



## ASSESSING BEACHES' LANDSCAPE AND ENVIRONMENT IN TOURISM DESTINATIONS: THE CASE OF SITHONIA, GREECE

 **Terzidis  
Antonios<sup>1\*</sup>**

 **Vagiona G.  
Dimitra<sup>2</sup>**

<sup>1,2</sup>Department of Spatial Planning and Development, Faculty of Engineering,  
Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.

\*Email: [antonisterzi@gmail.com](mailto:antonisterzi@gmail.com)

<sup>2</sup>Email: [dimvag@plandevol.auth.gr](mailto:dimvag@plandevol.auth.gr)



(+ Corresponding author)

### ABSTRACT

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In recent decades, the tourism industry has played an increasingly important role in countries' national economies, although, at the same time, a lack of necessary actions has contributed to the environmental and socioeconomic degradation of several travel destinations. Nevertheless, sustainable development is achievable through planning, preventive measures, and indicators. This study aimed to assess the coastal scenery of (38) selected Tourist Beaches (TBs) in the Municipality of Sithonia, Greece, by applying an indicator-based methodology, which evaluated 21 physical and 10 human parameters. For the analysis of the landscape of TBs, a system of indicators was applied, which consisted of modified indicators of the Coastal Scenery Evaluation System (CSES) method, as well as novel proposed indicators that focused on factors that indirectly influence the coastal environment. A Questionnaire Survey (QS) was performed to assess the importance of each Assessment Indicator (AI) based on locals' and tourists' opinions. The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method was then applied to rank the coastal scenery of the selected beaches in the study area, and three different classification maps were created based on the combined preferences of the participants in the QS, both locals and tourists. According to the results, the Porto Koufo and Koutloumousiou beaches obtained the highest scores in all three groups based on their important natural characteristics. Numerous TBs received high scores as tourism activity had not significantly affected their physical and anthropogenic environment.

**Contribution/Originality:** This study contributes to the evaluation of the coastal landscape and the surrounding area through the use of indicators, as well as to the creation of proposals for the improvement of the coastal landscape and sustainable tourism development. Additionally, the study uses modified existing indicators to evaluate the coastal environment, while novel indicators are used to assess indirect factors that contribute to the formation and quality of beaches.

### 1. INTRODUCTION

The tourism industry is one of the largest and fastest-growing economic industries in the world and plays an important role in the economic development of a country. It also makes a key contribution to the sustainable development of several regions around the world, with the result that it is necessary to plan it rationally in a way that supports the sustainability of local communities, the protection of the environment, and the promotion of cultural heritage (UN World Tourism Organization (UNWTO), 2013, 2018).

In terms of spatial development, tourism is characterized as a fragmented activity as it develops in specific areas that have natural, cultural, social, and environmental reserves. However, due to the high concentration of tourism in

limited areas, negative local impacts are created, which can expand and endanger the sustainability of the wider area (UNEP, 2009). One of the main forms of tourism is coastal tourism, which combines activities in coastal waters and on land, including the development of tourist accommodation (hotels, second homes, rooms for rent, etc.), support infrastructure (ports, marinas, power lines, sewerage, etc.), leisure and trade enterprises, and more. (Miller & Hadley, 2005; UN World Tourism Organization (UNWTO), 2004). Based on the above, coastal tourism contributes significantly to national economies (UNEP, 2009). To avoid negative impacts on the environment (soil erosion, depletion of natural resources, water pollution, etc.), on society (alteration of cultural characteristics of a place, tensions between residents and tourists, etc.), and on the economy (seasonality, strong dependence on tourism, low wages, etc.), the creation and implementation of policies aimed at sustainable development is necessary.

Tourists' primary reasons for visiting coastal tourism destinations are beaches (Honey & Krantz, 2007; Houston, 2013) and the 3S market (sun, sea, and sand). Beaches are regarded as ideal places for rest and relaxation and as a highly valued resource for aesthetic, cultural, economic, and historical reasons (Williams & Micallef, 2009). Tourist beaches are a socioecological resource that is developed and managed primarily for the purpose of attracting tourists interested in sun, sea, and sand activities (Botero, Cabrera, & Zielinski, 2018). Williams (2011) highlighted five important parameters of coastal destinations: safety, facilities, water quality, litter, and scenery. Scenic evaluation can be a very useful technique for preserving, protecting, and developing coastal areas, as it provides a solid scientific basis for future management plans. Several methods for assessing beach landscapes, as well as the factors that influence their changes, have therefore been employed in many different regions and landscapes (e.g., (Ergin, Karaesmen, Micallef, & Williams, 2004; Ergin, Karaesmen, & Uçar, 2011; Mooser, Anfusio, Mestanza, & Williams, 2018)). One widely known and applied method is the Coastal Scenic Evaluation System (CSES), which was created with the help of professional and trained groups and published through public survey evaluation processes (Ergin, Williams, Micallef, & Karakaya, 2002; Ergin et al., 2004; Ergin, Williams, & Micallef, 2006; Ergin et al., 2011; Ergin & Rangel-Buitrago, 2019). CSES assesses the coastal scenery quantitatively by scoring twenty-six (26) weighted coastal scenic parameters (18 physical and 8 human) using fuzzy logic analysis.

Using a literature search and questionnaire surveys conducted in Malta, Turkey, and the United Kingdom, Ergin et al. (2004) and Ergin and Rangel-Buitrago (2019) identified twenty-six (26) top-rated factors related to coastal scenery and used them to evaluate 57 areas. The resulting CSES includes assessment parameters ranging from low to high attribute values based on a five-point scale. Similarly, Ergin et al. (2011) used the CSES to evaluate coastal scenery in the four countries of their previous study (Ergin et al., 2004), as well as Australia, Ireland, the United States, New Zealand, and Japan. Anfusio, Williams, Cabrera Hernández, and Pranzini (2014) used checklist tables to assess the scenic value of 43 sites in western Cuba to assist managers in improving bathing areas, particularly for tourism purposes. Williams and Khattabi (2015) assessed the coastal scenic beauty of twenty-one (21) beach sites in 19 locations in Morocco's Nador Province using a 26-parameter (natural and anthropogenic) checklist graded on a 5-point (1-bad, 5-good) attribute scale. Mooser et al. (2018) used a checklist comprising 26 natural and human parameters, parameter weighting matrices, and fuzzy logic to assess coastal scenery in fifty (50) places along the 910km-long Andalusia coast (Spain). Cristiano, Portz, Anfusio, Rockett, and Barboza (2018) assessed over 80 attractive coastal spots along Santa Catarina's (Brazil) southern and central-southern coasts by gathering information on conservation status, beach awards, and human occupation levels and then applying the CSES. Mooser et al. (2021) conducted a scenic coastline evaluation in the Balearic Islands, focusing on two primary issues: coastal scenic beauty and sensitivity to natural processes and human pressure. The coastal scenic beauty was quantified using the CSES method, while the scenic sensitivity was evaluated using the natural sensitivity index (NSI), the human sensitivity index (HSI), and the total sensitivity index (TSI).

The aim of the present study was to assess the scenery of selected beaches and their environs that receive the most tourism flow over the summer season, evaluating the preservation of their natural features (rocky areas, soil quality, flora, etc.) as well as the intensity of human activity on and around the coastline. The Municipality of Sithonia

(Greece) was used as a case study. A modified CSES was employed that included an appropriate system of 31 Assessment Indicators (AI) relating to environmental elements (natural coastal characteristics, coastal quality, and aquatic environment) and anthropological elements (structured and unstructured environment), while particularly emphasizing the environmental characteristics of the coastal landscapes. A questionnaire survey of locals and tourists/visitors was conducted to acquire the indicator weights. To evaluate the scenery of the selected tourist beaches, the authors employed the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. Through the methodology that was developed and applied, the beaches and their surroundings were classified based on their suitability and level of human inconvenience. The rest of the paper is structured as follows. Section 2 includes a detailed overview of the Municipality of Sithonia (Greece), while Section 3 presents the methodology that was developed and applied to the study area. Section 4 presents the main results of the employed methodology, and Section 5 draws conclusions and implications.

## 2. STUDY AREA

The peninsula of Sithonia extends between the gulfs of Kassandra and Mount Athos and has a total land area of 514.7 km<sup>2</sup>. The central axis of the peninsula is formed by a long mountain range of low hills, the peak of which is Mount Itamos (817m). The Municipality shows rich relief, including lowlands and semi-mountainous and mountainous areas. Two important morphological features of the area are the main mountain range of the peninsula and the extensive coastline where the majority of settlements are located. The morphology of the area, as well as its natural environment, contributes to the development of tourism activity (Hellenic Republic of the Municipality of Sithonia, 2015). Regarding the weather conditions of Sithonia and the wider area, a coastal Mediterranean climate mainly prevails in the lowlands and coastal zones, a terrestrial Mediterranean climate in the higher altitude areas, and a humid continental climate in the mountainous areas. The coastal zones are characterized by mild winters and cool summers, while the microclimate found at the higher altitudes contributes to the absence of extreme weather events (frosts, high temperatures, etc.). High temperatures occur mainly during the summer season (July and August), while the lowest are recorded mainly in February and March. Also, the average annual rainfall is 500-600 mm, with the highest levels of rainfall recorded mainly in October, November, and December (152 mm), when the winds blow north and northeast (Halkidiki, 2017; Hellenic National Meteorological Service, 2021).

Regarding the temperature of the seawater of Sithonia, the official data of the Hellenic National Meteorological Service show that the average temperature of the seawater of the study area during the summer period is around 25.2 degrees Celsius, while during the winter season the average seawater temperature is 14.7 degrees Celsius (Hellenic National Meteorological Service, 2021).

Each year, intense tourism activity (the tourist season) takes place mainly in June, July, and August (the summer season), as well as in the first weeks of September (the beginning of the fall season). These months are characterized by decreased rainfall, increased seawater temperatures, and weak winds.

Small groups of islands, as well as the larger islands of Kelifos and Diaporos, are located around the perimeter of the peninsula and attract many tourists and marine activities every year. The coastal zones of the Municipality are lowland areas with low slopes and sandy soil. The area's long coastline contributes to the development of tourism activities (catering, water sports, recreation, etc.) and the attraction of tourists during the summer months. Important factors that endanger the area's coasts (coastal erosion) are mainly human activities (construction, pollution from farms, swamp drainage, tourism, etc.) as well as natural causes (erosion from ripples and currents, torrents) (Hellenic Republic of the Municipality of Sithonia, 2015; Melfos & Parlantza, 1989).

According to official data from the Municipality of Sithonia and the Hellenic Society for the Protection of Nature (HSPN), 19 beaches and marinas in the area have been awarded "Blue Flags" by the National Operator of the International Program (Hellenic Republic of the Municipality of Sithonia, 2015) (see Figure 1). The study area includes four protected areas (see Figure 1), which are part of the Natura 2000 network. Three of these are SCI/SCA

areas (Sites of Community Importance/Special Conservation Areas), and one is a Special Protection Area (SPA). According to official data from the Filotis website, two Landscapes of Special Natural Beauty exist in the area (the Vourvourou area of Sithonia and Toroni-Porto Koufo Sithonia) as well as a coastal zone with remarkable natural water quality (Armenisti Beach) (European Parliament, 2021; National Technical University of Athens (NTUA), 2015). In addition, according to official data from the Greek Biotope/Wetland Centre on the Sithonia Peninsula, the Pine of Nikiti is a Preserved Nature Monument (Hellenic Parliament, 1976) due to its size and aesthetic importance in the area. Moreover, the peninsula includes an institutionalized Wildlife Refuge with a total area of 129,000 acres (Hellenic Parliament, 2001), which covers the areas of Dragoudeli, Karra, Azapiko, and Parthenon. Mount Itamos is also noted as an Important Bird Area (Greek Biotope/Wetland Centre, 2021; Hellenic Parliament, 1976, 2001; World Wide Fund for Nature-WWF Greece, 2021).

Finally, Sithonia has two island wetlands located in the areas of the Kryftou Inlet (Diaporos Island) and Pounta Island (Ancient Lekythos), with areas of 1.11 hectares and 0.96 hectares, respectively (World Wide Fund for Nature-WWF Greece, 2021).

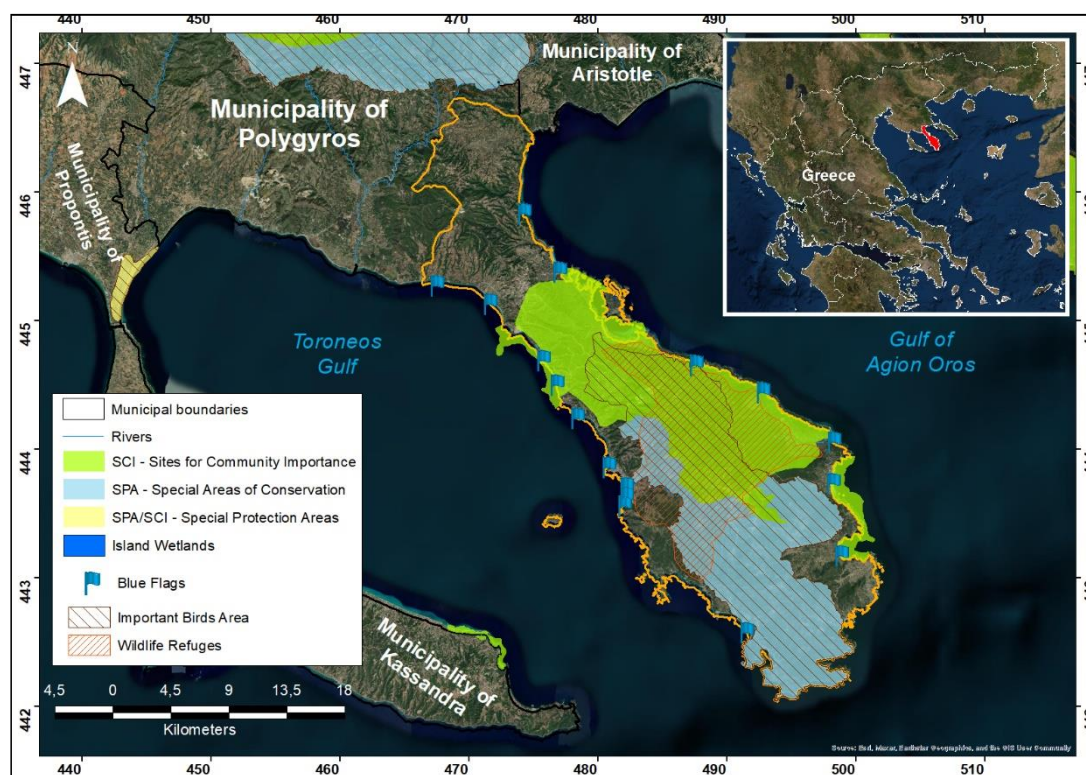


Figure 1. Map of the study area and protected areas of the Municipality of Sithonia.

### 2.1. Socioeconomic Aspects

According to the statistics of the Hellenic Statistical Authority (ELSTAT) (2011a), the population census of 2011 revealed that the permanent population of the Municipality of Sithonia was equal to 12,394 permanent residents. The Municipality showed a population increase of 5% compared to the previous census of 2001 (11,798 permanent residents) (Hellenic Statistical Authority (ELSTAT), 2011a).

The economic activity of the Municipality of Sithonia is mainly focused on the primary and tertiary production sectors. During the winter season, employment mainly focuses on activities relating to manufacturing and the primary sector. During the summer season (tourist season) employment focuses mainly on activities relating to tourism and leisure (e.g., catering, tourist accommodation, and marine activities). The tertiary sector is the most developed in the coastal zone and employs most of the active population as well as attracting several employees from outside the municipality. Important tourism centers in the area include Nikiti and Neos Marmaras. An important issue regarding

the economic activity of the coastal zone is the low level of networking of production units (horizontal networking and vertical networking), as well as a lack of cooperation between the manufacturing and service sectors (Halkidiki, 2017; Hellenic Republic of the Municipality of Sithonia, 2015).

According to the Hellenic Republic of the Municipality of Sithonia (2015), the study area represents 24% of the total number of tourist beds in Halkidiki. Mass tourism, combined with a lack of tourism planning, has negatively affected both the tourism sector and the environment (seasonality, overexploitation of natural resources, etc.). It should be noted that significant parts of the study area are covered by agricultural land (agricultural and livestock zones) as well as tourism accommodations (e.g., holiday homes). A large part of the Municipality is covered by natural and forest areas, where mild agricultural activities are allowed (e.g. controlled logging, beekeeping) (Hellenic Republic of the Municipality of Sithonia, 2015). Regarding productive activities, processing units for agricultural products (olive mills and apiaries) are located in the study area, and a marble quarry is located in the settlement of Metagitsi (Hellenic Republic of the Municipality of Sithonia, 2015).

A significant increase in the population of the Municipality is observed during the summer period due to the influx of tourists. The tourism flow can be categorized as long and medium-term holiday tourism in seasonal accommodations in private holiday homes, as well as short-term holiday tourism in tourist accommodations. The population increase also includes seasonal activity employees of tourism companies who are not permanent residents of the area (Hellenic Republic of the Municipality of Sithonia, 2015).

According to Tracela (2003), the phenomenon of seasonality is so strongly apparent because the tourism activity centers on the coastal areas due to their natural beauty, resulting in an increased burden on services and infrastructure during the summer season. Also, due to the lack of organized use of forest areas, the relationship between the frequency of tourists visiting forests and the distance from the coast is inversely proportional (Tracela, 2003).

### 3. MATERIALS AND METHODS

The present study focused on the assessment of the coastal scenery of beaches, considering the Municipality of Sithonia as the study area. A methodological process of three successive phases was developed and applied, based on the combined use of indicators, the TOPSIS method, Geographical Information Systems (GIS), and a Questionnaire Survey (QS) that was used to gather residents' and tourists' opinions of the importance of each indicator in the assessment (see Figure 2). All the respondents who lived permanently within the boundaries of the Municipality were considered residents of the Municipality of Sithonia. All respondents who resided permanently in an area outside the administrative boundaries of the Municipality, as well as those who carried out holiday activities during the period of the present survey, were considered tourists/visitors.

#### 3.1. Development of a Coastal Scenery Evaluation System

In the first phase of the process, a set of indicators was proposed for the scenery assessment of selected beaches in the Municipality of Sithonia (see Figure 3), which included modified indicators from the Coastal Scenery Evaluation System introduced by Ergin et al. (2004); Ergin et al. (2006); Ergin et al. (2011). Some parameters were modified for optimal application to the coastal evaluation and to better display the results (e.g., 1.4, 1.5, 2.2, 3.2, 4.2, 5.1), while some new Assessment Indicators (AI) were introduced in the CSES (e.g., 1.8, 2.4, 2.5, 3.3, 4.3, 4.4, 5.4, 5.5). The addition of the new indicators aimed to evaluate the factors that indirectly contributed to the development of the coastal area and the water quality. The specific indicators focused mainly on the evaluation of human activity and its effects on the beaches.

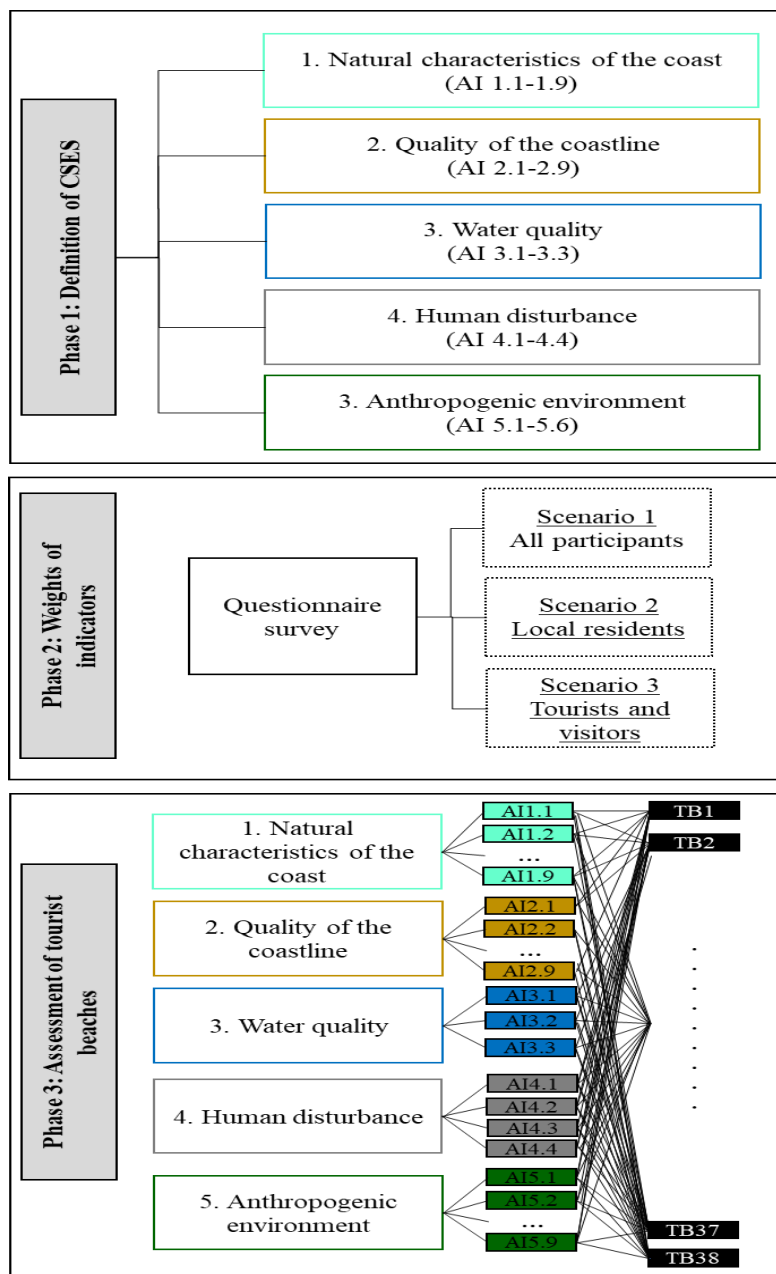


Figure 2. Methodological approach to beaches' scenery assessment in the Municipality of Sithonia (Greece).

The ultimate goal was the overall assessment of the coastal landscape based on environmental and human characteristics. Therefore, the proposed CSES included a checklist of 31 AI, grouped into five (5) main categories: (i) Category 1: natural characteristics of the coast (nine (9) indicators), (ii) Category 2: quality of the coastline (nine (9) indicators), (iii) Category 3: aquatic environment (three (3) indicators), (iv) Category 4: human disturbance (four (4) indicators), and (v) Category 5: anthropogenic environment (six (6) indicators). Qualitative data were converted into quantitative data using a five-point Likert scale from 1 (absence/bad quality or condition) to 5 (presence/excellent quality or condition). More specifically, the value one (1) indicated characteristics of the coastline that were in a poor condition or absent (poor quality, not at all attractive beach), while the value five (5) indicated the excellent quality of the evaluated features and the existence of several positive parameters (dense vegetation, large number of coastal natural elements, attractiveness, high quality of natural landscape, etc.).

More specifically, in the first category of indicators, Indicator 1.8 was modified based on the historical and cultural monuments that are located near the area's beaches. Archaeological sites, religious temples, and cultural

monuments are located on several of Sithonia's beaches. This indicator allowed the aesthetic value given to a beach to be evaluated, as well as the attractiveness of the beach for the visitor. The measurement of the indicator was carried out through an on-site survey, while Google Earth satellite images were also utilized.

In the second category of indicators, three indicators (2.2, 2.4, and 2.5) were modified to optimally display the results and the characteristics of the area. Indicator 2.2, concerning the measurement of the width of the beach, was carried out using Google Earth satellite images. Indicator 2.4, concerning the measurement of the length of the beach façade, also involved the use of satellite images. Using a Likert scale, the beaches were classified from 1 to 5 (1 corresponded to beaches with a length of 1 to 500 meters, and 5 corresponded to beaches with a length exceeding 1500 meters). The beaches were classified using a Likert scale for every 500 meters to optimally display the results and the average length of the beaches. Also, Indicator 2.5 dealt with the measurement of the surface area of rock formations on the sides of the beaches. The basic unit of measurement of the indicator was the square meter, and the data were collected using Google Earth satellite images.

Also, two novel indicators (3.2 and 3.3) were included in the third indicator category. Indicator 3.2 assessed the coverage of natural vegetation that extended into the coastal area at a distance of 20 meters from the shore. The presence of algae, bryozoans, angiosperms, anemones, phytoplankton, etc. was assessed via field research. Also, vegetation coverage was graded on a scale from 1 to 5 (1 = absence of vegetation; 5 = extensive coverage). The indicator aimed to evaluate the impact of the human environment, as well as the aesthetics of the landscape. Indicator 3.3 concerned the marine life that develops close to the coast and in its rocky areas. The presence of shellfish, large and small fish, mollusks, etc. was recorded during field research. The indicator aimed to assess the impact of the human environment on marine life (fishing, water sports, maritime activities, etc.).

Three novel indicators (4.2, 4.3, and 4.4) were included in the fourth category. Indicator 4.2 recorded the solid waste concentration within the coastlines of the Municipality of Sithonia. The indicator aimed to record waste generated by human activity and tourist flows. It was also an indication of the municipal authorities' concern for the protection and quality of the beaches. Data for this indicator were collected through field research. Next, Indicator 4.3 concerned the presence of liquid wastewater on the beaches of the Municipality of Sithonia, and the data collection for this indicator was conducted through field research. Indicator 4.4 recorded pollution incidents and accidents that had occurred in the municipality's coastal area in the last year. The indicator used data recorded during autopsy research as well as data on the beaches from the Municipality of Sithonia. The indicator aimed to assess the impact of pollution incidents and the municipal authorities' actions to deal with specific events.

Finally, the last category of indicators consisted of 6 sub-indicators (5.1, 5.2, 5.3, 5.4, 5.5, and 5.6). Indicator 5.1 related to the assessment of the natural landscape and the cultivated areas that extended around the coastal area. The indicator aimed to assess the degree of influence of human activity and urbanization in and around the coastal area. Data collection was carried out through field research and Google Earth images. Indicator 5.4 assessed coastal areas' access infrastructure. The infrastructure mainly included road signs, dirt roads, lighting, asphalt roads, etc. Using a rating scale from 1 to 5 (1 = high access, 2 = easy access, 3 = relatively difficult, 4 = difficult access, and 5 = great difficulty) it evaluated the possibility of tourist access to the coast, as well as tourist flows received by a beach. Data were collected through field research. Indicator 5.5 assessed the infrastructures that safeguarded the tourists/visitors of the beaches, as well as the existence of natural elements that contributed to the reduction of intense tidal phenomena and floods. A Likert scale was used to measure the presence of lifeguard towers, buoys, and breakwaters from 1 to 5 (1 = high protection, 2 = adequate protection, 3 = moderate protection, 4 = low protection, and 5 = absent). Data were again collected through field research. Indicator 5.6 assessed the density of leisure services operating in and around the coastal area. The indicator aimed to evaluate the services offered to a beach's tourists/visitors. The evaluation was carried out using a scale from 1 to 5, where 5 was considered the lowest (absence of services), and 1 was considered the highest value (large number of services). This indicator was evaluated through field research.

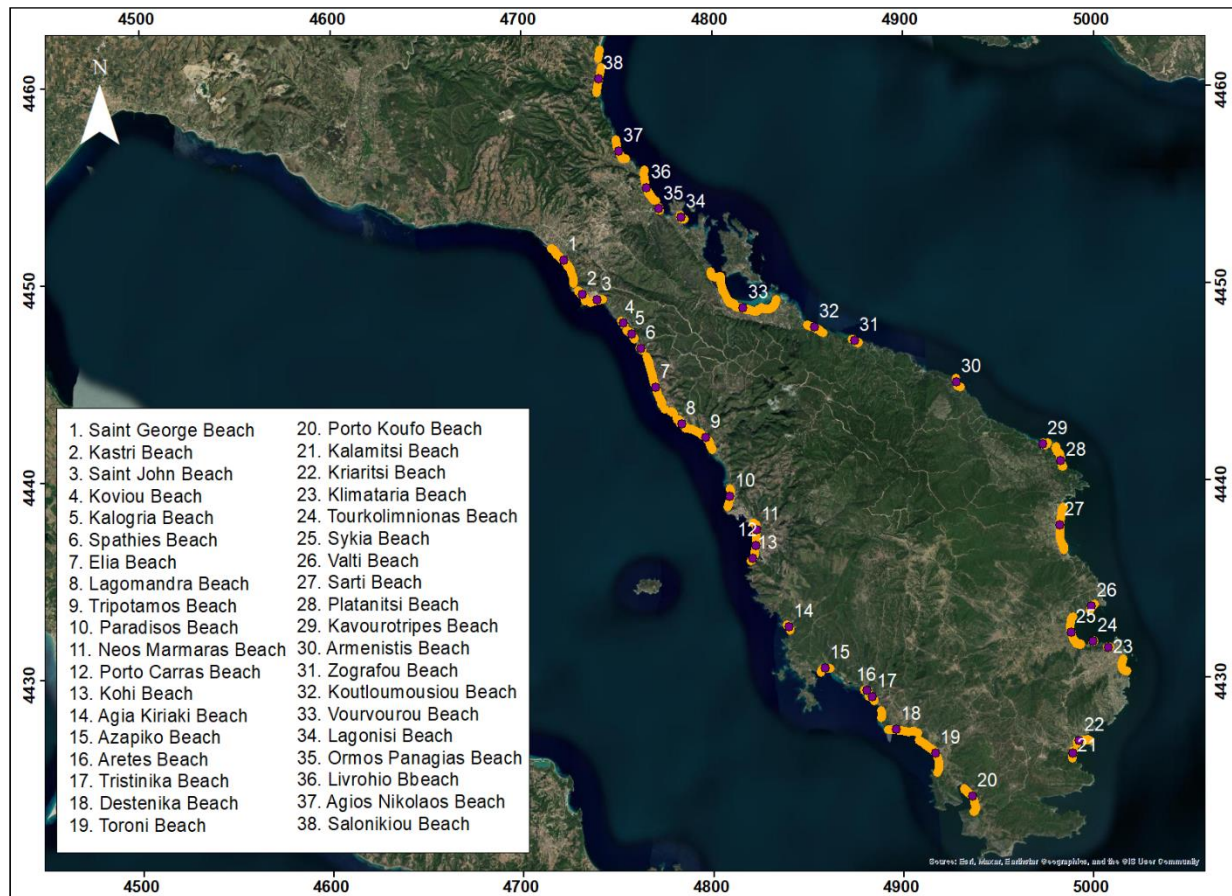


Figure 3. Location map of evaluated tourist beaches.

### 3.2. Weighting of Indicators

The second phase of the methodology included the QS that provided weights for the thirty-one (31) Assessment Indicators (AI), according to the participants' judgments and preferences. The QS consisted of seven sections. The first section captured the personal data of the participants (e.g., gender, age, educational level). In the second section, the participants were asked to assess the five main categories of the proposed set of indicators, using a five-point Likert scale (1 = unimportant to 5 = extremely important), while in the remaining five sections (third to seventh), they were asked to assess each indicator in each category separately. The final weight of each indicator was calculated under three (3) scenarios. Scenario 1 considered the responses of all QS participants. The second and third scenarios considered the preferences of two different focus groups in the QS: (i) local residents (Scenario 2), and (ii) tourists/visitors (Scenario 3). All the participants who permanently lived within the boundaries of the Municipality of Sithonia were considered local residents, while participants who either permanently lived outside the administrative boundaries of the Municipality or were on holiday when the QS was administered were considered tourists/visitors.

### 3.3. Assessment of Tourist Beaches

In the third phase, the TOPSIS method was used to assess the thirty-eight (38) selected Tourist Beaches (TBs) in the Municipality of Sithonia in the three scenarios. To perform the TOPSIS method, an initial assessment matrix was created, including the numerical value  $x_{ij}$  of each selected  $TB_i$ ,  $i = 1, \dots, n$  ( $n=38$ ) for each AI in the CSES  $AI_j$ ,  $j = 1, \dots, m$  ( $m = 31$ ) (Table A1).

Hwang and Yoon introduced the TOPSIS approach (Technique for Order Preference by Similarity to Ideal Solution) in 1981 (Hwang & Yoon, 1981). The technique was founded on the principle that in a multicriteria analysis situation, the chosen alternative should be as close to the ideally best solution as possible while being as distant from the ideally worst solution as possible. The steps of the method are described below.



A normalized decision matrix is created from the initial assessment matrix using Equation 1.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}} \tag{1}$$

The weighted normalized value  $v_{ij}$ ,  $i = 1, \dots, n$ ,  $j = 1, \dots, m$ , is calculated as follows:

$$v_{ij} = w_j * R_{ij} \tag{2}$$

Where  $w_j$  is the weight of the  $j$ th assessment criterion and  $\sum_{j=1}^m w_j = 1$ .

The optimal ideal solution  $A^+$  and the negative ideal solution  $A^-$  are calculated using Equations 3 and 4, respectively, and the Euclidean distance of each alternative from the optimal ideal ( $S_i^+$ ) and the negative ideal choice ( $S_i^-$ ) is calculated using Equations 5 and 6, respectively.

$$A^+ = \{v_1^+, \dots, v_m^+\} = \{(max v_{ij} | j \in J'), (min v_{ij} | j \in J'')\} \tag{3}$$

$$A^- = \{v_1^-, \dots, v_m^-\} = \{(min v_{ij} | j \in J'), (max v_{ij} | j \in J'')\} \tag{4}$$

Here  $J'$  and  $J''$  are associated with benefit and non-benefit criteria, respectively.

$$S_i^+ = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^+)^2} \tag{5}$$

$$S_i^- = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^-)^2} \tag{6}$$

Finally, the ranking order of the alternatives is determined according to the relative closeness coefficient  $C_i^+$ , calculated using Equation 7.

$$C_i^+ = \frac{S_i^-}{S_i^+ + S_i^-} \tag{7}$$

It should be noted that all the necessary data to define the values of the assessment indicators were obtained through field visits during the months of August and October 2021. Photographic material was collected to improve the display of data using a camera (Sony Cyber-shot) and a mobile phone (Samsung J5 2015). Google images were also collected using the Google Earth program. The ranking order of the selected TBs was based on the closeness coefficient  $C_i^+$  of each TB to the optimal ideal and negative ideal solutions. Finally, the TBs were classified into six (6) categories according to a modified classification inspired by Cristiano, Rockett, Portz, and de Souza Filho (2020) (see Table 1), and the results were spatially depicted on relevant maps with the use of GIS (ArcMap 10.4).

The distribution of the beaches and the classification of their attractiveness were estimated through the relative proximity  $C_i$  in 6 main categories. The categories of results in which the beaches were included were determined based on the optimal display of the results, while the price range covered by each category was determined based on the value of 0.14.

Table 1. Classification of tourist beaches based on the closeness coefficient.

Classification	Closeness Coefficient $C_i^+$	Explanation
1	$\geq 0.64$	High attractiveness of the natural landscape, excellent environmental quality
2	$< 0.64$ and $\geq 0.5$	Natural areas, significant natural landscape attractiveness, high aesthetic value
3	$< 0.5$ and $\geq 0.36$	Significant coverage of natural area, strong aesthetic value, little human nuisance
4	$< 0.36$ and $\geq 0.22$	Smaller natural areas, mild human activity, mild environmental nuisance
5	$< 0.22$ and $\geq 0.08$	Low aesthetic value, urban areas, low attractiveness
6	$< 0.08$	Intense urban development, unattractive environment, low aesthetics

#### 4. RESULTS AND DISCUSSION

The outcomes of the present research are provided and discussed in the following sub-sections. First, the assessment matrix of the TBs is provided. The results of the QS (second phase of the proposed methodology, Figure

3) are then presented. Finally, we present the results of the TOPSIS application (third phase of the proposed methodological framework, Figure 3) along with the classification maps corresponding to the three examined scenarios.

#### 4.1. Determination of Values for the Assessment of TBs

Using the modified CSES (Table A1), the assessment matrix of the selected TBs (Figure 3) was created. Also, through the field research carried out by the authors, the value of each indicator (on the Likert scale from 1 to 5) was estimated for each beach. Table 2 presents part of the assessment matrix for the natural characteristics of the coasts (Category 1).

Regarding the coverage of natural vegetation (AI1.7), 42% (sum of coasts evaluated at values 4 and 5) of the examined beaches were surrounded by mature natural areas. The majority of these beaches were located on the Toroneos Gulf. These specific areas were covered by pines and species of evergreen-broadleaf shrubs. The beaches that extended within settlement boundaries (TB1, TB11, TB27, TB25, TB35, etc.) had low scattered vegetation and were considered bare areas.

Based on the data from the field research, the types of beach face (AI2.1) that prevailed in the study area were sand (85%) and pebbles/gravel (15%). In addition, regarding the color of the beach face (AI2.3), 84% of the TBs were covered with white/gold sand, while the remaining ones were covered with light black or white sand.

The current condition of Sithonia's beaches was assessed using special evaluation cards. The beaches were evaluated on a Likert scale using the indicators. The processing and analysis of the data from the field research and the questionnaire were carried out in Microsoft Excel. Based on the results of the field research, 89% of the examined beaches had pure turquoise water with great clarity (AI3.1) (value 5 on the rating scale), while only 10% of the beaches had water adjacent to pure blue (TB35, TB33, TB37, TB20). Also, regarding the natural marine vegetation (AI3.2), it was observed that 23% of the beaches had an absence of marine flora at a distance of 20 meters from the shore, while 52% of the beaches showed little coverage. Significant coverage was found mainly in TB20 and TB5 (value 5 on the rating scale), and increased coverage (value 4) appeared at beaches TB2 and TB16. The biodiversity (AI3.3) found on the examined beaches included species of small fish, crustaceans, echinoderms, mollusks (octopuses), and zooplankton (jellyfish). Based on the results, the majority of beaches (89%) showed low to increased biodiversity (sum of assessment values 2 and 3), while 10% of the beaches showed relatively increased biodiversity.

Regarding solid waste (AI4.2), on several beaches (55%) no signs of waste were found, while on 39% of beaches a few scattered objects were found. In addition, 5% of the beaches (TB33, TB20) showed an accumulated amount of waste in a certain area of their total length. The main reason was the presence of human activity and coastal infrastructure (ports, marinas, chartered yachts, etc.), which increases waste production. Through the on-site survey, it was estimated that 92% of the beaches could not identify any sources of wastewater discharge (AI4.3), while 5% of the beaches were subject to the discharge of marine fuel oils (TB35 and TB33).

The results of the access indicator (AI5.4) showed that a large number of beaches were relatively difficult to access (36% of beaches were rated 3), as their long distance from the main road network was covered by either a dirt road or a narrow road. Also, 13% of the beaches showed access difficulties as access takes place via a network of dirt roads with no signs or lighting. On the other hand, beaches located near settlements or large tourist facilities were highly accessible (26% of beaches were rated 2 and 23% of beaches 1). Next, the safety of the beaches (AI5.5) in the Municipality of Sithonia is mainly enhanced by lifeguard towers and coastal works to deal with the tides (breakwaters), as well as buoys in the water area. Breakwaters were located mainly on beaches located within the boundaries of settlements and near port facilities (TB1, TB11, TB35, etc.). Also, 84% of the examined beaches (sum of values 4 and 5) had a low level of safety as they had natural cover, a lifeguard tower, or a buoy network, while 15% of the beaches (sum of values 1, 2, and 3) offered greater safety.

Table 2. Assessment matrix for Category 1 (Table A1).

Beaches	AI1.1	AI1.2	AI1.3	AI1.4	AI1.5	AI1.6	AI1.7	AI1.8	AI1.9
TB1	1	1	1	5	4	5	5	1	1
TB2	1	1	1	4	3	5	3	2	2
TB3	4	4	4	5	4	5	3	2	3
TB4	2	3	2	5	3	5	2	2	3
TB5	2	2	2	5	4	5	2	3	5
TB6	2	4	4	5	3	5	2	2	5
TB7	2	5	3	4	3	4	5	1	1
TB8	1	1	1	5	3	5	4	3	3
TB9	1	1	1	5	3	5	4	2	2
TB10	1	1	1	4	3	4	3	1	1
TB11	1	1	1	5	4	5	3	1	1
TB12	1	1	1	5	4	5	3	1	1
TB13	1	1	1	5	3	5	2	2	2
TB14	1	1	1	5	3	5	2	1	1
TB15	2	4	2	5	4	5	4	5	5
TB16	2	4	3	5	4	5	2	2	1
TB17	2	2	3	5	4	5	4	3	3
TB18	2	4	3	5	4	5	3	2	2
TB19	2	2	2	5	4	5	5	2	2
TB20	5	5	5	5	3	4	4	5	2
TB21	2	5	3	5	4	5	4	5	2
TB22	2	3	3	5	4	5	3	5	3
TB23	3	2	3	5	3	5	2	2	4
TB24	3	3	3	5	3	5	2	3	4
TB25	2	2	3	5	4	5	5	4	3
TB26	2	2	3	5	3	5	2	3	5
TB27	1	1	1	5	5	5	5	5	2
TB28	2	2	2	5	4	5	4	3	2
TB29	2	2	5	5	3	5	2	5	5
TB30	3	5	4	5	4	5	3	4	4
TB31	4	5	5	4	3	5	2	2	2
TB32	4	5	5	5	4	5	2	1	1
TB33	1	1	1	4	3	4	5	1	1
TB34	1	1	1	5	3	5	2	2	2
TB35	1	1	1	5	3	4	2	1	1
TB36	2	5	3	5	4	5	5	1	1
TB37	1	1	1	4	3	4	4	1	1
TB38	1	1	1	5	3	5	5	1	1

#### 4.2. QS Results

The QS was conducted between July and September 2021. A total of 302 fully completed questionnaires were collected. Of the participants, 196 (65%) were residents of the municipality, while 106 (35%) were tourists or visitors. Based on the results, 53% of the participants were male, while 47% were female. Furthermore, 22.5% of the sample was in the age group 45-55, while the next largest percentage was those aged 15-24 (19.5%). A significant percentage represented the age groups of 35-44 and 55-64 (17.5% and 16.2%, respectively). People over 65 and the 25-34 age group gathered smaller percentages (13.2% and 10.9%, respectively). Regarding their place of residence, 65.2% of the respondents stated that they were permanent residents of the Municipality of Sithonia, while 34.8% stated that they lived outside the municipality. In more detail, the largest percentage was those who did not live in the municipality and did not answer in which area they lived (31.79%), followed by 24.17% of respondents who lived in the settlement of Nikiti and 12.58% in the settlement of Vourvourou. Next, 23.2% answered that they worked as private employees, while students and freelancers followed with 18.2%. Civil servants gathered a percentage of 14.9%, while 5.6% were people in domestic work. Finally, small percentages of respondents were those looking for work (2.6%) and those working in another occupation (1.3%).

The participants' responses in the second section of the QS were analyzed to quantify the relative weights of the five main categories of the proposed CSES concerning the overall assessment of TBs. Figure 4 shows the relative weights of the five categories (Category 1 – Category 5) for the three scenarios deployed in this study. Scenario 1 considered all participants' responses in the QS, while Scenario 2 and Scenario 3 considered the responses of local residents and tourists/visitors, respectively.

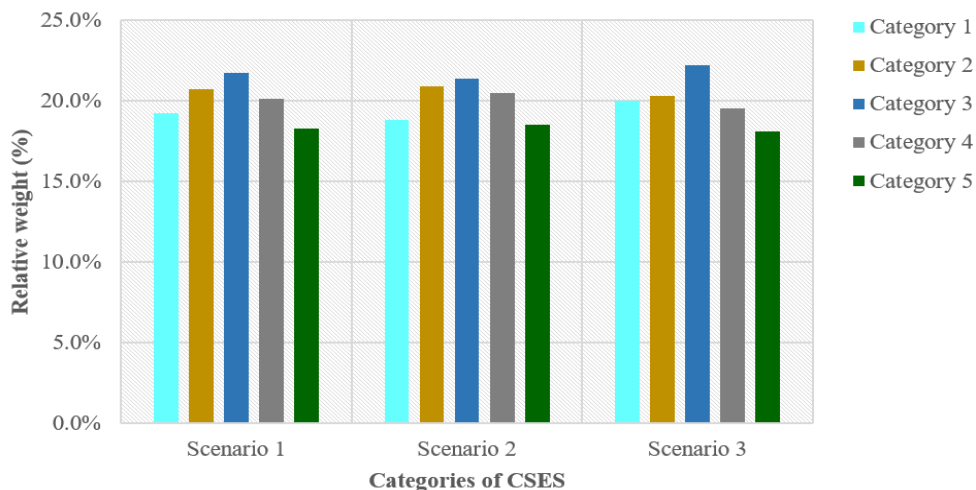


Figure 4. Relative weights of the five categories for the three scenarios.

In Scenarios 1 and 2, Category 3 (aquatic environment), Category 2 (quality of the coastline), and Category 4 (human disturbance) were the three most important categories for the overall assessment of TBs, since these three criteria obtained the largest relative weights (Scenario 1: 21.7%, 20.7%, and 20.1%; Scenario 2: 21.4%, 20.9%, and 20.5%, respectively). Category 1 (natural characteristics of the coast) was the fourth most important category, followed by Category 5 (anthropogenic environment). The relative weights of the last two categories added up to a total percentage of 37.5% and 37.3% in Scenarios 1 and 2, respectively. In Scenario 3, the relative weights of the five categories were quite similar to Scenarios 1 and 2. However, in contrast to Scenarios 1 and 2, tourists and visitors considered Category 1 (20%) and Category 4 (19.5%) to be the third and fourth most important categories for the overall assessment of TBs, respectively.

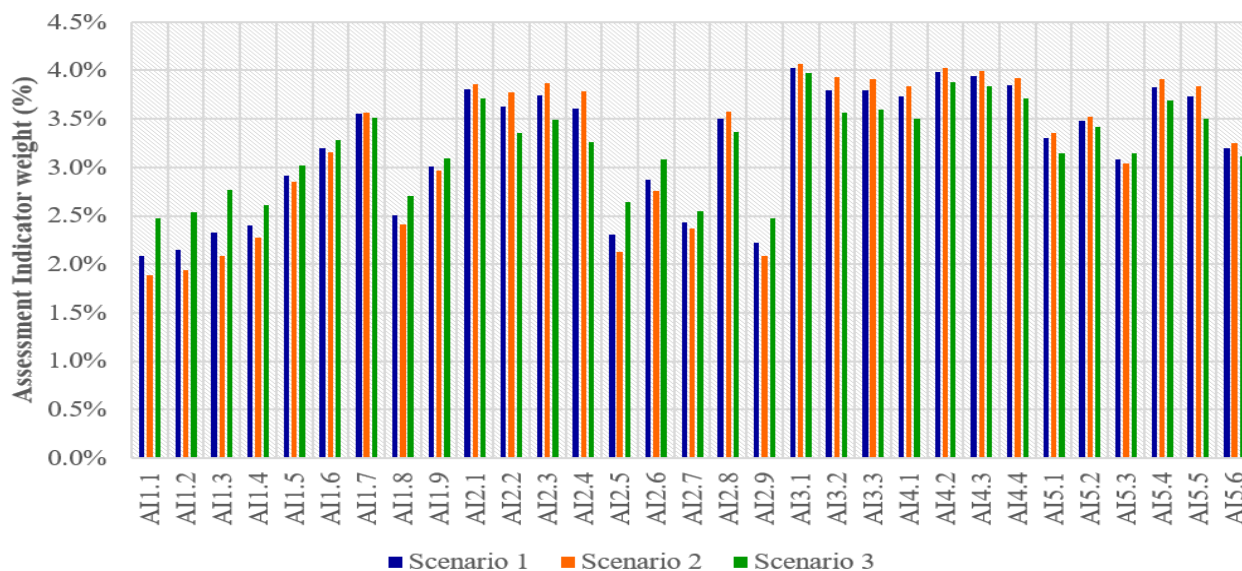


Figure 5. Relative weights of the assessment indicators according to all participants' preferences (Scenario 1), residents' preferences (Scenario 2), and tourists' and visitors' preferences (Scenario 3).

Figure 5 presents the relative weights of the assessment indicators for the three scenarios deployed in this study. It should be noted that assessment indicators AI3.1 (water color and clarity), AI4.2 (solid waste), and AI4.3 (disposal of wastewater) had the largest weights in all the examined Scenarios (4.0%, 4.0%, and 3.9% in Scenario 1; 4.1%, 4.0%, and 4.0% in Scenario 2; 4.0%, 3.9%, and 3.8% in Scenario 3, respectively). Indicators AI2.9 (tides), AI1.2 (cliffs – slope), and AI1.1 (cliffs – height) received the lowest relative weights in all three scenarios. The correlations in rankings among the three scenarios were examined further, using Kendall's  $\tau$  coefficient, and the correlation value (0.703) indicated a strong positive correlation.

**Table 3.** Closeness coefficient and classification of tourist beaches in the examined scenarios.

Beaches	Scenario 1		Scenario 2		Scenario 3	
	$C_i^+$	Class	$C_i^+$	Class	$C_i^+$	Class
TB1	0.321	4	0.427	4	0.401	4
TB2	0.444	3	0.370	3	0.341	3
TB3	0.425	3	0.377	3	0.386	3
TB4	0.465	3	0.371	3	0.366	3
TB5	0.515	2	0.508	2	0.484	3
TB6	0.533	2	0.438	2	0.439	2
TB7	0.443	3	0.366	3	0.358	3
TB8	0.353	3	0.363	3	0.349	4
TB9	0.408	3	0.366	3	0.350	3
TB10	0.248	4	0.308	4	0.288	4
TB11	0.292	4	0.361	4	0.341	4
TB12	0.322	4	0.453	4	0.424	4
TB13	0.334	4	0.392	4	0.368	4
TB14	0.427	3	0.395	3	0.366	3
TB15	0.530	2	0.493	2	0.483	2
TB16	0.490	3	0.459	2	0.438	3
TB17	0.521	2	0.480	2	0.469	2
TB18	0.535	2	0.466	2	0.451	2
TB19	0.434	3	0.445	3	0.441	3
TB20	0.602	2	0.642	2	0.652	2
TB21	0.501	2	0.549	2	0.537	3
TB22	0.492	3	0.446	3	0.449	3
TB23	0.473	3	0.399	3	0.398	3
TB24	0.484	3	0.418	3	0.421	3
TB25	0.523	2	0.491	2	0.499	2
TB26	0.465	3	0.390	3	0.391	3
TB27	0.412	3	0.495	3	0.476	3
TB28	0.508	2	0.454	2	0.440	3
TB29	0.531	2	0.467	2	0.473	2
TB30	0.473	3	0.477	3	0.486	3
TB31	0.503	2	0.452	2	0.458	2
TB32	0.545	2	0.479	2	0.481	2
TB33	0.344	4	0.402	4	0.386	4
TB34	0.343	4	0.323	4	0.309	4
TB35	0.219	5	0.299	4	0.280	5
TB36	0.460	3	0.487	3	0.481	3
TB37	0.388	4	0.335	3	0.307	3
TB38	0.314	4	0.352	4	0.322	4

### 4.3. Assessment of TBs

The examined TBs of the Municipality of Sithonia (Figure 3) were assessed and ranked using the TOPSIS method. The distance of every possible alternative (TB1–TB38) from the ideal solution (Equation 5) and the negative ideal solution (Equation 6) was obtained, and each TB was prioritized according to the relative degree of approximation (Equation 7). The corresponding results of the relative degree of approximation for each examined scenario are shown in Table 3, while the TBs' classification is spatially depicted in the relevant maps (Figure 6-8) for each of the three examined scenarios.

An important observation is that only one beach (TB20) was classified as class 2 in all three scenarios (Scenario 1, Scenario 2, and Scenario 3). Also, in none of the three scenarios was any beach included in class 1, which indicates that human facilities extended both on and around the beaches to a small or large extent.

In Scenario 1, the twelve beaches that fell into class 2 are located in the southern and central parts of the peninsula (e.g., TB5, TB21), where the intensity of tourism development is lower than in the northern part of Sithonia. Three of the beaches (TB33, TB34, TB38) that were classified as class 4 extend from the north side of the Gulf of Agion Oros. On the side of the Toroneos Gulf, the TBs adjacent to the settlements of Nikiti and Neos Marmaras (e.g., TB2, TB3, TB24) were classified as class 3, while none of the study area's beaches were classified as class 6. In addition, beach TB35 was the only class 5 beach due to the urban environment that surrounds it.

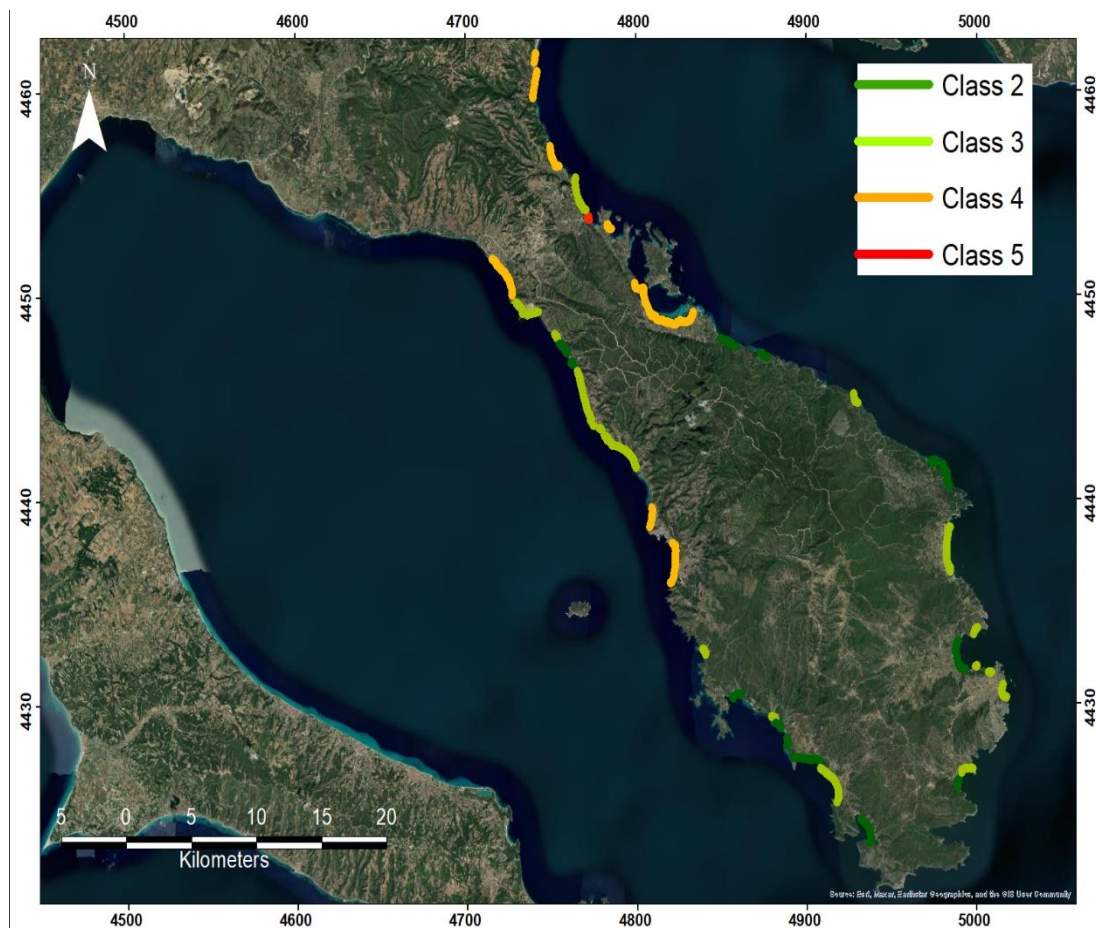


Figure 6. Class distribution map (Scenario 1).

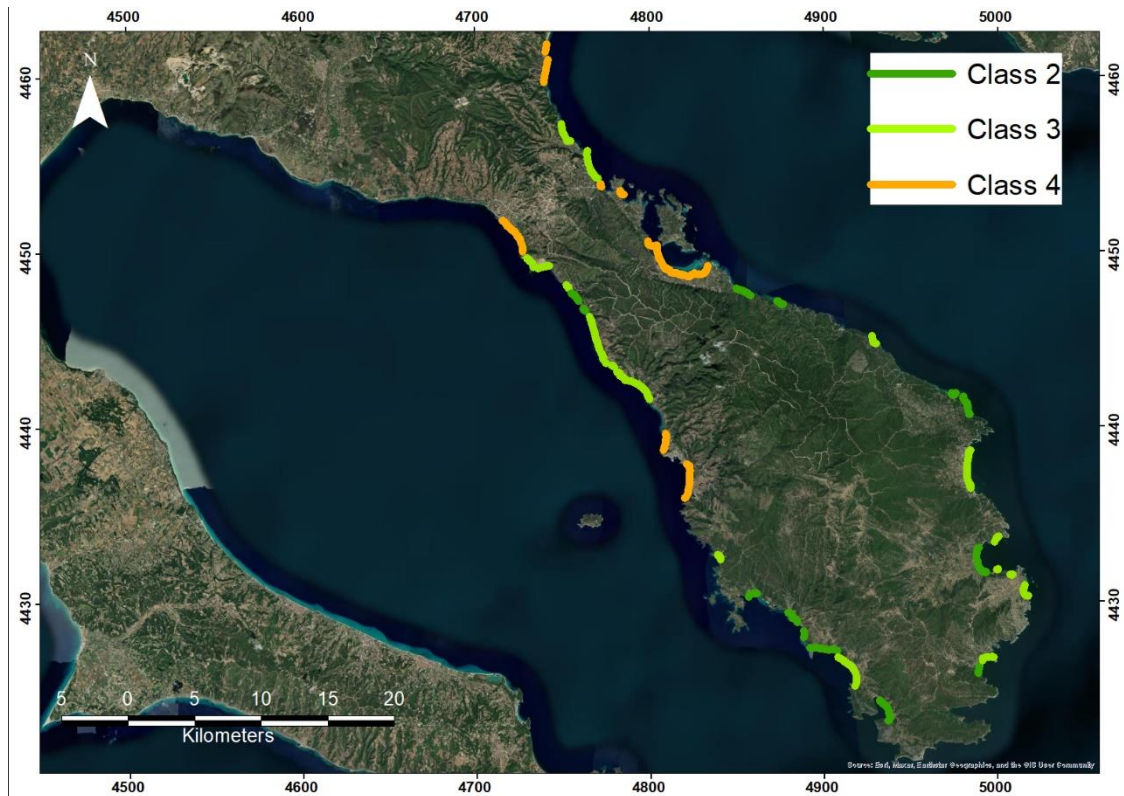


Figure 7. Class distribution map (Scenario 2).

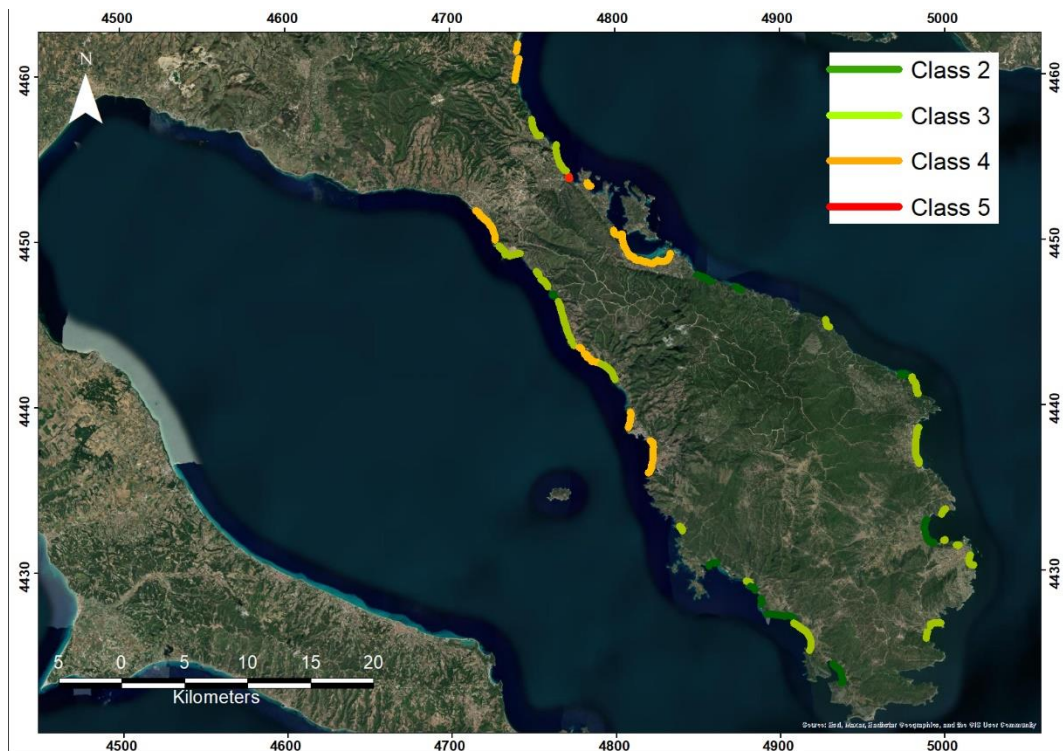


Figure 8. Class distribution map (Scenario 3).

In Scenario 2, the southeastern part of the study area included beaches that were classified in class 2 (TB5, TB21) and 3 (e.g., TB22, TB27). Beaches that were classified in class 3 (e.g., TB3, TB4, TB7) were in the northern and western parts of the study area, as these areas receive a high tourist flow during the summer, and tourism affects the

natural environment. Also, class 4 beaches were found mainly within the boundaries of local settlements (e.g., TB1, TB11, TB35). This results from their low aesthetic value due to the urban environment dominating them to a large extent. In Scenario 3, nine beaches (e.g., TB18, TB25, TB31) that were located in the southern part of the region were classified in class 2, while beaches that were classified in class 3 could be found on both sides of the peninsula (e.g., TB16, TB28, TB30). The northeastern part of the area mainly included beaches that were classified in class 4 (e.g., TB33, TB34, TB38), while none of the study area's beaches were classified as class 6. TB35 was the only beach in class 5, having obtained the lowest score in this scenario.

## 5. CONCLUSIONS

In the Municipality of Sithonia, coastal tourism is the main form of tourism due to the area's location, the weather conditions, and the region's many beaches. During the summer, there is intense economic activity in tourism-related sectors (recreation activities, transport, rental of holiday homes, etc.). However, due to the increase in tourism, there is a need both for the modernization of the existing infrastructure and the deployment of new facilities.

Sithonia has remarkable cultural and natural potential (historical and archaeological monuments, religious temples, cultural and religious events, forests, islands, etc.) for the development of alternative forms of tourism. Some important forms are religious and historical tourism as the municipality has a large number of religious and historical sites. Also, sports tourism is a form of tourism that could be promoted in the area, as swimming competitions, walking routes, diving trips, and marathons are organized every year. Enotourism offers additional alternative tourism potential. Through vineyard visits, festivals, and presentations about the products of Porto Carras, visitors have the opportunity to taste local wines and learn about wine production. The promotion of alternative forms of tourism in the region, as well as the strengthening of beach prevention and protection actions, can be important tools for Sithonia. Tourism helps the region prosper economically.

In the present paper, a methodological approach was developed and applied to assess the Tourist Beaches (TBs) in the Municipality of Sithonia (Greece). The approach was based on the combined use of modified and novel indicators from the CSES method, QS, TOPSIS, and GIS. To summarize the assessment results of Scenario 1, 0 sites were included in class 1, 12 sites were in class 2, 21 sites in class 3, 8 sites in class 4, and 1 site in class 5. Similarly, in Scenario 2, 0 sites were included in class 1, 13 sites were in class 2, 16 sites in class 3, and 9 sites in class 4. Finally, the results of Scenario 3 showed that 0 sites were included in class 1, 9 sites were in class 2, 19 sites in class 3, 9 sites in class 4, and 1 site was included in class 5. The results of the present investigation demonstrated that the study area has a wide number of beaches with considerable aesthetic value, surrounded by significant areas of mature natural vegetation. In addition, the TBs in the southern part of Sithonia receive less pressure from tourism activities than the beaches in the north. However, due to the seasonality of tourism in the study area, the natural environment of these TBs has the opportunity to return to its original condition during the winter season.

Also, regarding the improvement of the beaches' current situation in terms of the local environmental problems they face, it would be advisable to implement coastal engineering projects on beaches that have severe soil erosion problems to enrich the soil with natural elements (sand, gravel, sediments, etc.) and protect the coastal front. The specific actions should be applied to beaches that received low scores in all three scenarios (TB7, TB10, TB37), particularly in the indicators relating to soil quality (AI 2.1 and 2.3).

Subsequently, the protection of coastal waters is proposed, mainly on beaches that are located a short distance from local ports and marinas (TB1, TB11, TB12, TB20), as well as on beaches with intense local shipping activity (TB33, TB35). A basic evaluation of the achievement of this specific objective must be undertaken by the local administration of the study area through the systematic sampling of the bathing water to assess the concentration of bacteria and inform the public about the types of water pollution. An additional policy could be the modernization of the biological water treatment facility in the settlement of Nikiti as well as the creation of new ones, particularly on beaches located within the boundaries of settlements with intense tourist activity (TB11, TB12, TB33, and TB35).



The ultimate goal is to improve the overall score of the specific beaches, as well as to strengthen the public health of tourists.

Based on the characteristics of the study area and its protection from tourism saturation, we propose implementing a policy aimed at sustainable development with an emphasis on the environment and the preservation of natural ecosystems. This environmental policy should mainly be applied to TBs with low class values (e.g., TB37, TB38, and TB35) and to areas with significant tourism pressures during the summer season (e.g., TB1, TB5, and TB11). By adopting alternative forms of tourism (e.g., sports tourism, religious tourism, archeological tourism, ecotourism, wine tourism) and deploying new infrastructures both to protect TBs (erosion, tides, fires) and enhance their tourists/visitors' services (e.g., installation of lifeguard towers, improvement of transport and accessibility), sustainable tourism development should be achieved in the study area.

To preserve the quality of the beaches and their waters, we propose creating an integrated strategy for the management of Sithonia's beaches with the main objective of cleaning them of solid waste that can be channeled into the coastal waters, as well as highlighting the cultural and natural resources of Sithonia. Within the framework of this strategy, the prohibition of arbitrary construction and uncontrolled expansion of the urban environment should be intensified with the aim of liberating and healing the coastal front. An important measure of environmental protection would be afforded by the creation of water quality control points, particularly in areas with intense tourism and productive activity. This specific action could be fruitfully implemented in the areas of Kastri, Elia Nikitis, Neos Marmaras, and Vourvourou. Also, in the areas that receive lower tourist flows (Sykia, the Salonikiou area, Toroni), we propose creating Integrated Tourism Development Areas that include all the prerequisites established in Greek legislation. These areas could be the settlements of Nikiti and Vourvourou. At the same time, studies should be carried out in these places to limit overfishing and control the fish population so that it is kept at a safe level. In addition, the specific strategy must contribute to the sustainable development of the region and avoid the negative consequences of mass tourism, while at the same time harmonizing with the European Union's environmental policy (European Parliament, 2021).

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## APPENDIX

Table A1. Coastal scenic evaluation system. categories and assessment indicators.

Id	Assessment Indicator Name	Rating				
		1	2	3	4	5
Category 1. Natural Characteristics of the Coast						
1.1	Cliffs – Heights (m)	Absent	5-30 metres	31-60 metres	61-90 metres	90 metres
1.2	Cliffs - Slope (°)	Absent	45°	circa 60°	circa 75°	circa vertical
1.3	Cliffs – Special features*	Absent	1	2	3	More than 3
1.4	Valleys and estuaries	Absent	Dry valley	(1-4 metres) stream	(5-20 metres) stream	River gorge / limestone gorge
1.5	Landmarks on the horizon (distant landscapes)	Not visible	Flat horizon	Wavy horizon (Distant slopes with indistinguishable features)	Heavily wavy horizon (steep slopes)	Mountainous/Island
1.6	Coastline sides with view	Open on one side	Open on two sides	-	Open on three sides	Open on four sides
1.7	Coverage of natural vegetation	Bare area (very sparse vegetation, grass, few bushes)	Scrub (reeds)/garigue (near trees, shrubs)	Wetlands/meadows	Coppices (tall shrubs), maquis (short shrubs)	Mature tree variety/mature natural vegetation
1.8	Historical and cultural monuments	Absent	1	2	3	More than 3
1.9	Characteristics of coastal landscape**	Absent	1	2	3	More than 3
Category 2. Quality of the Coastline						
2.1	Beach face -Type	Absent	Mud	Cobble/boulder	Pebble/gravel	Sand
2.2	Beach face – Width (m)	Absent	1<X<5	5<X≤25	25<X≤50	50<X≤100
2.3	Beach face - Color	Absent	Dark-Black	Dark	Light tanning/whitening	White/gold
2.4	Beach face - Length (m)	<100m	101-500m	501-1000m	1001-1500m	More than 1500m
2.5	Rock formations – Areas (m <sup>2</sup> )	Absent	1-900 sq.m.	901-1800 sq.m.	1801-2700 sq.m.	More than 2700 sq.m.
2.6	Rock formations – Roughness	Absent	Heavily serrated	Deep cavity and/or irregular	Shallow pits	Smooth surface
2.7	Sand dunes	Absent	Residues	Fore-dune	Secondary ridge	Several

Id	Assessment Indicator Name	Rating				
		1	2	3	4	5
2.8	Vegetation residues within the coast (dry algae, dry leaves, branches, etc.)	Continuous	Full strand line	Single accumulation	Slightly scattered / Thin line	None
2.9	Tides	Macro (4 m)	-	Meso (2-4m)	-	Micro (2m)
Category 3. Aquatic Environment						
3.1	Water color and clarity	Muddy brown/gray	Milky/blue/green/opaque	Green/gray/blue	Pure blue/dark blue	Very clean turquoise
3.2	Marine natural vegetation (algae, anemones, mosses, angiosperms)	Absent	Low coverage (sparse phytoplankton coverage)	Scattered cover (phytoplankton, corals, algae, etc.)	Increased coverage	Great coverage
3.3	Marine life	Absent	Reduced (shells, shellfish, crustaceans, etc.)	Small (small fish, octopuses, etc.)	Relatively increased (larger fish, herds of fish, etc.)	Increased (large fish, cetaceans)
Category 4. Human Disturbance						
4.1	Noise pollution	Unbearable (existence of beach bar and settlement, short distance from the road)	Tolerated (existence of sparse beach bar, other infrastructure, road infrastructure, leisure)	Limited sound (existence of settlement, rooms to let, small area beach bar, etc.)	Quite Limited (existence of small houses sparsely, caravans, a beach bar)	No sound
4.2	Solid wastes	Very high concentration of waste	Full leg line (Large accumulation)	Single accumulation	A few scattered objects	Almost absent
4.3	Disposal of wastewater	Important sewage evidence	High concentration (Existence of sewage pipeline, high concentration of marine pollutants, eutrophication, etc.)	Single accumulation	A few elements (foam in the sea, small eutrophication phenomena, phytoplankton, etc.)	There is no sewage
4.4	Number of coastal pollution incidents in a year (oil spills, dumping, liquid boat effluent, etc.)	More than 3	3	2	1	None

Id	Assessment Indicator Name	Rating				
		1	2	3	4	5
Category 5. Anthropogenic Environment						
5.1	Unstructured environment	None/Minimal vegetation	Trees in parallel with the coastline/Shrubs	Shrub fences/terraces/mono culture	Annual crops	Mixed crop fields/natural landscapes
5.2	Structured environment ***	Heavy industry (hotels, large tourist facilities, developed settlement)	Heavy tourism and/or urban fabric (large concentration of tourist accommodation nearby)	Light tourism and/or urban and/or sensitive (rooms for rent scattered, leisure infrastructure)	Sensitive tourism or urban (very sparse tourist accommodation, low concentration of leisure activities)	Sparse houses or not at all
5.3	Supporting infrastructure ****	More than 3	3	2	1	None
5.4	Beach accessibility	High accessibility (good connection to the road network, lighting, asphalt, beach signage, etc.)	Easy access (wide road width, beach signage, lighting, short distance from the main road)	Relatively difficult access (narrow road, small entrances)	Difficult access (small dirt road, strong ground call, long distance from main road axis, absence of signs)	Great difficulty (dirt road, long distance from main network)
5.5	Safety infrastructures	Great protection (lifesaving towers at multiple points, lifeguard boat, buoys, lighthouses, artificial protection works, breakwaters, etc.)	Adequate protection (two lifeguard towers, technical ripple protection works, buoys, arms)	Moderate protection (lifeguard tower at one point, buoys)	Low protection (buoys, absence of lifeguard and protection infrastructure)	Absent (natural coastal features that help protect visitors)
5.6	Services offered (quality and presence of leisure services, refreshments, restaurants, water sports, etc.)	Large number of refreshments and restaurants as well as water sports	Large number of restaurants and refreshments nearby	Scattered refreshments and water sports at a sparse distance	Minimum service infrastructure (small concentration of refreshments, absence of water sports, small area of beach bar, existence of only one service)	Absent

Note: \* special characteristics of a cliff: recess, belt, folding, trees and irregular profile  
 \*\* peninsulas, rocks, irregular capes, arches, windows, waterfalls, caves, deltas, lagoons, islands, rocky stacks, estuaries, reefs  
 \*\*\* large caravanserai (grade 2), small caravanserai (grade 3), minimal caravans (grade 4)  
 \*\*\*\* power lines, pipesz, street lamps, grooves, earthworks for tides, flood infrastructure.

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