

CARRYING CAPACITY ASSESSMENT OF THE SOUTH AEGEAN REGION, GREECE

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Abstract. Since the early 1950's Greece has been a top travel destination providing high-quality tourism services. This was amplified by the diverse landscape, extended sandy beaches, numerous archaeological sites, people's mentality, safety, and adequate infrastructure. In particular, the south Aegean Archipelago attracts more than six million (6,000,000) visitors annually, approximately 27% of tourist arrivals in Greece. The Carrying Capacity Assessment of the South Aegean Region aims to improve the already high standards of the offered tourist services. The relevant socio, economic and physical data were analyzed to highlight the adverse effects of traditional and current activities and increase tourism attractiveness by offering alternative products, such as hiking, biking, diving, fishing tourism, archaeological tourism, medical tourism and excursions in the remarkable landscapes. Furthermore, the outcomes of the application of the carrying capacity indicators provide specialized solutions to control the over-tourism impact, mitigate the natural environmental degradation, and, finally, establish a roadmap for sustainable development of the Region. The required data (socio, economic and physical) was analyzed according to the PAP/RAC as more suitable.

Keywords: Carrying Capacity Assessment, sustainable development, tourist industry assessment, South Aegean region

1. Introduction

Greece depends mainly on the tourism economic sector; thus, various types of research have been conducted to maintain excellent product. The latest Gross National Product (GNP) surveys point out that shortly the offered tourism services need to be more catching and environmentally friendly in order to attract more investments and, thus, maintain their leading position in the Greek economy (Vandarakis et al., 2021; Vandarakis et al., 2019). The process of quantifying the tourist sector includes quantitative and qualitative variables. Greek territory has a variable landscape with 9,835 islands and more than 15,000 km length of shoreline, providing tourists with various options for their destination.

According to World Tourism Organization, Carrying Capacity is defined as "the maximum number of tourists who may visit a destination at the same time without affecting the economic, physical and social environment and not to limit the satisfaction of tourists" (UNEP, 1997). Consequently, for the last 20 years, tourism standards have tried to match the social requirements for better environmental quality, using novice ecological practices and taking advantage of cultural differences to benefit the region's tourist development. In order to determine the most appropriate-sustainable tourist load of a particular area, the World Tourism Organization (WTO, 2004) published a guidebook with many indicators of sustainable growth for tourism destinations. Similarly, UNEP-WTO (2005) recommended a guide with policies and indicator tools based on real cases, collected worldwide. European Commission (2006) also published a methodological manual for the measurement of the sustainable development of tourism.

A combination of indicators will be used, aiming to cover all the socio-economic-geomorphological perspectives delineating and describing the present state of the carrying capacity for tourism in the South Aegean Region (Fig. 1). The results of this study can contribute in order the best practices possible, to be recommended to the local administration, the decision makers and the stakeholders of each specific area for its sustainable development.

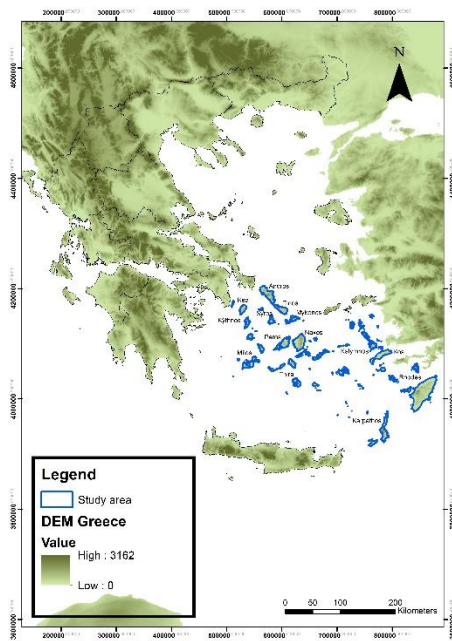


Figure 1: Location map

2. Regional Settings

The South Aegean Region (Fig. 1) has a diverse landscape, including extended sandy, tourist-orientated beaches, numerous archaeological sites and adequate infrastructures. The Cyclades are situated in the central part of the Aegean Sea on a shallow plateau (or platform) with water depths to be < 200 m (Pavlopoulos et al., 2010; Kapsimalis et al., 2009). The Plateau area is part of the Attic-Cycladic geological complex consisting of resistant to weathering, metamorphic and igneous rocks. Because of the lithology mentioned above, the sediment load that ends up to the shore and the very shallow marine areas is limited.

The Dodecanese islands are located in the southeastern part of the Aegean Sea, near the Hellenic Trench. A complicated fault-controlled relief system, including deep submarine troughs and high terrestrial ridges, shapes the landscape. In some islands, e.g. Rhodes, Karpathos and Kassos, active tectonics has uplifted shorelines up to 3.8 m since the mid-Holocene. The Dodecanese Archipelago is mostly formed by metamorphic and sedimentary rocks belonging to various geotectonic units, which supply non-cohesive sediments (mainly, sands) to the coastal zones.

3. Methodology

The estimation of Carrying Capacity Assessment in the field of tourism has included, over recent years, measurable physical and ecological-environmental parameters as well as demographic and socio-cultural factors that they are not so easy to be quantified (UNEP-PAP / RAC, 1997), in order the role of the administration in planning of the tourist development to be strengthened. This can be achieved by increasing or restricting the economic measures (tax policy, construction of large-scale public infrastructure systems, etc.) and the handling and utilization of the CCA, especially in developed countries

of the Mediterranean, mainly to which these guidelines are addressed. The general context for quantifying the Carrying Capacity Assessment for Mediterranean Tourism is based on three sets of parameters: the physical-ecological, socio-demographic and political-economic parameters.

The quantification of the available data gathered for the purpose of the current research was achieved by the application of the appropriate equations proposed by WTO (2004), PAP/RAC (1997), Varelas and Belias (2019), Vandarakis et al., (2019). The indicators selected for the Carrying Capacity Assessment are demonstrated below

Specifically,

1. TOI is calculated by the equation:

$$\frac{\text{Total Beds}}{\text{Population}} \times 100$$

2. TDI is calculated by the equation:

$$\frac{\text{Total beds} \times 100}{\text{Resident population} \times \text{total Area}}$$

3. The Indicator of Tourist Tolerant Population is calculated by the equation of:

$$\frac{\text{Number of tourists per peak day}}{\text{Population}}$$

TOI, TDI and TTPI describe the current situation of the tourist pressure on the islands studied to identify the encumbered sites and to apply more indexes to delineate in detail the endangered areas. The mathematical equations which calculate the indexes used are presented above; the TOI and TDI are self-explanatory, as for the TTPI, the “number of tourists per peak day” is the number of tourists plus the visitors from cruise traffic. These indicators were specially selected due to their applicability and description of the Greek reality, based on the availability of the data.

After the statistical analysis of the data possible scenarios for short and long-term sustainable development for the South Aegean Region have been proposed.

4. Results

According to the TOI classification, significant but not main tourism development presents the island of Kalymnos (25.66) in Dodecanese region (table 3). All the rest of the islands show Main and Great tourist development. Mykonos has the higher TOI score (303.10), which corresponds to great/almost exclusive tourist-based development according to the WTO (2004) and PAP / RAC (1997) methodology. The second most significant score is that of Thira (Santorini). Its score is estimated at 269.69 (Table 3), corresponding to great / almost exclusive tourist-based development. Subsequently, the rest of the islands which supplement the list of great/almost exclusive

tourist-based development are from Cyclades complex, Naxos (117.67), Paros (187.39), Milos (156.79), Kea-Kythnos (122.91) and from Dodecanese, Kos (167.10) and Karpathos (150.51) (Table 3). The rest of the islands, except Syros (39.43), also ranked among those with significant but not main tourism development, presenting scores corresponding to main tourist development concerning other economic sectors. Specifically, these islands are, Tinos (75.22), Andros (64.31) and Rhodes (94.02) (table 3).

Following the calculations, the scores of TDI, were separated into classes (scale from 0 to 2) according to the WTO (2004) and PAP / RAC (1997) directives. Based on the scale of TDI, low level of tourist services with significant prospects for development (Scale 1) presents the island of Kalymnos and Rhodes in Dodecanese region (table 3) and Syros, Tinos and Andros from Cyclades complex. Finally, the island offering the highest TDI is Mykonos (Scale 2), which according to proposed by WTO (2004), PAP/RAC (1997), Vandarakis et al., (2019), Varelas and Belias (2019), methodology, has overpassed the limit of the Carrying Capacity and it must take immediate actions the possible degradation of the tourist product to be controlled.

TTPI scale ranges from 0 to >2. Based on the calculations, the islands present low scores, corresponding to “low number of tourists - capability for the area to receive a larger number of visitors”. The lower scores are those of Kalymnos (0.26) and Rhodes (0.94) in the Dodecanese (Table 3) and Syros (0.39), Tinos (0.75) and Andros (0.64) in the Cyclades (Table 3). Finally, the islands with the highest scores, meaning “they exceed the carrying capacity—so the tourist traffic must be controlled,” are the well-known and most visited islands of Thira (2.70) and Mykonos (3.03) (Table 3). Visitors owning holiday homes have not been calculated.

4. Conclusions

Since the South Aegean Region's primary economic sector is tourism, assessing its carrying capacity is crucial. The application of international and local reference standards and methods were followed, selected mainly from the World Tourism Organization (WTO (2004) and UNEP-PAP / RAC (1997). The Carrying Capacity estimation is a useful and internationally tested tool to indicate the proper strategies policymakers should adopt for the area's environmentally friendly/sustainable growth in the next decades (Vandarakis et al., 2019). The analysis of social-economic-geomorphological characteristics of the South Aegean Region shows that the Cyclades receives the largest number of tourists in terms of total tourist accommodation and food service (INSETE 2019; ELSTAT 2018).

However, the unconditional growth of tourism can lead to a major environmental degradation. This risk is higher during periods of intense tourist concentration in the coastal areas, particularly in the top destinations of the

South Aegean Region. For example, the island of Santorini faces multi-variable dangers, social, and space privatization, and decline in purchasing power parity for local residents vs. visitors. Meanwhile, it is increasingly necessitating appropriate and effective tourism planning and management. On the other hand, Rhodes presents over tourism in specific areas and not in its totality which means that the most suitable management is the spread of the tourists in other areas in favor of the sustainability of the tourist product (Vandarakis et al., 2019).

Although the low values of TTPI scored by some popular travel destinations indicate that the specific Region can serve a larger number of tourists. The tourist load is not equally distributed throughout the study area since some islands attract more travelers than others. According to the results of the selected indicators, these islands are Mykonos, Thira, and Paros. TDI indicated the potential for tourism development in specific areas throughout the South Aegean Region but not for the overcrowded tourist islands (Mykonos, Thira). Following such indexes, each island's population and area (km²) play a significant role. Thus, many top priority islands, such as Rhodes, present “medium” tourism development with many opportunities; its tourism sector will be further augmented (Vandarakis et al., 2019).

It is necessary to design and implement a tourism development plan based on local environmental particularities (Vandarakis et al., 2021; Vandarakis et al., 2019). The main environmental pressure is placed on the littoral area of the islands, where the tourist burden is concentrated. At the same time, the exploitation of the beaches brings enormous revenues to the local community, around 784432€ per km of beach (INSETE, 2019) and to the state through taxation. For this reason, modern tourism development strategies should follow socially and financially multidimensional approaches to protect the natural environment and achieve different types of tourism throughout the year, mainly in areas that have already overcome their Carrying Capacity. Besides the natural environment, tourism development should follow different patterns not only the “sea and sun” directive, based on the extension of the tourist period due to local climatic conditions following global climate change should also be considered.

In order to achieve good environmental policies in tourism activities, obstacles must be diminished, including the pressure on the coastal environment, lack of waste-water management and incomplete spatial planning. The high quality of the services provided (in terms of human resources and infrastructures), combined with significant areas (culturally, environmentally, and geologically), give the South Aegean Region a major push over its competitors (INSETE, 2019). It is necessary, therefore, to have a concerted effort by the state and local administration to adopt alternative tourist models for sustainable development.

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Table 1: Results of the calculation of TOI, TDI and TTPI for the South Aegean Region. TOI, TDI and TTPI colors have been scaled according to limits proposed by various researchers

S/N	Island	Coastal Length (m)	Area (m ²)	Total Beds	Resident Population	TOI	TDI	TDI-scale	TTPI
1	Thira	76524.85	75943303.65	50926	18,883	269.69	2.70	1.50	2.70
2	Mykonos	127868.38	86327158.87	30716	10,134	303.10	3.03	2.00	3.03
3	Naxos	177748.19	428664393.82	24565	20,877	117.67	1.18	1.50	1.18
4	Paros	152478.71	195548174.34	27970	14,926	187.39	1.87	1.50	1.87
5	Milos	176838.15	157390922.98	15572	9,932	156.79	1.57	1.50	1.57
6	Syros	119433.45	84060589.74	8480	21,507	39.43	0.39	1.00	0.39
7	Tinos	159983.52	194768316.77	6496	8,636	75.22	0.75	1.00	0.75
8	Andros	254945.03	378976172.29	5930	9,221	64.31	0.64	1.00	0.64
9	Kea-Kythnos	248187.77	230531802.93	4807	3,911	122.91	1.23	1.50	1.23
10	Rhodes	298603.78	1404009537.92	112664	119,830	94.02	0.94	1.00	0.94
11	Kos	141693.99	287226645.97	57475	34,396	167.10	1.67	1.50	1.67
12	Karpathos	237705.92	300189988.73	11002	7,310	150.51	1.51	1.50	1.51
13	Kalymnos	133102.70	110432006.23	7557	29,452	25.66	0.26	1.00	0.26

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