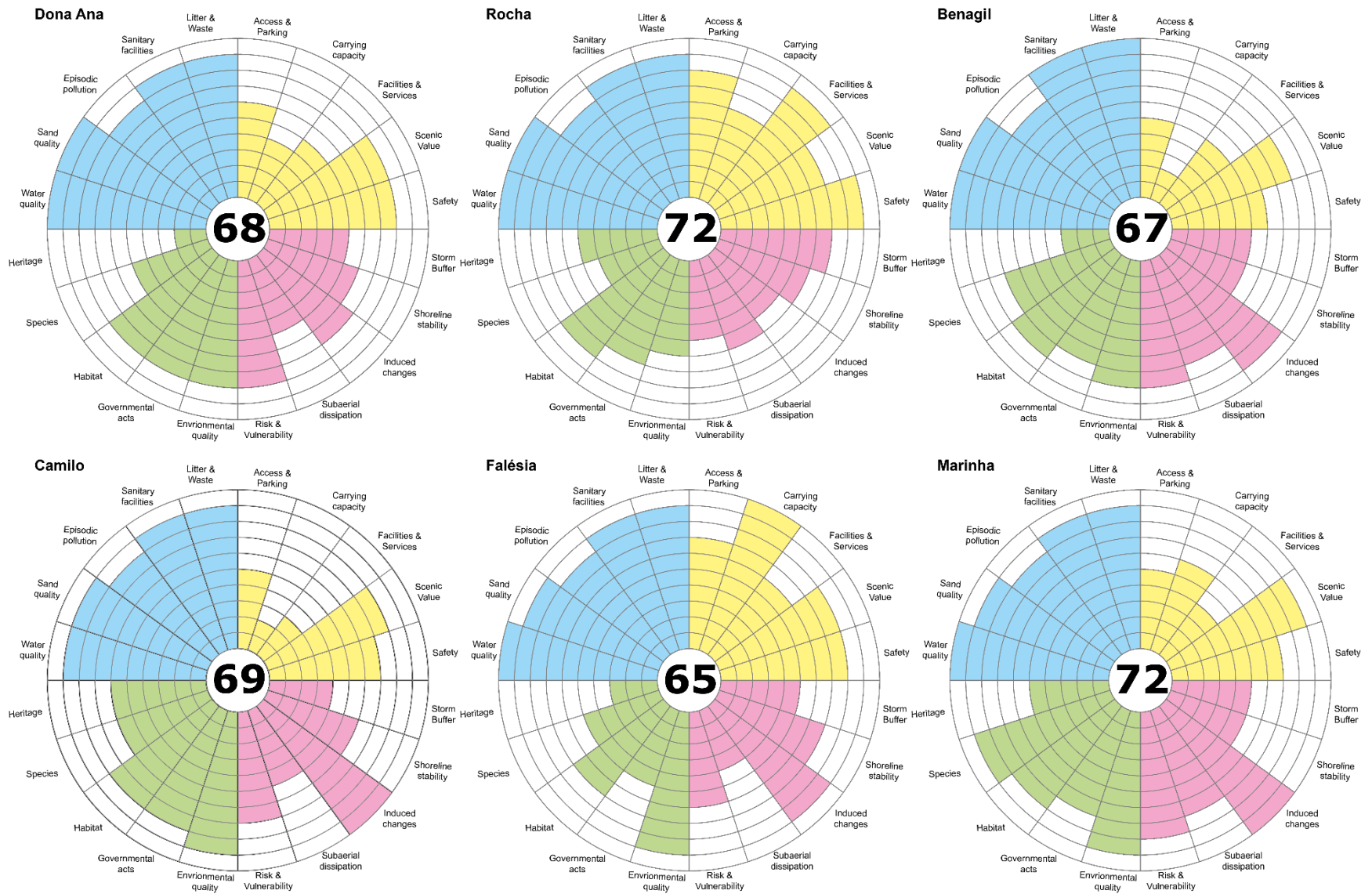


Figure 14: Graphic output of the normalized values for rural and urban beaches

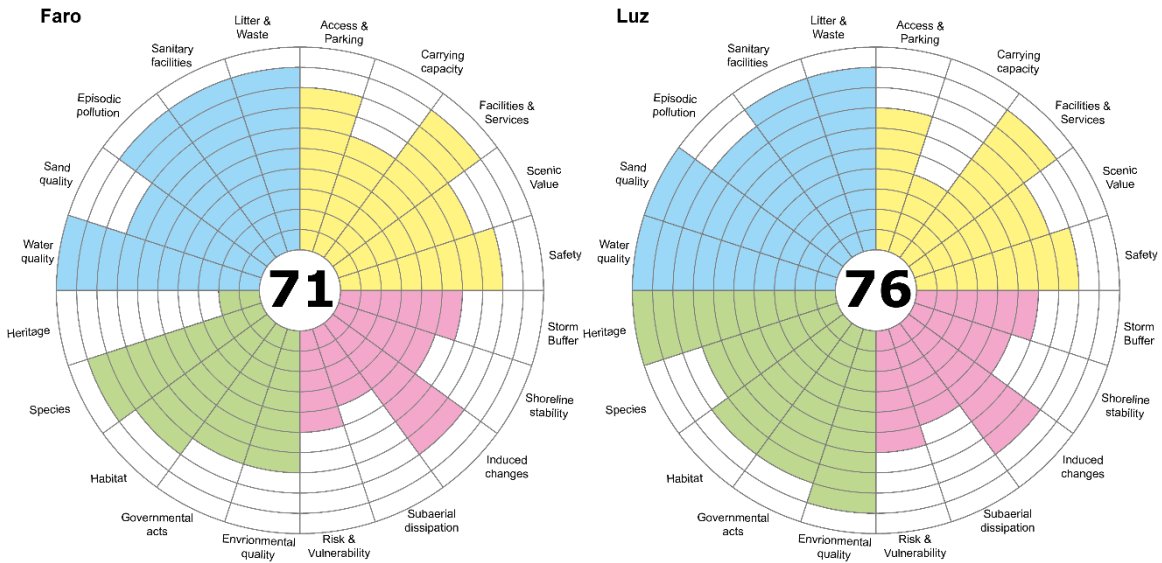


Figure 15: Graphic output of the normalized values for village beaches.

All the beaches presented good performance in the sanitary domain, which contributed to elevate the individual final score. Furthermore, the beaches presented similar BQV despite the variations between the domains. The allocation of weights, in turn, helped to compensate for the weakness of some categories. Figure 14 exhibits the final performance of beaches in each domain. Rocha beach presented the highest value on the recreational domain, whereas Marinha is the best on conservation. All beaches show very similar results on Protection and little variation on the Sanitary domain.

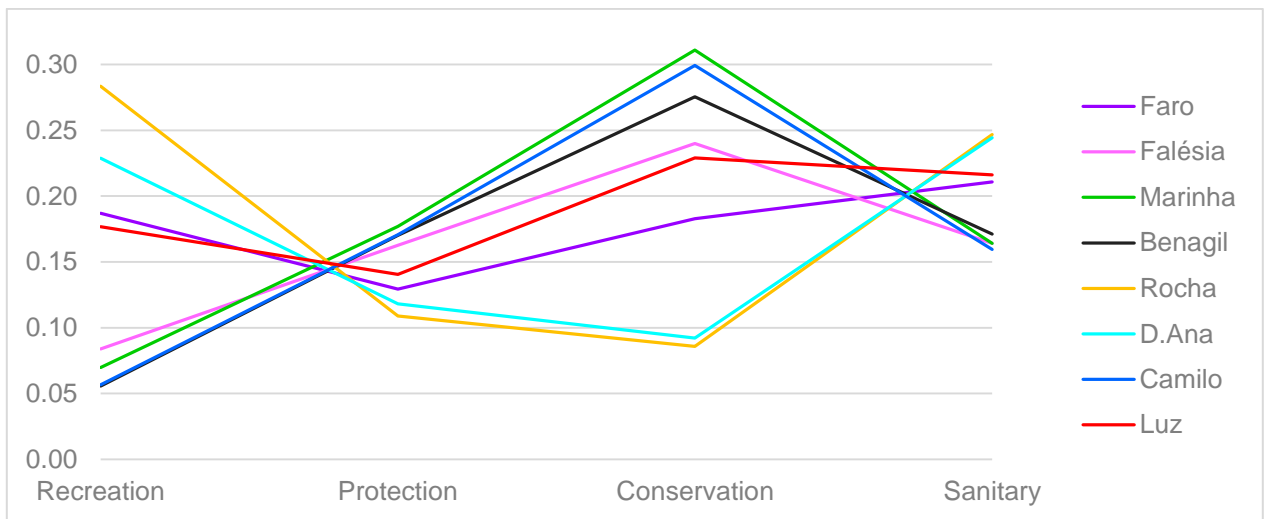


Figure 16: Performance of beaches in each domain.

The ranking of best beaches is shown in figure 16. The best beach (#1) is Luz, a village beach in the municipality of Lagos. The beach won due the combination of a good conservation (presence of a Natura 2000 site) and sanitary component, aligned with a median performance in the recreation domain. The beach at the last position, Falésia, had a low performance in the conservation domain, and a good performance in recreation. The ranking shows different beaches at the 3 first positions, confirming that the framework is not favoring a unique beach type.

## BEST BEACHES



Figure 17: Ranking of the beaches in Algarve using the beach ranking framework

## Chapter 5. Discussion

The analysis of the internet-based revealed that the existing rankings are mostly subjective. There is no scientific, analytic or objective methodology to rank beaches. Moreover, most part does not compare the beaches directly to one another and the positions are a reflection of the singularities of each one. The majority of 'best beaches' lists are either an overview of places that appeal to the person that wrote the webpage or the winners of social contests. Additionally, since the profile can influence the perception of a user, the rankings become even more subjective as different outcomes can be expected if the authors are changed.

Besides, they seem to be judging beauty rather than quality, since they are relying on the aesthetic component to classify the beaches. Even when indicators are considered, those are mostly a reflection of the idea of a paradisiac beach: a beautiful, isolated, warm and exotic area with crystal blue waters and white sand (Costa, 1998; Gössling, 2002; Prayag, 2011). Although attractiveness is a key element for the public, they should incorporate a broader range of indicators (such as water quality, carrying capacity, and ecosystem balance) to fully assess the healthy status and deliver a comprehensive ranking of the best beaches. Moreover, since tourists use these rankings to choose their destination, the assessment of quality, including a wide spectrum of measurable indicators, is essential in order to guarantee and safeguard the health of the ecosystem prior and after the visit.

Comparing websites rankings with the scientific literature, some differences can be found. First, the dissimilarity is reflected in the nature of indicators used. Whereas water and sand color are the priority for users in websites, access & parking is more recurrent in scientific articles. In addition, cleanliness is cited as the most valued feature on studies about users perception (Vousdoukas *et al.*, 2009; Marin *et al.*, 2009; Rodella *et al.*, 2017; Peña-Alonso *et al.*, 2018; Roca & Villares, 2018; Lucrezi *et al.*, 2018). Second, while the scientific literature on users perception is trying to understand what factors drive users to choose a beach and how geography, culture, and social aspects can influence it; the webpages are more interested in extracting which beaches are most appealing for

tourists, proved by the use of terms from the aesthetic vocabulary, like 'beautiful', 'paradise' and 'picturesque' (Miller & Hadley, 2019).

The difference is mainly underpinned by the content and nature of indicators used in the ranking process. Whereas websites use an average of 8 indicators (with a maximum of 17), in the indices, the average reaches 47 (with a maximum of 131). This difference shows that scientists are trying harder to evaluate the overall quality, including all the relevant functions of a beach. Regarding thematic area, indicators in websites concentrate mostly on the recreational use, physical characteristics of the beach, and sanitary aspects. Scientific articles, on the other hand, embrace a broader spectrum of areas, including not only physical and human welfare but also ecological, economic, sanitary, and management indicators. Finally, unlike the majority of websites, the articles are just qualifying the beaches, through indices, rather than ranking them.

The indicators mentioned by websites rankings are almost all related with scenic evaluation and recreational use of the beach. Although the scientific literature is incorporating a larger set of indicators, they are also focusing on the recreational aptitude and on the satisfaction of the user (Bombana & Ariza, 2018). An effective beach management should cover all aspects relevant, including not only the recreational objective, but also the protection of the environment, the conservation of the ecosystem and the issues related with litter, which can affect the beach in multiple ways. With this in mind, the framework created consists of 72 indicators divided into 4 domains that aims to describe the overall quality of a beach respecting all the pertinent characteristics mentioned.

The use of specific and measurable indicators to rank the beaches covering all these aspects guided the process and allowed the true comparison between all the beaches analyzed. The elements chosen to compose the framework evaluates the beach by a holistic approach, considering it as a socio-ecological system in order to respect the ecosystem services and functions provided by the beach. The indicators included can be used to identify some of the most common environmental issues in beaches, such as erosion, flooding, eutrophication, pollution, alteration of landscape and decrease of biodiversity. At the same time, it will draw attention to the quality of the services provided. The use of weights allowed beach differentiation, respecting the most important features

of every beach type. This is a crucial step to avoid generalization and highlight the strong components of each one. The use of a rating score with measurements for each indicator, instead of a simple rating by order of excellence, helped to decrease the subjectivity of the index, since the scale of comparison is the same for every investigator applying the framework. Consequently, all beaches are going to be analyzed based on the same criteria and the ranking is a reliable comparison of elements.

The graphic representation of the framework, inspired by the combination of CS and OHI, allows the visualization of the performance of the beach at each domain, facilitating the communication and interpretation of the data. The graphic output allows the user to understand why the beach is at a specific position on the rank and help the managers to identify which categories could be improved to raise their status. Moreover, users can use the graphic representation to identify beaches that have higher performance at a specific domain. Families, for example, can choose beaches that are better in the recreation quadrant, whereas groups that are looking for nature or adventure can look at conservation and find the beaches that fit their visitation purpose. The same applies for the categories. Users can look for slices of the graph in order to identify the beaches with better access or greater diversity of species and habitats.

The application of the Beach Ranking Framework on the Algarve region was possible and validated the methodology created. Through the graphs, we can confirm that urban beaches have higher performance in the recreational domain, compared with rural beaches that favor conservation. This outcome proves the importance of weights. If equal weights were applied to all beaches, regardless of the typology, the final ranking would not be fair, since the beaches do not have the same strength in each area. Rural beaches, for example, would be jeopardized by the lack of structure, even though it is not expected to have it. In addition, the application highlighted the importance of reducing the amount of data to be gathered in order to create an effective management tool that can be applied at the beach by managers, without intensive literature data survey.

Some of the indicators included in the present study are more difficult to collect, while others depend upon laboratory analysis. For a scientific approach, that information can be collected with time and digging through public databases. For beach managers, on the other hand, the framework can be seen as overwhelming and time demanding.

Seeing this limitation, two types of framework were designed: the first, with the complete set and description of the 72 indicators, for scientific studies and reference consultation. The second, a robust and summarized version, available on *Google Forms* (<https://forms.gle/w1xptjFE2PVT8etdA>) and exhibited in Appendix 5; with a limited number of categories (merging all the content created), to be applied by managers and specialists directly at the beach.

Although the proposed methodology is working, some improvements could be made in order to strengthen the framework. First, a robust analysis of rating scores, identifying the best measurement technique for each indicator and the clear division between the classes. The literature review on environmental rating scores is scarce. The majority of measurements suggested in this research are from more than one decade ago, while others are just the opinion of the authors' article. Thus, an up to date, consistent and integrated rating score to measure ecosystem services indicators (what is good or bad) is urgent. Second, stakeholders, beach managers and the expanded peer-community should be incorporated into the framework formulation and in the weight process to amplify the range of perceptions relevant for beach quality ranking. The use of a limited focus group helped to reduce the bias of a single evaluation, but could deliver better results if a bigger group with different interests was involved in the process. Third, this study performed the AHP only on three types of beach (urban, village and rural) due the amount of information to be shared with the focus group and the limited time. However, weights should be calculated for all beach types, including resort and remote, in order to completely respect the attributes of each one. Fourth, the creation of an application to apply the framework and plot the results should be pursued, since it will facilitate the use of the framework by managers and users worldwide. Finally, the framework must be shared with managers and users in order to see the acceptance between different groups.

## Chapter 6. Conclusion

The 'Beach Ranking Framework' is a clear and standardized methodology composed by indicators that respect the functions and ecosystem services of a beach and which is measured through a rating score scheme that enables true comparisons by a holistic view. The use of weights allows differing the importance of each component for each beach type, avoiding generalization and incorrect classification. The findings of the present study can support the management of beaches by highlighting the characteristics and classifying the quality of each beach. Additionally, the Beach Ranking Framework will standardize the ranking methodologies, allowing the tourist to compare the beaches and understand which criteria the ranking was based on.

Therefore, the study confirmed its hypothesis as the framework with standardized indicators helped to reduce the subjectivity of beach rankings and created a tool that allows the identification of priority areas for beach and tourism management. Finally, answers to the research questions that motivated this work are presented below.

Answer to the first research question (*which indicators are used to rank beaches on the 'best beaches' lists?*): The majority of 'best beaches' lists are relying on personal experiences and opinion to rank the beaches, which confirms the subjectivity of these rankings. The inclusion of indicators are mainly restricted to color of water, color of sand, vegetation cover and cleanliness, which are criteria used for scenic evaluation.

Answer to the second research question (*is there a scientific approach to rank beaches? Which indicators are used?*): The assessment of beach quality by the scientific literature is done by quality indices that integrates a large set of indicators covering different aspects of a beach (economy, environment, physical characteristics, climate, management, recreation and sanitary). These indices are applied worldwide in different types of beaches and have distinct methodologies to score and weight the indicators. The most recurrent indicators are access, parking, beach width, noise and facilities & services. However, even covering a broader spectrum, these indicators are mainly focused on the user satisfaction.

Answer to the third research question (*is it possible to create a framework that will reduce the subjectivity and support beach and tourism management?*): The present work

shows that it is possible to create an objective and understandable tool to rank beaches, based on the evaluation of indicators. The framework provided a holistic view, addressed the main issues and pointed out the weakness and strengths of each beach. The graphical output of the results can be used by tourists, who can use the images to filter the beach that best meets their desire, and by managers, who can use the framework to identify the main problematic spots.

Sustainable tourism is a sector of the Blue Economy and a goal of the Ocean Health Index. To achieve sustainable tourism, we need to respect the characteristics of different beaches, we need to educate the public so they understand the principles of resilience and socio ecological systems, and we need to stop selling prettiness and start teaching environmental quality. The proposed beach ranking framework can help achieve these goals and transform the tourism industry towards a more sustainable future.

### 6.1. *Dissemination & Exploitation*

Different stakeholders can benefit with the use of the beach ranking framework. The government, for example, can look at the results to identify the weak areas that demand management, while the tourists can use the graphics to select the beach that suits their needs. Hotels can use the output to promote the beach where they are located, whereas the tourism industry can divulge their region and the status of their beaches. Considering the applications, distinct products can be exploited to disseminate the information. Table 13 shows a list of possible products to be pursued for each group.

Table 13: Options of products that could be used to disseminate the results of the framework

<b>Stakeholder</b>	<b>Product for dissemination</b>
<i>Scientific community</i>	Article in scientific journal and conference presentations
<i>General public</i>	Website or Application with the beaches' evaluation and ranking
<i>Managers</i>	Signs and posters; Telegram Bot; Material for environmental education
<i>Hotels</i>	Flyers
<i>Tourism industry</i>	Beach Guide; Videos and social media content;

In the context of scientific dissemination, this work has been divided into two articles. The first one, “Best beaches of the world: a critique of web-based rating” is ready to be submitted as a research paper for Ocean & Coastal Management. The second, “Development of a management-based ranking of beaches” is under preparation to be submitted to a peer-reviewed scientific journal. The work is also going to be presented in Symposiums and Conferences happening in 2022.

The framework for managers, available on Google Forms, is going to be translated (Portuguese and Spanish) in order to be applied by members of Proplayas Network on beaches of Latin America still in 2022. Flyers and signs are under preparation as a product test for the Tourism Industry and Algarve municipalities.

## Chapter 7. References

- AMYOT, J. & GRANT, J. (2014). Environmental function analysis: A decision support tool for integrated sandy beach planning. *Ocean & Coastal Management*, 102, 317-327.
- ANTUNES, C. & TABORDA, R. (2009). Sea level at Cascais tide Gauge: Data, analysis and results. *Journal of Coastal Research*, SI 56, 218-222.
- ARAÚJO, M.C.B. & COSTA, M.F. (2008). Environmental quality indicators for recreational beaches classification. *Journal of Coastal Research*, 24(6), 1439-1449.
- ARIZA, E.; JIMENEZ, J.A.; SARDA, R.; VILLARES, M.; PINTO, J.; FRAGUELL, R.; ROCA, E.; MARTI, C.; VALDEMORO, H.; BALLESTER, R. & FLUVIA, M. (2010). Proposal for an integral quality index for urban and urbanized beaches. *Environmental Management*, 45, 998-1013.
- ATKINS, J.P.; BURDON, D. & ELLIOTT, M. (2015). Identification of a practicable set of ecosystem indicators for coastal and marine ecosystem services. In R.K. Turner & M. Schaafsma (Eds.), *Coastal zones ecosystem services* (pp.79-102). Cham: Springer.
- AUBRY, A. & ELLIOTT, M. (2006). The use of environmental integrative indicators to assess seabed disturbance in estuaries and coasts: Application to the Humber Estuary, UK. *Marine Pollution Bulletin*, 53, 175-185.
- BARTRAM, J., & REES, G. (1999). *Monitoring bathing waters: a practical guide to the design and implementation of assessments and monitoring programs*. London: CRC Press.
- Beach guide* (2014). Faro, Portugal: Algarve Tourism Board.
- BECKER, E. (2012). Social-ecological systems as epistemic objects. In: Glaser, M.; Krause, G.; Ratter, B.M.W. & Welp, M. (Eds.). *Human-nature interactions in the Anthropocene: Potentials of social-ecological systems analysis*, (pp. 37-59). New York: Routledge.
- BIMONTE, S., & FARALLA, V. (2012). Tourist types and happiness a comparative study in Maremma, Italy. *Annals of Tourism Research*, 39(4), 1929-1950.
- BIRD, E.C.F. (1996). *Beach Management*. Chichester: John Wiley and Sons.
- BIRD, E.C.F. (2008). *Coastal geomorphology: an introduction*. Chichester: John Wiley & Sons Ltd, Second edition.
- BOMBANA, B. & ARIZA, E. (2018). Clarifying some assumptions of coastal management: Analysis of values and uncertainties embedded in beach quality indexes. *Ecological Indicators*, 91, 376-385.

- BOMBANA, B. & ARIZA, E. (2019). A double-loop process for beach quality index construction: Approaching the complexity of the Catalan coast. *Journal of Environmental Management*, 240, 177-189.
- BOTERO, C.M. (2019). Beach Awards and Certifications. In C.W. Finkl & C. Makowski (Eds.), *Encyclopedia of Coastal Science* (pp.220-228). Switzerland: Springer, 2 edition.
- BOTERO, C.; ANFUSO, G.; WILLIMAS, A.T.; ZIELINSKI, S.; P. da SILVA, C.; CERVANTES, O.; SILVA, L. & CABRERA, J.A. (2013). Reasons for beach choice: European and Caribbean perspectives. *Journal of Coastal Research*, SI.65, 880-885.
- BOTERO, C.; PEREIRA, C.; TOSIC, M. & MANJARREZ, G. (2015). Design of an index for monitoring the environmental quality of tourist beaches from a holistic approach. *Ocean & Coastal Management*, 108, 65-73.
- BOTERO, C. M., CABRERA, J. A., & ZIELINSKI, S. (2018). Tourist beaches. In C.W. Finkl & C. Makowski (Eds.), *Encyclopedia of Coastal Science* (pp.1790-1796). Switzerland: Springer, 2 edition.
- BRETON, F., CLAPES, J., MARQUES, A., & PRIESTLEY, G. K. (1996). The recreational use of beaches and consequences for the development of new trends in management: the case of the beaches of the Metropolitan Region of Barcelona (Catalonia, Spain). *Ocean & Coastal Management*, 32(3), 153-180.
- CAMARSA, G.; SILVA, J. P.; TOLAND, J.; ELDRIDGE, J.; HUDSON, T.; JONES, W.; O'HARA, E.; THORPE, E. & THÉVIGNOT, C. (2012). *LIFE and coastal management*. European Union (EU). Luxembourg: Life Environment.
- CAGILABA, V., & RENNIE, H. G. (2005). *Literature review of beach awards and rating systems*. Hamilton: Environment Waikato.
- CCDR - Comissão de Coordenação e Desenvolvimento Regional do Algarve (2004). *Plano Regional de Ordenamento do Território (Volume III Caracterização e Diagnóstico)*. Retrieved from <http://prot.ccdr-alg.pt/Download.aspx>
- CERVANTES, O., & ESPEJEL, I. (2008). Design of an integrated evaluation index for recreational beaches. *Ocean & Coastal Management*, 51(5), 410-419.
- CHEN, C-L. & BAU, Y-P. (2016). Establishing a multi-criteria evaluation structure for tourist beaches in Taiwan: A foundation for sustainable beach tourism. *Ocean & Coastal Management*, 121, 88-96.
- CINNER, J. E. & BARNES, M. L. (2019). Social dimensions of resilience in social-ecological systems. *One Earth*, 1(1), 51-56.
- COSTA, J.A. (1998). Paradise discourse: A critical analysis of marketing and consuming Hawaii. *Consumption, Markets and Culture*, 1(4), 303-346.

COSTA, M.; SILVA, R. & VITORINO, J. (2001). Contribuição para o estudo do clima de agitação marítima na costa portuguesa. *2ª Jornadas Portuguesas de Engenharia Costeira e Portuária*, 20.

DORAN, G.T. (1981). There's a SMART way to write management's goals and objectives. *Management review*, 70(11), 35-36.

EC (1975). Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States. Official Journal L194, pp. 26-31.

EC (1991). Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources. Official Journal L375, pp. 1-8.

EC (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal L327, pp. 1-73.

EC (2006). Directive 2006/7/EC of the European Parliament and of the Council of 16 February 2006 concerning the management of bathing water quality and repealing directive 76/160/EEC. Official Journal of the European Union L64, pp.37-51.

EC (2021). Communication from the commission to the European Parliament, the Council, the European economic and social committee and the committee of the regions on a new approach for a sustainable blue economy in the EU transforming the EU's Blue Economy for a Sustainable Future. COM/2021/240 final.

ELLIOTT, M. (2011). Marine Science and management means tackling exogenic unmanaged pressures and endogenic managed pressures – A numbered guide. *Editorial/ Marine Pollution Bulletin*, 62, 651-655.

ERGIN, A.; KARAESMEN, E.; MICALLEF, A. & WILLIAMS, A.T. (2004). A new methodology for evaluating coastal scenery: fuzzy logic systems. *Area*, 36(4), 367-386.

ESPÍNOLA, R.S. & MARQUES JUNIOR, S. (2021). Índices de qualidade para praias turísticas: uma revisão de literatura para estudos de turismo (2014-2019). *Ateliê do Turismo*, 5(1), 1-21.

GARCÍA, M.C. & VENEZIANO, M.F. (2011). Proyectos de ley de costas y desarrollo litoral sostenible desde la óptica geográfica. *Contribuciones Científicas GÆA*, 23, 95-107.

GÖSSLING, S. (2002). Human-environmental relations with tourism. *Annals of Tourism Research*, 29(2), 539-556.

HARVEY, L. (2006). Understanding quality. In: Froment, E.; Kohler, J.; Purser, L. & Wilson, L. (Eds.), *EUA Bologna Handbook: Making Bologna work* (pp. 1-29). Berlin: Raabe.

- HARVEY, L. & GREEN, D. (1993). Defining Quality. *Assessment & Evaluation in Higher Education*, 18(1), 9-34.
- HATTAM, C.; ATKINS, J.; BEAUMONT, N.; BÖRGER, T.; BÖHNKE-HENRICHS, A.; BURDON, D.; GROOT, R.; HOEFNAGEL, E.; NUNES, P.A.L.D.; PIWOWARCZYK, J.; SASTRE, S. & AUSTEN, M.C. (2015). Marine ecosystem services: Linking indicators to their classification. *Ecological Indicators*, 49, 61-75.
- HARZING, A-W.; BALDUEZA, J.; BARNER-RASMUSSEN, W.; BARZANTNY, C.; CANABAL, A; ANABELLA, D; ESPEJO, AL; FERREIRA, R.; GIROUD, A.; KOESTER, K.; LIANG, Y-K.; MOCKAITIS, A.; MORLEY, M.J.; MYLONI, B.; ODUSANYA, J.O.T.; O'SULLIVAN, S.L.; PALANIAPPAN, A.K.; PROCHNO, P.; CHOUDHURY, S.R.; SAKA-HELMHOUT, A.; SIENGTHAI, SL; VISWAT, L.; SOYDAS, A.U. & ZANDER, L. (2009). Ranting versus ranking: What is the best way to reduce response and language bias in cross-national research? *International Business Review*, 18, 417-432.
- HECOCK, R. D. (1970). Recreation behavior patterns as related to site characteristics of beaches. *Journal of Leisure Research*, 2(4), 237-250.
- HENRIQUES, N.S.; RESSUREIÇÃO, A.; OLIVEIRA, F.; MONTEIRO, P.; RANGEL, M.; BENTES, L.; LINO, P.; JACOB, J.; AFONSO, C.M.L.; MOURA, DL; BEREÇIBAR, E.; HORTA e COSTA, B. & GONÇALVES, J.M.S. (2018). *Baía de Armação de Pêra: Informação de base dos valores naturais e dos usos do espaço marinho*. Faro, Portugal: CCMAR, Universidade do Algarve, Fundação Oceano Azul, 84p.
- JAMES, P. (2015). *Urban sustainability in theory and practice: circles of sustainability*. New York: Routledge.
- JAMES, R.J. (2000). From beaches to beach environments: linking the ecology, human-use and management of beaches in Australia. *Ocean & Coastal Management*, 43, 495-514.
- JANSSEN, M. A. & OSTROM, E. (2006). *Governing social-ecological systems*. Handbook of computational economics, 2, 1465-1509.
- KELLER, R.P.; GEST, J.; JESCHKE, J.M. & KÜHN, I. (2011). Invasive species in Europe: ecology, status, and policy. *Environmental Sciences Europe*, 23(23), 1-17.
- LAND, F.J. & FARR, J.L. (1980). Performance rating. *Psychological Bulletin*, 87(1), 72-107.
- LEATHERMAN, S.P. (1997). Beach rating: A methodological approach. *Journal of Coastal Research*, Technical Communication, 13(1), 253-258.
- LOUREIRO, C.; FERREIRA, O. & COOPER, J.A.G. 2013). Applicability of parametric beach morphodynamic state classification on embayed beaches. *Marine Geology*, 346, 153-164.

LUKOSEVICIUTE, G. & PANAGOPOULOS, T. (2021). Management priorities from tourists' perspectives and beach quality assessment as tools to support sustainable coastal tourism. *Ocean and Coastal Management*, 208, 105646, 1-11.

LUCREZI, S., SAAYMAN, M. & VAN DER MERWE, P. (2016). An assessment tool for sand beaches: A case study for integrating beach description, human dimension, and economic factors to identify priority management issues. *Ocean & Coastal Management*, 121, 1-22.

LUCREZI, S., GELDENHUYS, L. L., VAN DER MERWE, P., & SAAYMAN, M. (2018). Utility of users data and their support for differential beach management in South Africa. In C.M. Botero; O. Cervantes & C.W. Finkl, *Beach Management Tools-Concepts, Methodologies and Case Studies* (pp. 933-960). Cham: Springer.

MAES, J.; TELLER, A.; ERHARD, M.; GRIZZETTI, B; BARREDO, J; PARACCHINI, M.L.; CONDÉ, S.; SOMMA, F.; ORGIAZZI, A.; JONES, A.; ZULIAN, G.; VALLECILO, S.; PETERSEN, J-E.; MARQUARDT, D.; KOVACEVIC, V.; MALAK, D.A.; MARIN, A.I.; CZÚCZ, B.; MAURI, A.; LOFFLER, P.; BASTRUP-BIRK, A.; BIALA, K.; CHRISTIANSEN, T. & WERNER, B. (2018). *Mapping and assessment of ecosystems and their services: an analytical framework for ecosystem condition*. Luxembourg: Publications office of the European Union.

MARIN, V., PALMISANI, F., IVALDI, R., DURSI, R., & FABIANO, M. (2009). Users' perception analysis for sustainable beach management in Italy. *Ocean & Coastal Management*, 52(5), 268-277.

MARTINS, V.N.; PRIES, R. & CABRAL, P. (2012). Modeling of coastal vulnerability in the stretch between the beaches of Porto de Mós and Falésia, Algarve (Portugal). *Journal of Coastal Conservation*, 16, 503-510.

MCLACHLAN, A.; DEFEO, O.; JARAMILLO, E.; & SHORT, A.D. (2013). Sandy beach conservation and recreation: Guidelines for optimizing management strategies for multi-purpose use. *Ocean & Coastal Management*, 71, 256-268.

MICALLEF, A.; WILLIAMS, A.T.; RADIC, M. & ERGIN, A. (2004). Application of a Novel Bathing Area Evaluation Technique – a case study of Croatian Island beaches. *World Leisure Journal*, 46(4), 4-21.

MILLER, M.L. & HADLEY, N.P. (2019). Tourism and coastal development. In C.W. Finkl & C. Makowski (Eds.), *Encyclopedia of Coastal Science* (pp.1773-1785). Switzerland: Springer, 2 edition.

MORGAN, R. (1999). Preferences and priorities of recreational beach users in Wales, UK. *Journal of Coastal Research*, 653-667.

MOURA, D.; GAREL, E.; MARTINS, FL; MENDES, I.; JANEIRO, J.; JÚNIO, R L.; CARRASCO, R.; SAMPATH, R.; COSTAS, S. & VEIGA-PIRES, C. (2019). *Relatório setor zonas costeiras e mar: vulnerabilidades atuais e futuras*. CIMA.

- NIEMEIJER, D. & GROOT, R.S. (2008). A conceptual framework for selecting environmental indicator sets. *Ecological Indicators*, 8, 14-25.
- PALAZÓN, A.; LÓPEZ, I.; GILART, V.; ARAGONÉS, L.; MARCOS-JORQUERA, D. & FOTI, D. (2019). New ICT-based index for beach quality management. *Science of the Total Environment*, 684, 221-228.
- PEÑA-ALONSO, C., ARIZA, E., & HERNÁNDEZ-CALVENTO, L. (2018). User's Perception of Beach Characteristics and Management in Summer and Autumn Seasons: The Case of Gran Canaria Island (Spain). In C.M. Botero; O. Cervantes & C.W. Finkl, *Beach Management Tools-Concepts, Methodologies and Case Studies* (pp. 913-932). Cham: Springer.
- PHILLIPS, M. R., & HOUSE, C. (2009). An evaluation of priorities for beach tourism: Case studies from South Wales, UK. *Tourism Management*, 30(2), 176-183.
- PICKEN, F. (2017). Beach tourism. In: LOWRY, L.L. *The SAGE international encyclopedia of travel and tourism* (135-136). SAGE Publications, Thousand Oaks.
- PINTO, C.A.; SILVEIRA, T.M. & TEIXEIRA, S.B. (2018). *Alimentação artificial de praias na faixa costeira de Portugal Continental: Enquadramento e retrospectiva das intervenções realizadas (1950-2017)*. Amadora: Agência Portuguesa do Ambiente.
- PRAYAG, G. (2011). Paradise for who? Segmenting visitors' satisfaction with cognitive image and predicting behavioral loyalty. *International Journal of Tourism Research*, 14(1), 1-15.
- RANGEL-BUITRAGO, N.; WILLIAMS, A.T.; ERGIN, A.; ANFUSO, G.; MICALLEF, A. & PRANZINI, E. (2019). Coastal Scenery: An introduction. In N. Rangel-Buitrago (Ed.), *Coastal Scenery: Evaluation and Management* (pp. 1-16). Cham, Switzerland: Springer.
- REYES, J.L.; MARTINS, J.T.; BENAVENTE, J.; FERREIRA, Ó.; GRACIA, F.J.; ALVEIRINHO-DIAS, J.M. & LÓPEZ-AGUAYO, F. (1999). Gulf of Cadiz beaches: a comparative response to storm events. *Boletín Instituto Español de Oceanografía*, 15 (1-4): 221-228.
- ROCA, E., RIERA, C., VILLARES, M., FRAGELL, R., & JUNYENT, R. (2008). A combined assessment of beach occupancy and public perceptions of beach quality: A case study in the Costa Brava, Spain. *Ocean & Coastal Management*, 51(12), 839-846.
- ROCA, E., VILLARES, M., & ORTEGO, M. I. (2009). Assessing public perceptions on beach quality according to beach users' profile: A case study in the Costa Brava (Spain). *Tourism Management*, 30(4), 598-607.
- ROCA, E., & VILLARES, M. (2018). Integrating Social Perceptions in Beach Management. In C.M. Botero; O. Cervantes & C.W. Finkl, *Beach Management Tools-Concepts, Methodologies and Case Studies* (pp. 875-893). Cham: Springer.

- RODELLA, I., CORBAU, C., SIMEONI, U., & UTIZI, K. (2017). Assessment of the relationship between geomorphological evolution, carrying capacity and users' perception: Case studies in Emilia-Romagna (Italy). *Tourism Management*, 59, 7-22.
- SAATY, R.W. (1987). The analytic hierarchy process – what it is and how it is used. *Mathl Modeling* 9(3-5): 161-176.
- SAATY, R.W. (1994). How to make a decision: The analytic hierarchy process. *Interfaces*, 24(6): 19-43.
- SAATY, R.W. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences*, 1(1): 83-98.
- SANTOS, I. R., FRIEDRICH, A. C., WALLNER-KERSANACH, M., & FILLMANN, G. (2005). Influence of socio-economic characteristics of beach users on litter generation. *Ocean & Coastal Management*, 48(9-10), 742-752.
- SARDÁ, R.; VALLS, J.F.; PINTÓ, J.; ARIZA, E.; LOZOYA, J.P.; FRAGUELL, R.M.; MARTÍ, C.; RUCABADO, J.; RAMIS, J. & JIMENEZ, J.A. (2015). Towards a new integrated beach management system: The ecosystem-based management system for beaches. *Ocean & Coastal Management*, 118: 167-177.
- SEALEUM, S.; CHANKAEW, K.; INKAPATTANAKUL, W. & NAVANUGRAHA, C. (2007). Environmental quality assessment criteria for recreational beach: a case study of Cha-Am beach, Petchburi Province. *Environmental and Natural Resources Journal*, 5(1), 69-79.
- SEMEOSHENKOVA, V.; NEWTON, A.; CONTIN, A. & GREGGIO, N. (2016). Development and application of an integrated beach quality index (BQI). *Ocean & Coastal Management*, 143, 74-86.
- SHEWFELT, R.L. (1999). What is quality? *Postharvest Biology and Technology*, 15, 197-200.
- SHORT A.D. (Ed.), 1999. *Beach and Shoreface Morphodynamics*. Chichester: Wiley.
- SHORT A.D., and Jackson D.W.T. (2013) Beach Morphodynamics. In: John F. Shroder (ed.) *Treatise on Geomorphology*, Volume 10, pp. 106-129. San Diego: Academic Press.
- SIMM, J.D. (1996). *Beach Management Manual*, London: CIRIA.
- SOUSA, M.L.S.B. (2016). *Avaliação do impacto da subida do nível do mar nas praias encastradas da costa Sul do Algarve* (Master's thesis). Retrieved from Sapiencia Repositório da Universidade do Algarve (<http://hdl.handle.net/10400.1/9845>).
- SOUSA, L.B.; LOUREIRO, C. & FERREIRA, O. (2018). Morphological and economic impacts of rising sea levels on Cliff-backed platform beaches in southern Portugal. *Applied Geography*, 99: 31-43.

TEIXEIRA, S.B. (2009). *Demarcação do leito e da margem das águas do mar no litoral sul do Algarve*. Faro: Administração da Região Hidrográfica do Algarve, 207 p.

TODD, D.J. & BOWA, K. (2016). Development of beach health index for the Gold Coast, Australia. *Journal of Coastal Research*, SI 75, 710-714.

VIRAPONGSE, A., BROOKS, S., METCALF, E. C., ZEDALIS, M., GOSZ, J., KLISKEY, A. & ALESSA, L. (2016). A social-ecological systems approach for environmental management. *Journal of Environmental Management*, 178, 83-91.

VOUSDOUKAS, M. I., VELEGRAKIS, A. F., KONTOGIANNI, A., & MAKRYKOSTA, E. N. (2009). Implications of the cementation of beach sediments for the recreational use of the beach. *Tourism Management*, 30(4), 544-552.



WILLIAMS, A.T. (2009). The 'art' of Beach Management. *Proceedings of the Ninth International Conference of the Mediterranean Coastal Environment*, Medcoast 09, 469-478.

WILLIAMS, A. & MICALLEF, A. (2009). *Beach Management Principles & Practice*. London- Sterling: Earthscan.

WRIGHT, L. D., & SHORT, A. D. (1984). Morphodynamic variability of surf zones and beaches: a synthesis. *Marine geology*, 56(1-4), 93-118.



## 8.2. Appendix 2: Focus Group

	<p style="text-align: center;"><b>BRIANA BOMBANA</b></p> <p><a href="mailto:brianaab@gmail.com">brianaab@gmail.com</a>          PhD: Geography          Country: Brazil, Spain          Position: Post-doctoral researcher at UAB (Spain)          Topics: Beach Management, quality assessment, governance          Orcid: 0000-0002-6044-3116          H-Index: 5</p>
	<p style="text-align: center;"><b>CAMILO BOTERO</b></p> <p><a href="mailto:playascol@gmail.com">playascol@gmail.com</a>          PhD: Water &amp; Coastal Management          Country: Colombia          Position: Researcher in Marine Topics          Topics: Beach &amp; coastal management, impact assessment          Orcid: 0000-0001-6886-8920          H-Index: 25</p>
	<p style="text-align: center;"><b>CHRIS HOUSER</b></p> <p><a href="mailto:chris.houser@uwindsor.ca">chris.houser@uwindsor.ca</a>          PhD: Geography          Country: Canada          Position: Dean and Professor at University of Windsor (Canada)          Topics: Coastal and Aeolian geomorphology          Orcid: 0000-0002-7880-7619          H-Index: 36</p>
	<p style="text-align: center;"><b>FLÁVIA LINS DE BARROS</b></p> <p><a href="mailto:flaviamlb@gmail.com">flaviamlb@gmail.com</a>          PhD: Geography          Country: Brazil          Position: Professor at UFRJ (Brazil)          Topics: Coastal processes; geomorphology; oceanography          Orcid: 0000-0003-2006-9948          H-Index: 9</p>
	<p style="text-align: center;"><b>GERARDO PERILLO</b></p> <p><a href="mailto:gmperrillo@gmail.com">gmperrillo@gmail.com</a>          PhD: Oceanography          Country: Argentina          Position: Investigator at Instituto Argentino de Oceanografía          Topics: Oceanography; hydrology, geomorphology          Orcid: 0000-0002-1200-5138          H-Index: 44</p>

### 8.3. Appendix 3: List of websites

Ranking	Region	Link
Algarve Fun	Algarve	<a href="https://www.algarvefun.com/algarve-tips/top-beaches-algarve/">https://www.algarvefun.com/algarve-tips/top-beaches-algarve/</a>
Alpha Travel Insurance	World	<a href="https://www.alphatravelinsurance.co.uk/best-beaches-in-the-world/">https://www.alphatravelinsurance.co.uk/best-beaches-in-the-world/</a>
Amante de Viagens	World	<a href="https://amantesdeviagens.com/conheceromundo/dicas-dos-amantes-de-viagens/melhores-praias-do-mundo/">https://amantesdeviagens.com/conheceromundo/dicas-dos-amantes-de-viagens/melhores-praias-do-mundo/</a>
Aquae Fundación	Spain	<a href="https://www.fundacionaquae.org/las-10-mejores-playas-de-espana/">https://www.fundacionaquae.org/las-10-mejores-playas-de-espana/</a>
Assegur	World	<a href="https://www.assegur.com/totmagazine/mejores-playas-del-mundo-que-debes-visitara-una-vez-en-la-vida/">https://www.assegur.com/totmagazine/mejores-playas-del-mundo-que-debes-visitara-una-vez-en-la-vida/</a>
Aviatur	Caribe	<a href="https://www.aviatur.com/blog/experiencias/playas-en-el-caribe">https://www.aviatur.com/blog/experiencias/playas-en-el-caribe</a>
Big 7 Travel	World	<a href="https://bigseventravel.com/the-50-best-beaches-in-the-world/">https://bigseventravel.com/the-50-best-beaches-in-the-world/</a>
Blog Cachos Aventureiros	Sardenha	<a href="https://cachosaventureiros.com/7-das-melhores-praias-sardenha/">https://cachosaventureiros.com/7-das-melhores-praias-sardenha/</a>
Blog Esse Mundo Nosso	Brazil	<a href="https://www.essemundoenosso.com.br/10-das-melhores-praias-do-brasil/">https://www.essemundoenosso.com.br/10-das-melhores-praias-do-brasil/</a>
Blog Go to Portugal	Portugal	<a href="https://gotoportugal.eu/pt/melhores-praias-de-portugal/">https://gotoportugal.eu/pt/melhores-praias-de-portugal/</a>
Blog Lisboa Secreta	Portugal	<a href="https://lisboasecreta.co/melhores-praias-portugal-segundo-leitores-lisboa-secreta/">https://lisboasecreta.co/melhores-praias-portugal-segundo-leitores-lisboa-secreta/</a>
Blog Mala de Aventuras	Brazil	<a href="https://maladeaventuras.com/melhores-praias-do-brasil/">https://maladeaventuras.com/melhores-praias-do-brasil/</a>
Blog Partiu pelo Mundo	Lagos	<a href="https://partiupeleomundo.com/melhores-praias-em-lagos/">https://partiupeleomundo.com/melhores-praias-em-lagos/</a>
Blog Viajante Comum	Brazil	<a href="https://www.viajantecomum.com/melhores-praias-do-brasil-ferias/">https://www.viajantecomum.com/melhores-praias-do-brasil-ferias/</a>
Blog Viajeros	Spain	<a href="https://viajerosblog.com/las-posiblemente-25-mejores-playas-de-espana.html">https://viajerosblog.com/las-posiblemente-25-mejores-playas-de-espana.html</a>
Blog Viajeros 360	World	<a href="https://viajeros360.com/2020/01/08/las-15-mejores-playas-del-mundo-2020/">https://viajeros360.com/2020/01/08/las-15-mejores-playas-del-mundo-2020/</a>
Club del Paseo	Colombia	<a href="https://clubdelpaseo.co/blogitem/53/las-10-mejores-playas-de-colombia-que-debes-conocer">https://clubdelpaseo.co/blogitem/53/las-10-mejores-playas-de-colombia-que-debes-conocer</a>
CNN Travel	World	<a href="https://edition.cnn.com/travel/article/100-best-beaches/">https://edition.cnn.com/travel/article/100-best-beaches/</a>
Condé Nast Traveler	World	<a href="https://www.cntraveller.com/gallery/best-beaches-in-the-world">https://www.cntraveller.com/gallery/best-beaches-in-the-world</a>
Costa Crociere	World	<a href="https://www.costacrociere.it/costa-club/magazine/spiagge/spiagge-piu-belle-del-mondo.html">https://www.costacrociere.it/costa-club/magazine/spiagge/spiagge-piu-belle-del-mondo.html</a>
El Blog del Viajero	Colombia	<a href="https://elblogdelviajero.com/15-mejores-playas-en-colombia/">https://elblogdelviajero.com/15-mejores-playas-en-colombia/</a>
El Correo	Spain	<a href="https://www.elcorreo.com/mendian/mejores-playas-para-visitara-espana-este-verano-20210701025052-ga.html#imagen4">https://www.elcorreo.com/mendian/mejores-playas-para-visitara-espana-este-verano-20210701025052-ga.html#imagen4</a>
El Pais	Spain	<a href="https://elviajero.elpais.com/elviajero/2019/06/20/album/1561049646_966282.html#foto_gal_1">https://elviajero.elpais.com/elviajero/2019/06/20/album/1561049646_966282.html#foto_gal_1</a>
El Viaje de Sofi	Spain	<a href="https://www.elviajedesofi.com/mejores-playas-de-espana/">https://www.elviajedesofi.com/mejores-playas-de-espana/</a>
Elle	World	<a href="https://www.elle.fr/Loisirs/Evasion/les-plus-belles-plages-du-monde/PLAYA-DEL-AMOR-AU-MEXIQUE">https://www.elle.fr/Loisirs/Evasion/les-plus-belles-plages-du-monde/PLAYA-DEL-AMOR-AU-MEXIQUE</a>
Em Viajes	Colombia	<a href="https://enviajes.cl/colombia/playas-de-colombia/">https://enviajes.cl/colombia/playas-de-colombia/</a>
Esquire	Spain	<a href="https://www.esquire.com/es/viajes/g11325241/las-mejores-playas-espana/">https://www.esquire.com/es/viajes/g11325241/las-mejores-playas-espana/</a>
European Best Destinations	Europe	<a href="https://www.europeanbestdestinations.com/best-beaches-in-europe-2019/">https://www.europeanbestdestinations.com/best-beaches-in-europe-2019/</a>
Famiglia in Fuga	World	<a href="https://famigliainfuga.com/le-spiagge-piu-belle-del-mondo/">https://famigliainfuga.com/le-spiagge-piu-belle-del-mondo/</a>
Far & Wide	World	<a href="https://www.farandwide.com/s/most-dangerous-beaches-world-3d2e3a80e3454d9d">https://www.farandwide.com/s/most-dangerous-beaches-world-3d2e3a80e3454d9d</a>
FlightNetwork	World	<a href="https://www.worlds50beaches.com/">https://www.worlds50beaches.com/</a>
Full Suitcase	Algarve	<a href="https://fullsuitcase.com/algarve-best-beaches/">https://fullsuitcase.com/algarve-best-beaches/</a>
Grazia IT	World	<a href="https://www.grazia.it/stile-di-vita/viaggi/spiagge-piu-belle-del-mondo-quali-sono">https://www.grazia.it/stile-di-vita/viaggi/spiagge-piu-belle-del-mondo-quali-sono</a>
Haphazard Traveler	Algarve	<a href="https://thehaphazardtraveler.com/best-algarve-beaches/">https://thehaphazardtraveler.com/best-algarve-beaches/</a>
Hoteis.com	Brazil	<a href="https://pt.hoteis.com/go/brasil/melhores-praias-do-brasil">https://pt.hoteis.com/go/brasil/melhores-praias-do-brasil</a>
INR (praia acessível)	Portugal	<a href="https://www.inr.pt/programa-praia-acessivel">https://www.inr.pt/programa-praia-acessivel</a>

Ranking	Region	Link
Intermundial ES	World	<a href="https://www.intermundial.es/blog/las-mejores-playas-del-mundo/">https://www.intermundial.es/blog/las-mejores-playas-del-mundo/</a>
Kiwi	World	<a href="https://www.kiwi.com/stories/these-are-officially-the-best-10-beaches-in-the-world/">https://www.kiwi.com/stories/these-are-officially-the-best-10-beaches-in-the-world/</a>
Lonely Planet	Portugal	<a href="https://www.lonelyplanet.com/articles/best-beaches-portugal">https://www.lonelyplanet.com/articles/best-beaches-portugal</a>
Los Viajes de Domi	Spain	<a href="https://losviajesdedomi.com/mejores-playas-de-espana/">https://losviajesdedomi.com/mejores-playas-de-espana/</a>
Mademoiselle-Voyage FR	World	<a href="https://www.mademoiselle-voyage.fr/themes-plages-criques-du-monde/">https://www.mademoiselle-voyage.fr/themes-plages-criques-du-monde/</a>
Melhores Destinos	Brazil	<a href="https://www.melhoresdestinos.com.br/melhores-praias-do-brasil.html">https://www.melhoresdestinos.com.br/melhores-praias-do-brasil.html</a>
Money Co UK	World	<a href="https://www.money.co.uk/credit-cards/beautiful-beaches">https://www.money.co.uk/credit-cards/beautiful-beaches</a>
My Fault Compass	Algarve	<a href="https://myfaultycompass.com/beaches-in-algarve-portugal-the-top-7/">https://myfaultycompass.com/beaches-in-algarve-portugal-the-top-7/</a>
My Guide Algarve	Algarve	<a href="https://www.myguidealgarve.com/top-10-algarve-beaches">https://www.myguidealgarve.com/top-10-algarve-beaches</a>
National Geographic	World	<a href="https://www.nationalgeographic.com/travel/article/top-10-beaches">https://www.nationalgeographic.com/travel/article/top-10-beaches</a>
National Geographic Viajes	World	<a href="https://viajes.nationalgeographic.com.es/a/31-mejores-playas-mundo_7481">https://viajes.nationalgeographic.com.es/a/31-mejores-playas-mundo_7481</a>
PlanetWare	World	<a href="https://www.planetware.com/world/best-beaches-in-the-world-tci-1-3.htm">https://www.planetware.com/world/best-beaches-in-the-world-tci-1-3.htm</a>
Portal Mochilero	Colombia	<a href="https://www.portalmochilero.com/las-10-mejores-playas-colombia/">https://www.portalmochilero.com/las-10-mejores-playas-colombia/</a>
Publico	Spain	<a href="https://www.publico.es/viajes/las-mejores-playas-de-espana-en-2021/9/">https://www.publico.es/viajes/las-mejores-playas-de-espana-en-2021/9/</a>
Q Pasa	Colombia	<a href="https://qpasa.com/destinos/estas-son-las-mejores-playas-d-colombia-que-debes-visitar-por-lo-menos-una-vez-en-la-vida/">https://qpasa.com/destinos/estas-son-las-mejores-playas-d-colombia-que-debes-visitar-por-lo-menos-una-vez-en-la-vida/</a>
Rumbo	Spain	<a href="https://www.rumbo.es/es/ideas-para-viajar/mejores-playas-de-espana.html">https://www.rumbo.es/es/ideas-para-viajar/mejores-playas-de-espana.html</a>
Sapo Viagens	World	<a href="https://viagens.sapo.pt/viajar/viajar-mundo/artigos/as-praias-de-areia-negra-mais-bonitas-do-mundo-tres-delas-em-portugal#&amp;gid=1&amp;pid=4">https://viagens.sapo.pt/viajar/viajar-mundo/artigos/as-praias-de-areia-negra-mais-bonitas-do-mundo-tres-delas-em-portugal#&amp;gid=1&amp;pid=4</a>
Seguros Promos	Mexico	<a href="https://www.seguros promo.com.br/blog/conheca-as-melhores-praias-do-mexico/">https://www.seguros promo.com.br/blog/conheca-as-melhores-praias-do-mexico/</a>
Skyscanner	Brazil	<a href="https://www.skyscanner.com.br/noticias/inspiracao/20-belas-praias-no-brasil">https://www.skyscanner.com.br/noticias/inspiracao/20-belas-praias-no-brasil</a>
Spend Life Traveling	World	<a href="https://www.spendlifetraveling.com/15-best-beaches-by-travel-bloggers/">https://www.spendlifetraveling.com/15-best-beaches-by-travel-bloggers/</a>
Time Out	Spain	<a href="https://www.timeout.com/es/espana/que-hacer/mejores-playas-espana">https://www.timeout.com/es/espana/que-hacer/mejores-playas-espana</a>
Travel 365	World	<a href="https://www.travel365.it/spiagge-piu-belle-mondo.htm">https://www.travel365.it/spiagge-piu-belle-mondo.htm</a>
TripAdvisor	World	<a href="https://www.tripadvisor.com/TravelersChoice-Beaches-cTop-g1">https://www.tripadvisor.com/TravelersChoice-Beaches-cTop-g1</a>
US News	World	<a href="https://travel.usnews.com/rankings/best-beaches-in-the-world/">https://travel.usnews.com/rankings/best-beaches-in-the-world/</a>
Viagem e Turismo - Abril	Portugal	<a href="https://viagemeturismo.abril.com.br/materias/fotos-as-15-melhores-praias-de-portugal/">https://viagemeturismo.abril.com.br/materias/fotos-as-15-melhores-praias-de-portugal/</a>
Viagens e Caminhos	Portugal	<a href="https://www.viagensecaminhos.com/2021/01/melhores-praias-de-portugal.html">https://www.viagensecaminhos.com/2021/01/melhores-praias-de-portugal.html</a>
Viago Ca	World	<a href="https://viago.ca/top-20-des-plus-belles-plages-du-monde/">https://viago.ca/top-20-des-plus-belles-plages-du-monde/</a>
Viaja con tu Familia	World	<a href="https://www.viajacontufamilia.com/algunas-de-las-mejores-playas-del-mundo">https://www.viajacontufamilia.com/algunas-de-las-mejores-playas-del-mundo</a>
Viajali BR	World	<a href="https://www.viajali.com.br/30-praias-paradisiacas-para-voce-curtir-pelo-mundo/">https://www.viajali.com.br/30-praias-paradisiacas-para-voce-curtir-pelo-mundo/</a>
Volta ao Mundo	World	<a href="https://www.voltaaomundo.pt/2019/06/12/estas-sao-15-das-praias-mais-bonitas-do-planeta-e-ha-portuquesas-na-lista-b/destinos/343804/">https://www.voltaaomundo.pt/2019/06/12/estas-sao-15-das-praias-mais-bonitas-do-planeta-e-ha-portuquesas-na-lista-b/destinos/343804/</a>
Wonderlist	World	<a href="https://www.wonderlist.com/10-most-beautiful-beaches-in-the-world/">https://www.wonderlist.com/10-most-beautiful-beaches-in-the-world/</a>
World Beach Guide	World	<a href="https://www.worldbeachguide.com/top-100-beaches-earth.htm">https://www.worldbeachguide.com/top-100-beaches-earth.htm</a>
World Travel Awards	World	<a href="https://www.worldtravelawards.com/award-worlds-leading-beach-destination-2020">https://www.worldtravelawards.com/award-worlds-leading-beach-destination-2020</a>
WorldPackers	Brazil	<a href="https://www.worldpackers.com/pt-BR/articles/as-melhores-praias-para-viajar-sozinha">https://www.worldpackers.com/pt-BR/articles/as-melhores-praias-para-viajar-sozinha</a>

#### 8.4. Appendix 4: Score Assessment for the Study Area

Indicator									Source
	Faro	Falésia	Marinha	Benagil	Rocha	D. Ana	Camilo	Luz	
Path to the beach	4	4	1	5	1	1	1	5	Beach guide; INR; Cm-Albufeira; Observations
Public transport	5	3	2	2	5	4	3	5	Cm (Faro, Albufeira, Portimão); Vamus Algarve; A onda transportes
Access Road	3	3	5	3	5	5	5	5	Beach Guide; Google Earth
Parking	4	4	5	2	4	4	3	3	Beach Guide
Bicycle parking	4	5	1	1	5	1	1	1	Cm-Portimão; Observations
Availability of sand by user	3	5	3	1	3	2	1	2	Google Earth
Umbrellas and chairs	3	3	1	1	3	1	1	3	Google Earth
Dining facilities	5	4	3	3	5	4	2	4	Algarve Tips; Beach Guide; Algarve-tourist.com
Adaptations for disabled users	5	5	1	1	5	1	1	5	INR; Cm-Albufeira
Facilities for children	4	1	1	1	5	1	1	5	Cm-Albufeira Observations
Showers and feet washers	5	1	1	5	5	5	1	5	Blue Flag;; Cm (Albufeira, Lagoa); APA; Turismo Portimão
Sports facilities	5	3	5	3	5	3	3	5	Beach guide; Cm-Albufeira; Observations
Color of Sand (Beach Face)	5	5	5	5	5	5	5	5	Beach Guide; Observations
Color of Water	4	4	4	4	4	4	4	4	Observations
Skyline	3	5	5	5	3	5	5	5	Lukoseviciute & Panagopoulos (2021); Beach Guide; Observations
Vegetation cover	2	4	4	4	3	3	4	2	Google Earth; Observations
Coastal Features	1	2	5	5	4	5	5	3	Teixeira (2009); CCDR; Beach Guide; Observations
Water clarity	5	5	5	5	5	5	5	5	Beach guide; Cm-Lagos; Observations
Vista	5	4	4	1	2	2	2	2	Observations
Lifeguards	4	4	4	1	4	4	4	4	Beach Guide
Signposting	5	5	5	5	5	5	5	5	Blue Flag; Observations; Cm Albufeira
Dangerous animals: jellyfish shark	4	4	4	4	4	5	5	5	Shark Attack Data; Gel a Vista; IPMA
Dangerous cliffs	5	3	1	1	3	1	1	3	CCDR; Beach Guide
Pickpockets & crime	4	4	4	4	5	4	4	4	Autoridade Marítima Nacional; Eurostat; Cm-Portimão
Wave regime risk	4	5	5	5	5	5	5	5	Reyes <i>et al.</i> (1999); Costa <i>et al.</i> (2001); Souza <i>et al.</i> (2018)
Rip Currents	5	5	5	5	5	5	5	5	DGAM
Rescue material	4	4	4	1	4	4	4	4	Beach Guide; Cm-Faro
Zoning of activities	3	3	1	3	5	3	1	3	Blue Flag; Observations; Cm Albufeira; Google Earth

Indicator	Faro	Falésia	Marinha	Benagil	Rocha	D. Ana	Camilo	Luz	Source
Beach Width	3	2	3	3	5	3	2	4	Reyes <i>et al.</i> (1999); Google Earth
Beach slope	2	2	2	2	4	2	2	3	Teixeira (2009)
Dune type	4	4	4	4	5	4	4	4	Natura 2000; Observations; Google Earth
Vulnerability to erosion	4	2	1	1	1	1	1	1	Martins <i>et al.</i> (2012) ; Moura <i>et al.</i> (2019); CCDR
Dunes	2	4	3	3	3	2	2	2	Observations
Sediment budget	3	3	1	1	1	1	1	1	Moura <i>et al.</i> (2019); CCDR
Hard coastal defense	1	3	1	1	5	5	5	5	Google Earth
Impervious surface	5	5	5	5	3	5	5	5	Natura 2000
Changes in grain size	2	4	5	4	1	2	5	2	Pinto <i>et al.</i> (2018)
Changes in volume (nourishment)	5	5	5	5	5	5	5	5	Pinto <i>et al.</i> (2018)
Bathing area protection	5	5	5	4	1	3	5	5	Henriques <i>et al.</i> (2018) ; Observations
Bathing area material	1	1	5	5	3	3	3	1	EEA; CCDR
Morphodynamic state	3	3	2	2	3	2	2	4	Reyes <i>et al.</i> (1999); Loureiro <i>et al.</i> (2013); Observations
Harmful storms	2	3	3	3	3	3	3	3	Teixeira (2009)
Sea level rise	5	5	5	5	5	5	5	5	Antunes & Taborda, 2009
Natural disaster	2	3	3	3	2	3	2	4	CCDR Algarve
Exposure to waves	1	1	5	5	1	5	5	1	Sousa (2016); Google Earth
Noise	5	5	5	3	1	3	5	5	Algarve Daily News; Encosta da Luz; Observations; Cm-Albufeira
Degree of urbanization	1	4	4	4	2	3	4	3	Google Earth; CCDR
Air quality (air pollutants)	5	5	5	5	5	5	5	5	APA
Concentration of Nutrients	4	4	5	5	4	5	5	5	APA
Restrictions & Regulations	2	2	5	5	5	5	5	5	Blue Flag; Observations; Cm-(Albufeira, Lagoa, Lagos)
Protected areas (%)	4	1	1	1	1	2	2	2	ICNF; Natura 2000; INE PT; EEA; Henriques <i>et al.</i> (2018) ;; CCDR
Environmental Educational	5	5	5	5	5	5	5	5	Blue Flag; Cm-(Faro, Albufeira, Lagoa, Lagos)
Ecosystem connectivity	5	4	5	5	5	5	5	5	Park Ria Formosa, ICN, Natura 2000; Mesh Atlantic; CCDR; EUNIS
Ecosystem condition	3	3	3	3	3	3	3	3	Natura 2000
Diversity & Abundance	5	3	5	3	1	3	3	3	Parque Ria Formosa; Natura 2000; Henriques <i>et al.</i> (2018) ; CCDR
Endangered and iconic	5	2	5	5	2	2	3	5	Natura 2000; ICNF; CCDR; Henriques <i>et al.</i> (2018) ; Beach Guide
Invasive species	3	3	3	3	3	3	3	3	Biomar PT
Geological interest	1	1	1	1	1	1	5	5	Geoportal

Indicator	Faro	Falésia	Marinha	Benagil	Rocha	D. Ana	Camilo	Luz	Source
Historic, archaeological & scientific	1	2	4	2	4	1	1	5	Portal do Arqueólogo PT; CCDR; Beach Guide
Sewage discharge evidence	5	5	5	5	5	5	5	5	Blue Flag; Observations; APA
Microbiological water quality	5	5	5	5	5	5	4	5	ERSAR; EEA
Accumulation of algae/leaves	1	4	4	5	5	5	5	5	Lukoseviciute & Panagopoulos, 2021; Blue Flag; APA; Observations
Unpleasant Odors	5	5	5	5	5	5	4	5	Observations
Feces on the sand	5	5	5	5	5	5	5	5	Blue Flag; Observations; APA
Blooms	4	3	3	3	3	3	3	3	UNESCO Harmful algae info system
Oil spills	5	5	5	5	5	5	5	5	DiscoMap EEA
Cleaning of the beach	4	4	5	5	4	4	4	4	Blue Flag; APA; Cm-(Albufeira, Lagos)
Litter bins	5	5	5	5	5	5	5	5	Cm-(Albufeira, Lagoa); Observations; Google Earth
Toilet provision	5	5	4	5	5	4	4	5	Blue Flag; Observations; APA
Floating debris/litter	5	5	5	5	5	5	5	5	Blue Flag; Observations; APA
Solid human waste	4	4	4	5	4	4	4	4	Lukoseviciute & Panagopoulos, 2021; Blue Flag; APA; Observations
Oil & tar balls	5	5	5	5	5	5	5	5	Blue Flag; Observations; APA

## 8.5. Appendix 5: Framework for Managers on Google Forms

10/06/2022 13:59

Beach Ranking Framework

### Beach Ranking Framework

This survey is part of the thesis development by Elaine Baroni de Oliveira under the Water and Coastal Management Masters Degree (WACOMA). The goal is to evaluate beaches through the qualification of the indicators below. The indicators that appear on this survey are a result of a literature review on Beach Quality Assessments and they are going to be evaluated from a 5-point scale.

The first section collects the details from the person judging the beach. The next asks for the characterization of the beach. In the following four sections you will have to select the alternative that best describes the indicator for the beach you are judging.

All the information received will be compiled and processed by the author.

In advance, THANK YOU for your generosity in answering this form.

---

\*Obrigatório

1. E-mail \*

---

Investigator details	These information will allow us to contact you and account for your level of relationship with coastal management.
----------------------	--

2. Name and Surname \*

---

3. Affiliation

---

4. Area of Expertise \*

*Marcar apenas uma oval.*

- Biology
- Oceanography
- Geology
- Coastal Management
- Chemical
- Geography
- Natural Sciences
- Engineering
- Tourism
- Other

5. Works with Coastal Management \*

*Marcar apenas uma oval.*

- Yes
- No

Beach  
characterization

These information will allow us to classify and plot the results of the beach you are judging.

6. Name of the Beach \*

---

7. Location \*

---

## 8. Coordinates

---

## 9. Beach Type (according Williams &amp; Micallef, 2009): \*

*Marcar apenas uma oval.*

- Resort
- Urban
- Village
- Rural
- Remote

## Recreation

The recreational domain refers to the provision of services and infrastructure that enable beach users to relax, have fun and be entertained. Please select the alternative that best describes each indicator for your beach.

## 10. Access &amp; Parking \*

*Marcar apenas uma oval.*

- Stairs; only private transport; no parking
- Steps > 20 cm; Bus stop far from the beach; <3 bus/day; limited parking (far, private, small)
- Small step to the beach; Bus stop far from the beach; moderate parking; access road narrow and asphalted
- Main access clear; Bus every 1 - 2 hours; bike roads and parking available; abundant parking
- Clear path to beach; Diverse transport (<1h/day); abundant public parking; Bike roads and parking; Access road well signposted and wide

## 11. Carrying capacity \*

*Marcar apenas uma oval.*

- Overcrowded; [ $< 4\text{m}^2/\text{user}$ ]; Small beach with very high number of visitors
- Crowded [ $4\text{-}8\text{ m}^2/\text{user}$ ]; Small to median beach
- Crowded [ $4\text{-}8\text{ m}^2/\text{user}$ ]; Large beach
- Satisfactory [ $4\text{-}8\text{m}^2/\text{user}$ ]; small to median beach
- Optimal conditions [ $>8\text{m}^2/\text{user}$ ]; Large beach

## 12. Facilities &amp; Services \*

*Marcar apenas uma oval.*

- Concentrated on the beach; Facilities for sports and children absent; no adaptations for disabled; no restaurants or showers
- Showers at a walking distance; Scarce restaurants ( $<3$ ); Facilities for sports and children absent; no adaptations for disabled;
- Seasonal dining facilities; Rent sports equipment;  $>1$  shower; small facilities for children ( $>150\text{ m}$  from the beach)
- Good variation of restaurants; 1-2 adaptations for disabled; Rent sports equipment; small facilities for children at the beach
- Scarce; Wide selection and well-distributed restaurants;  $>2$  adaptations for disabled; medium/large facilities for children at the beach; Rent sports equipment and presence of facilities on the surroundings

## 13. Scenic Value \*

*Marcar apenas uma oval.*

- Dark sand; water brown/ grey and muddy; very unattractive skyline; absence of vegetation or coastal features;
- Dark sand; Opaque Milk blue or green waters; Bare vegetation cover (<10%); 1 coastal feature
- Dark tan sand; Green, grey or blue waters; Sensitively designed skyline; scattered vegetation; 2 coastal features;
- Light tan sand; Clear Light or dark Blue waters; Very sensitively designed skyline; High natural cover; 3 coastal features; Vista (Open on 3 sides)
- White/gold sand; very clear Turquoise waters; skyline with natural/historic features; Very high natural cover; >3 coastal features; Vista (Open on 4 sides)

## 14. Safety \*

*Marcar apenas uma oval.*

- Absence of lifeguards/ signposting; no zoning of activities; Rip currents frequent and Not well marked; Dangerous wave regime (Wave >1,5m; surging and plunging waves); No surveillance; Dangerous loose cliffs; Frequent (>5/y) jellyfish and shark attacks
- Occasional lifeguard/ rescue material; Frequent (>5/y) jellyfish and occasional (<5/y) shark attacks; Occasional surveillance; Presence of Sea state warning flags; Wave >1,5m
- Lifeguards at peak season weekends; Signposting present but not well-located/clear; Occasional (1-5/y) jellyfish and shark attacks; Stonefall danger; Sea state warning flags; Moderate energy (0.5 to 1.5 m); Occasional Rips well marked; Water zoning activities
- Seasonal lifeguards; Rare (<1/y) jellyfish and no history of shark attacks; Surveillance during high season; Safe (waves of 0.5 to 1.5 m)
- Permanent lifeguard; Visible and clear signposting; Absence of dangerous animals, cliffs and rip currents; Permanent surveillance; Safe; Low energy: (<0.5m); Spilling breaking wave; Zoning of activities on water and land

## Protection

The protection domain includes indicators that are going to evaluate the beach potential to dissipate energy and defend the city against possible harmful events. Please select the alternative that best describes each indicator for your beach.

## 15. Storm Buffer \*

*Marcar apenas uma oval.*

- Narrow width (<10 m); Very Steep (>20°); Very Reflexive; Absence of dunes
- 10-30 m width; Slope 15°-20°; Mostly reflexive; Incipient dunes
- 30-60 m width; Slope 10-15°; Intermediate morphodynamic state; Foredune ridge only
- 60-100 m width; Slope 5-10°; Mostly dissipative; Secondary ridge
- wide width >100 m; Gentle slope (<5°); Very dissipative; Several, fixed dunes

## 16. Shoreline Stability \*

*Marcar apenas uma oval.*

- Very High vulnerability to erosion (>1m/year); Erosional Sediment budget; >3 Hard coastal defense
- High vulnerability to erosion; 2-3 Hard coastal defense
- Moderate vulnerability to erosion; Stable Sediment budget; 1-2 Hard coastal defense
- Low vulnerability to erosion; Stable Sediment budget; 0-1 Hard coastal defense
- Very Low vulnerability to erosion (0 m/year); Depositional Sediment budget; No Hard coastal defense

## 17. Induced changes \*

*Marcar apenas uma oval.*

- Impervious surface (>60%); Severe changes in grain size/volume (>30%); >3 nourishment
- Impervious surface (40-60%); 3 nourishments
- Impervious surface (20-40%); Moderate changes in grain size/volume (<30%); 1-2 nourishment
- Impervious surface (5-30%); No alterations on grain size or volume
- Impervious surface (<5%); No alterations on grain size or volume

## 18. Subaerial dissipation \*

*Marcar apenas uma oval.*

- Absence of saltmarshes/reefs/mangrooves; Rocky bathing area material
- Mixed rock and coarse sand bathing area material
- Low coverage (saltmarshes/reefs); coarse sand bathing area material
- Median coverage; Mixed coarse and fine sand bathing area material
- High protection and coverage (saltmarshes, reefs); Fine or medium sand Mixed coarse and fine sand

## 19. Risk &amp; vulnerability \*

*Marcar apenas uma oval.*

- Frequent harmful storms (>50); High vulnerability; sea level rise >20 mm/year; Exposed to waves
- Storms recurrent (26-49); Natural disaster (return period 100 - 1000 years); High vulnerability
- Storms occasional (11 - 25); Medium vulnerability; sea level rise 0.5 to 20 mm/y; Half-sheltered
- Storms scarce (1-10); Low vulnerability to sea level
- Storms rare (<1); Low vulnerability to sea level rise; Sheltered

## Conservation

Conservation refers to the preservation of the environment, including indicators to measure the biodiversity, environmental quality and management conservation actions. Please select the alternative that best describes each indicator for your beach.

## 20. Environmental quality \*

*Marcar apenas uma oval.*

- Intolerable noise; >75% urbanized; visible eutrophication and air pollution; history of impacts
- Tolerable noise; 50 - 75% urbanized; visible alteration on the environmental quality
- 25 - 50% urbanized; detectable noise; visible good air quality
- Little noise; visible good air quality; no alterations or pollution close
- Pristine area, without urbanization; no alterations or pollution close; Good environmental quality

## 21. Governmental acts \*

*Marcar apenas uma oval.*

- Absent
- One restriction (e.g. dogs); <10% protected areas; few education activities
- Moderate (two restrictions visible); 10-30% protected areas; moderate education activities
- Protected areas covering 30 - 50%; many educational activities
- Protected areas covering >50%; Many restrictions and regulations (e.g. dogs, drinks, dunes, parking); many educational activities with high engagement

## 22. Habitat \*

*Marcar apenas uma oval.*

- Very badly preserved (>75%)
- Few (1-5) habitats (medium and disconnected); badly preserved (50-75%)
- Many (5) habitats (small and connected); Moderately preserved (20-50%)
- Many (medium-large, connected); Moderate to well preserved
- Numerous (>10) habitats (medium-large, connected); Very well preserved; <5%

## 23. Species \*

*Marcar apenas uma oval.*

- Low abundance; high modification; missing the majority of communities; Absence of endangered; well-established invasive species with impacts reported and no commercial value
- Intermediate diversity; high modification; missing some expected communities; well-established invasive species with low commercial value and high potential for impacts
- Intermediate diversity; moderate modification; missing some communities; presence of endangered species at low numbers (not nesting); Species established invasive species with high commercial value
- Species rich and abundant; little modification; missing some communities; Species with low invasive potential and Very high commercial value introduced
- Species rich and abundant; pristine; all expected communities present; Nesting/spawning iconic species present in large numbers; Absence of invasive species

## 24. Heritage \*

*Marcar apenas uma oval.*

- Absence of geological, historical or cultural interest
- Little historic interest, bad conservation
- Moderate historic OR geological interest with fair conservation
- High historic and geological interest with fair conservation
- High geological, cultural and historic interest with good conservation;

Sanitary

Sanitary issues that aims to identify the presence and impacts of litter and pollution. Please select the alternative that best describes each indicator for your beach.

## 25. Water quality \*

*Marcar apenas uma oval.*

- Clear evidence of sewage (>3 items); Bathing not recommended
- Constant warnings about water quality
- Some evidence of sewage (1-3 items);
- No history of bad quality water but with presence of pollution sources on the surroundings (e.g. ports, docks)
- No evidence of sewage; no history of bad quality water

## 26. Sand quality \*

*Marcar apenas uma oval.*

- Heavily accumulation of wood, algae (>10); Unpleasant walking; Strong odors; Frequent feces on the sand
- High accumulation of wood, algae; Strong odors; Some feces on the sand
- Some accumulations of wood/algae (5-10); Detectable odor
- Traces (0-5) of wood/algae
- Absent

## 27. Episodic Pollution \*

*Marcar apenas uma oval.*

- >5 blooms/year; toxicity detected; economic and environmental impacts; >2 oil spill/year
- >5 blooms/year; toxicity not detected; only economic impacts
- 2-5 blooms/year; toxicity detected; only economic impacts; >1 oil spill/year
- 2-5 blooms/year; toxicity not detected; without impacts
- <2 blooms/year; without any effects; no oil spill history

28. Sanitary facilities & Services \*

*Marcar apenas uma oval.*

- Cleaning Absent; No litter bins or toilet provision
- Mechanic cleaning - high frequency (>3/week); Scarce, rarely emptied litter bins; poorly managed toilets
- Mechanic cleaning - low frequency; Existing but poorly managed litter bins and toilets; no gender specification
- Mixed cleaning (mostly manual); Regularly emptied litter bins, without separation; Clean toilets
- Manual/ Not necessary cleaning; Regularly emptied and with litter segregation; Clean, public toilet at the beach; gender specific

29. Litter & Waste \*

*Marcar apenas uma oval.*

- Many oil patches evident; Continuous accumulation of floating litter; High solid human waste along all the beach
- Full strand line of floating litter; High solid human waste next to the access point
- Single accumulation of floating litter; Traces of oil; Scattered solid human waste
- Few scattered
- Visually absent

You have completed the survey!

Thank you for your participation. Your beach has been evaluated and scored. Soon the results are going to be shared with the email address you provided.

30. Is there any criterion relevant for your beach that was not considered? Please specify below.

---

---

---

---

---

Este conteúdo não foi criado nem aprovado pelo Google.

Google Formulários