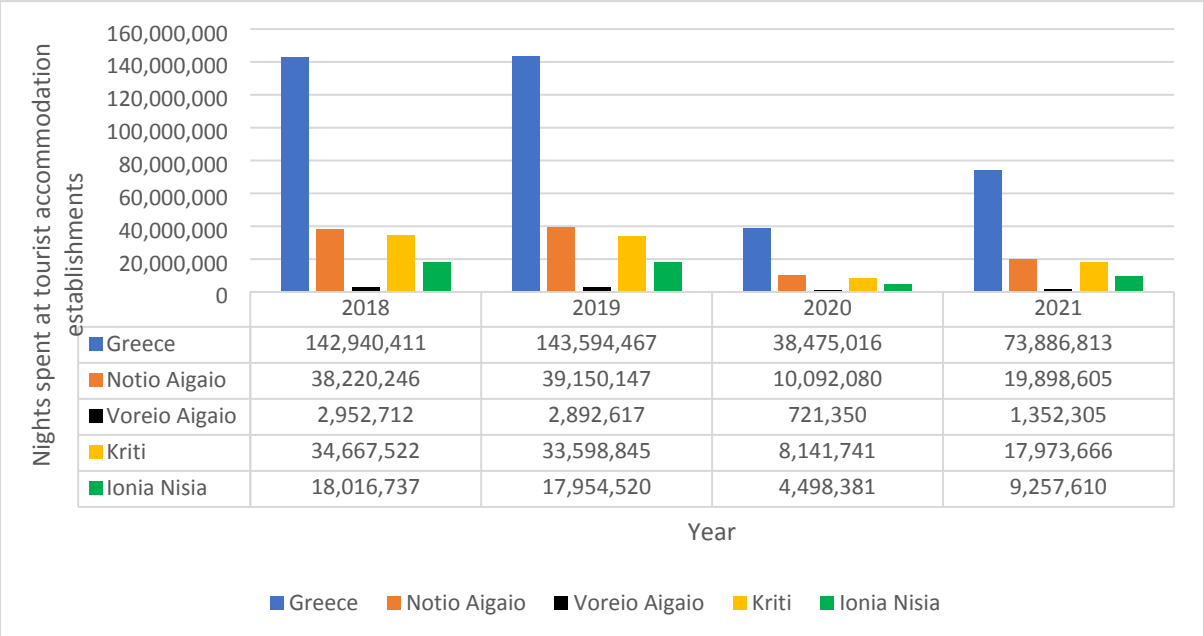
Unveiling Touristification Patterns in Greek Islands: A Composite Index Approach

Journal:	*Journal of Hospitality and Tourism Horizons*
Manuscript ID	JHTH-08-2025-0114
Manuscript Type:	Research Paper
Keywords:	Islands, Touristification, Composite Index, Tourism Demand, Tourism Supply, Aegean Regions

Figures



	2018	2019	2020	2021
Greece	142,940,411	143,594,467	38,475,016	73,886,813
Notio Aigaio	38,220,246	39,150,147	10,092,080	19,898,605
Voreio Aigaio	2,952,712	2,892,617	721,350	1,352,305
Kriti	34,667,522	33,598,845	8,141,741	17,973,666
Ionia Nisia	18,016,737	17,954,520	4,498,381	9,257,610

Figure 1: Nights spent at tourist accommodation establishments.

Data Source: EUROSTAT

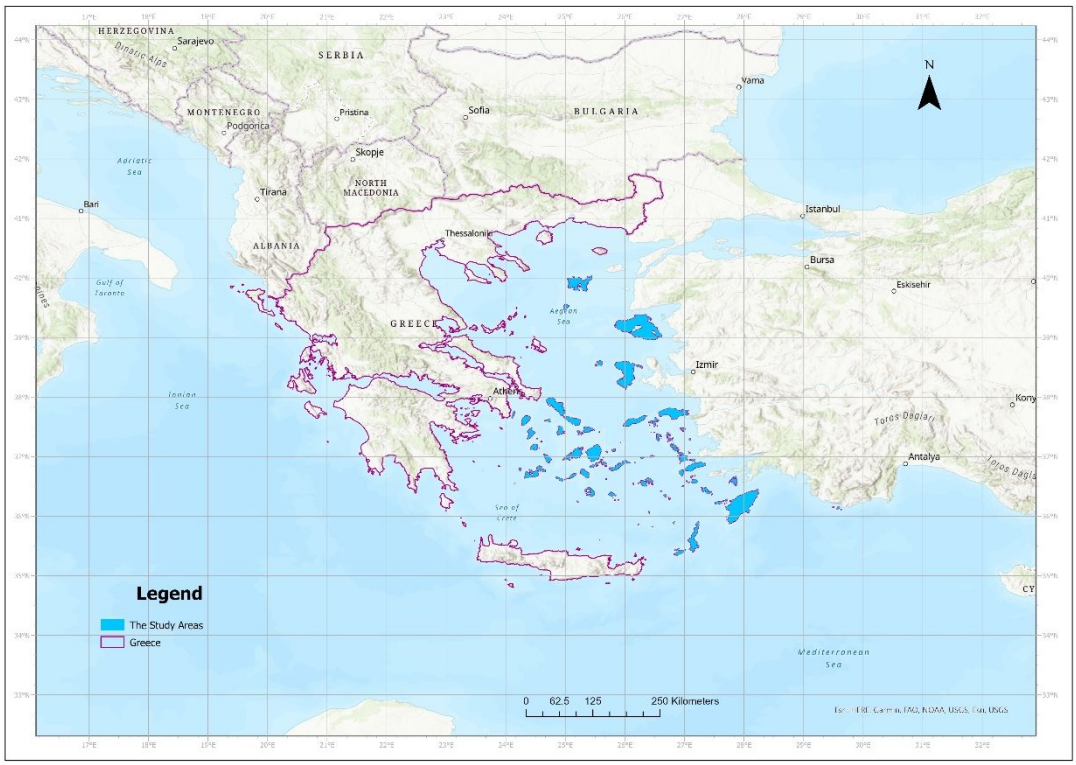


Figure 2: The study area in its national settings

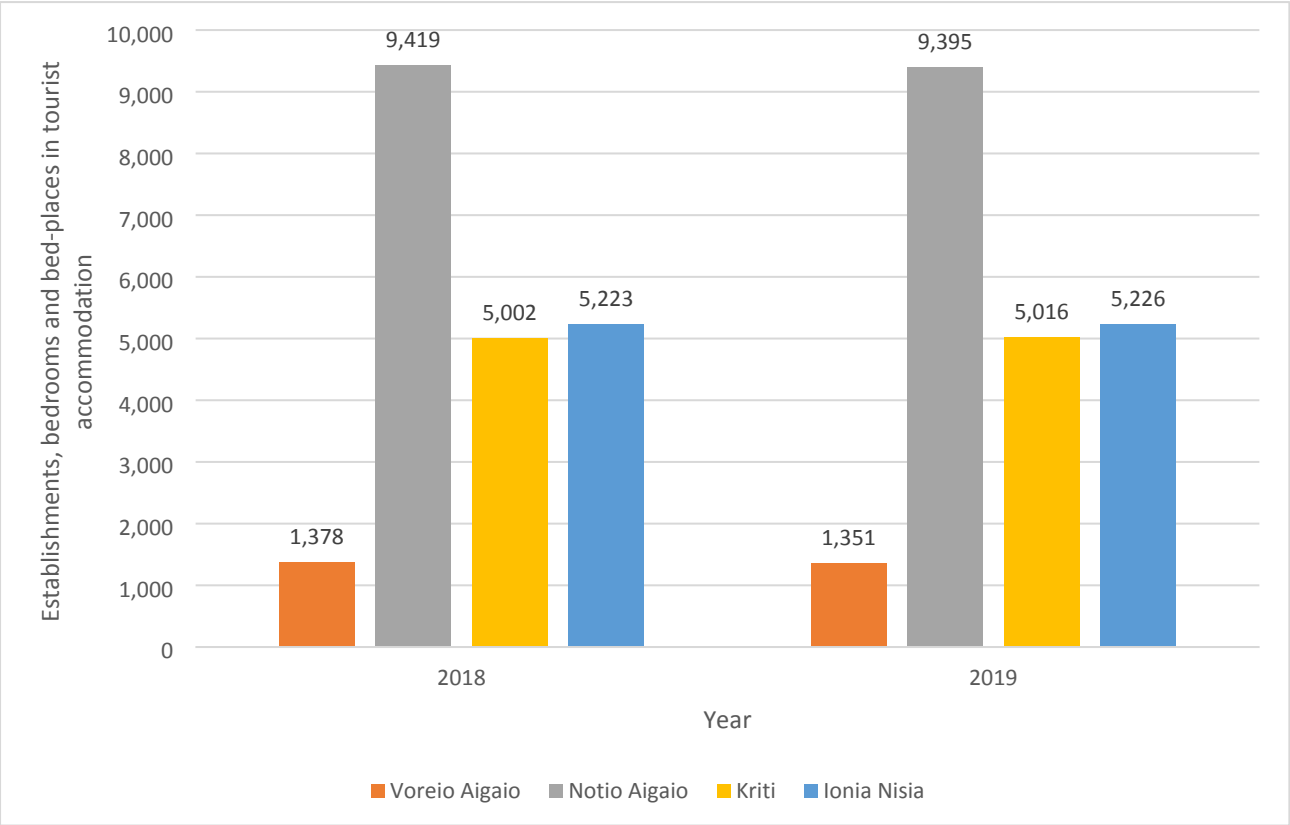


Figure 3: Establishments, bedrooms and bed-places in tourist accommodation.

Data Source: EUROSTAT

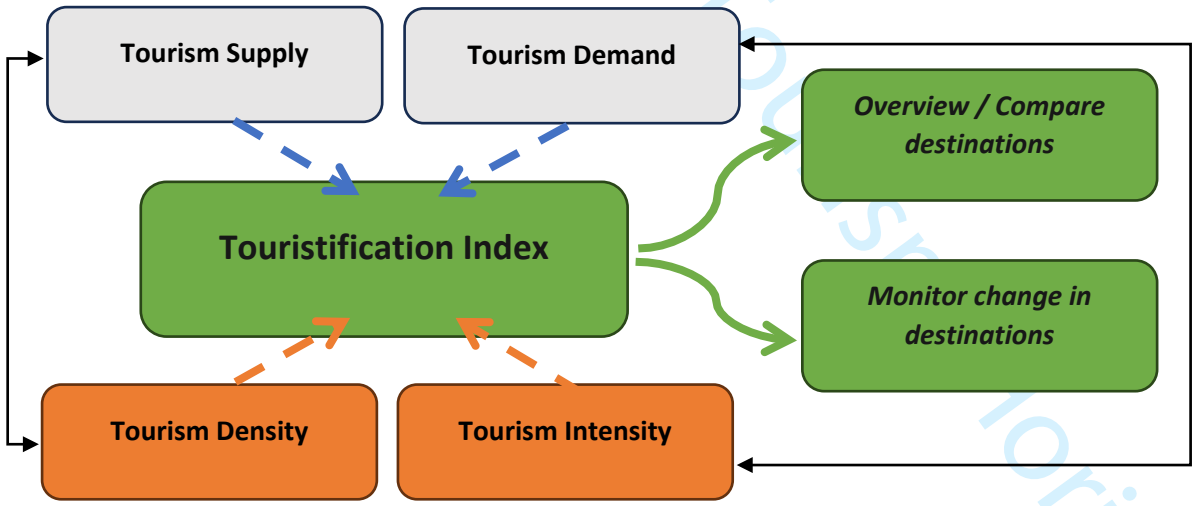


Figure 4: Framework

Source: Authors

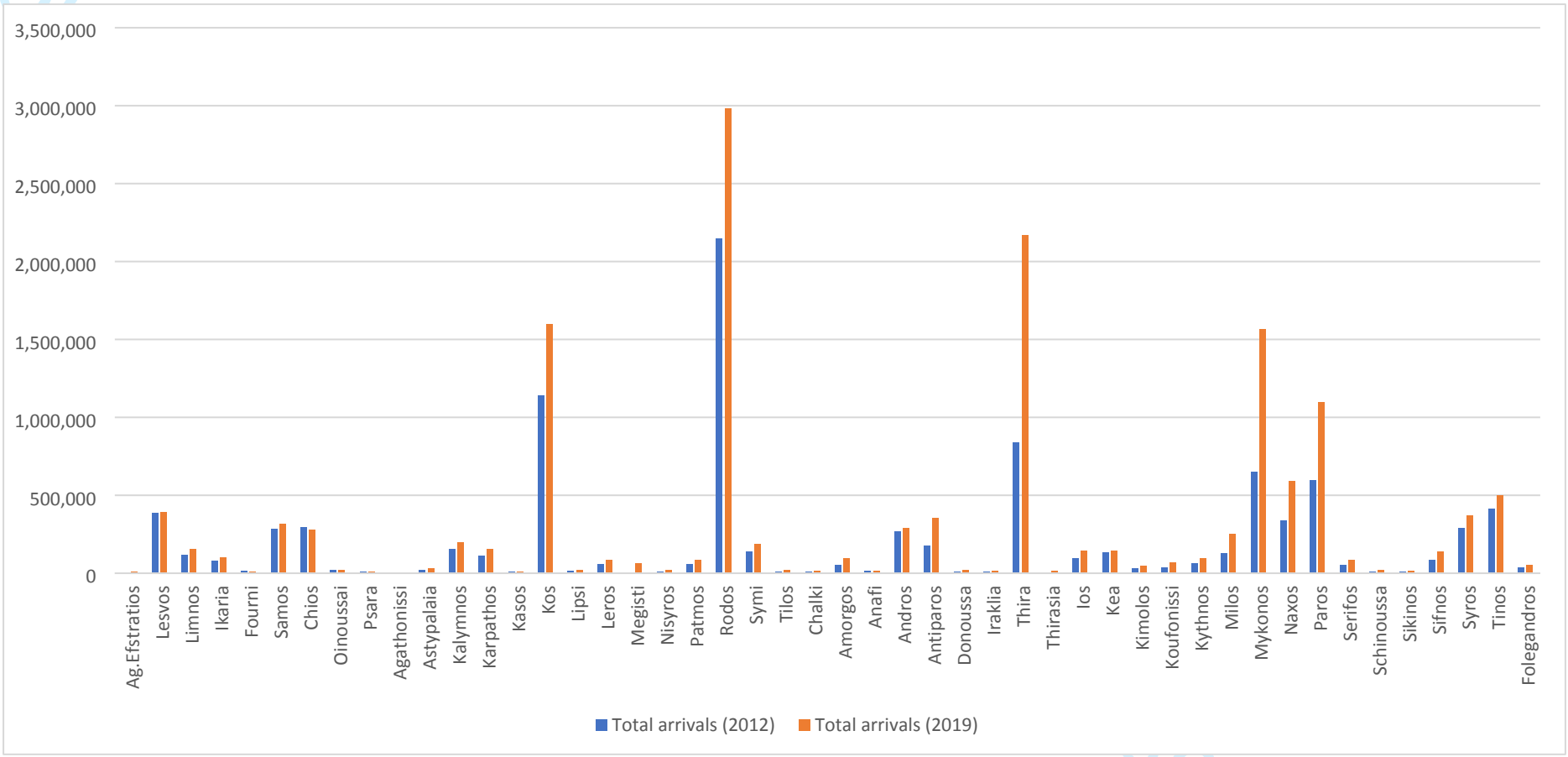


Figure 5: Tourist Arrival (2012 and 2019)

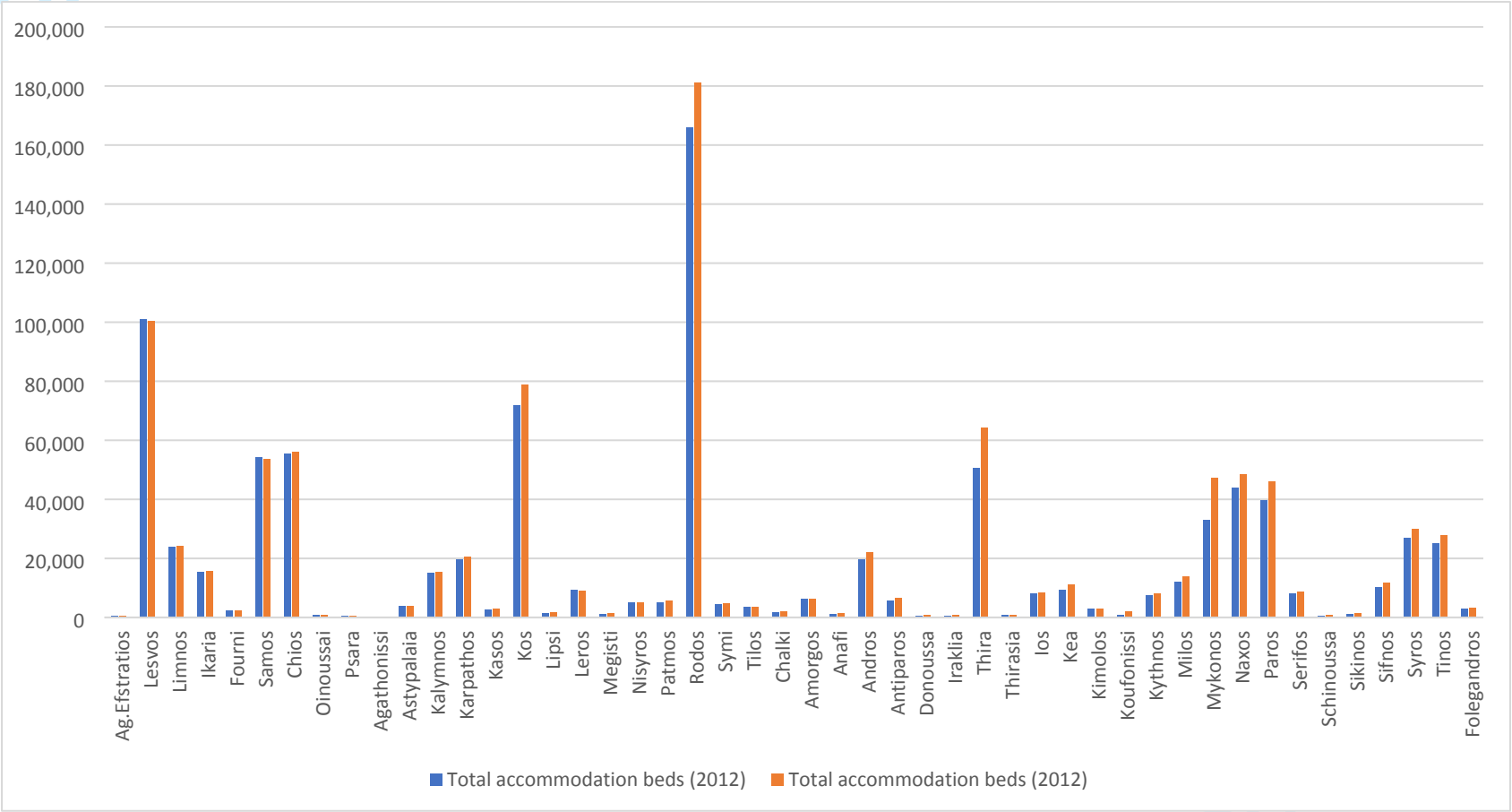


Figure 6: Total accommodation beds (2012 and 2019)

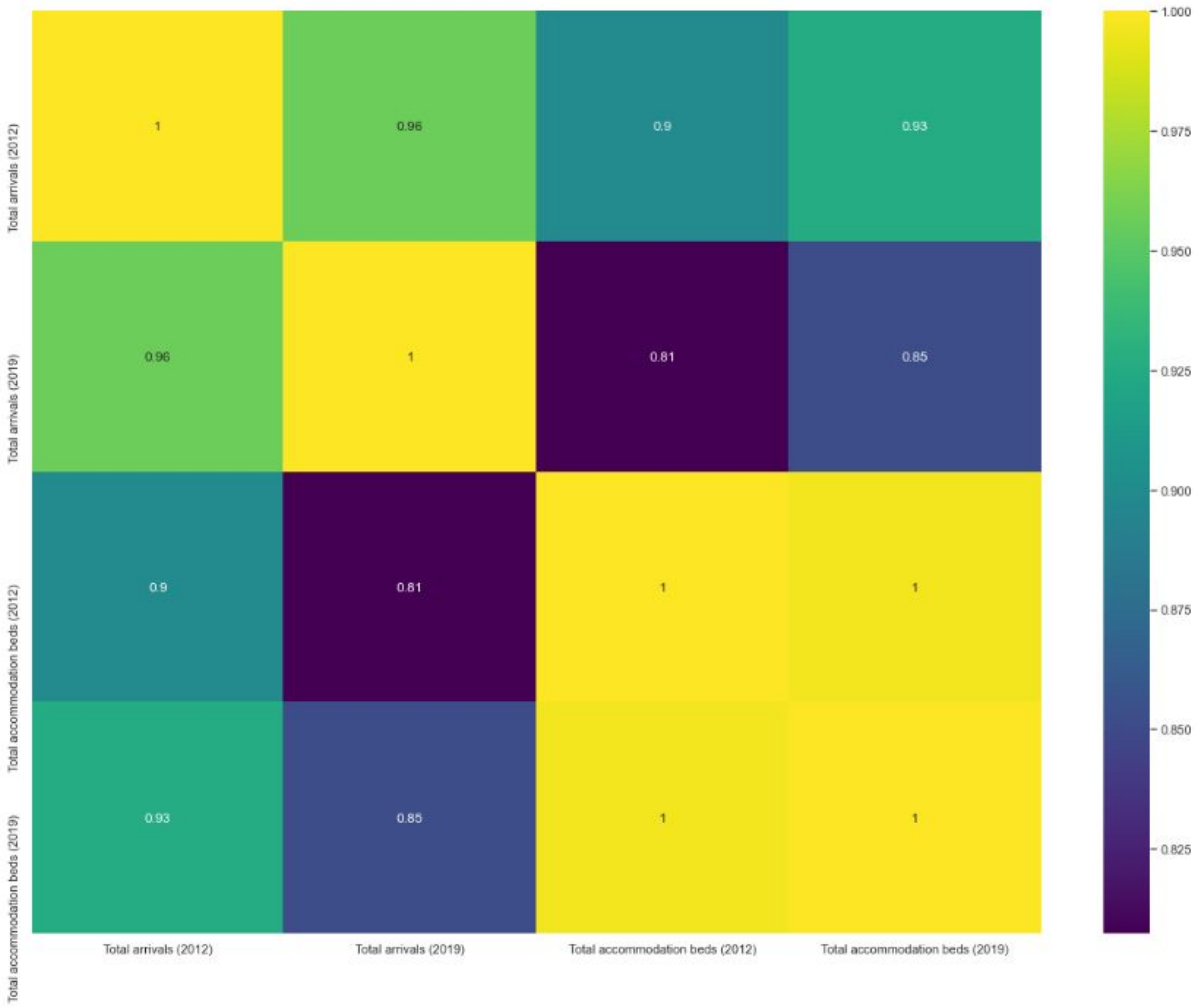


Figure 7: Correlation Heatmap (Total arrivals and Total accommodation beds, 2012 and 2019)

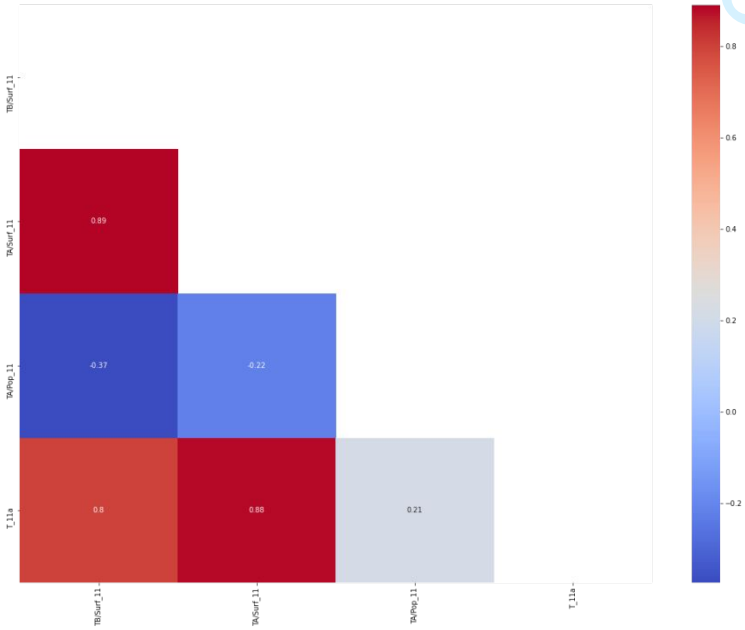


Figure 8: Correlation analysis between individual indicators and the touristification index (2012)

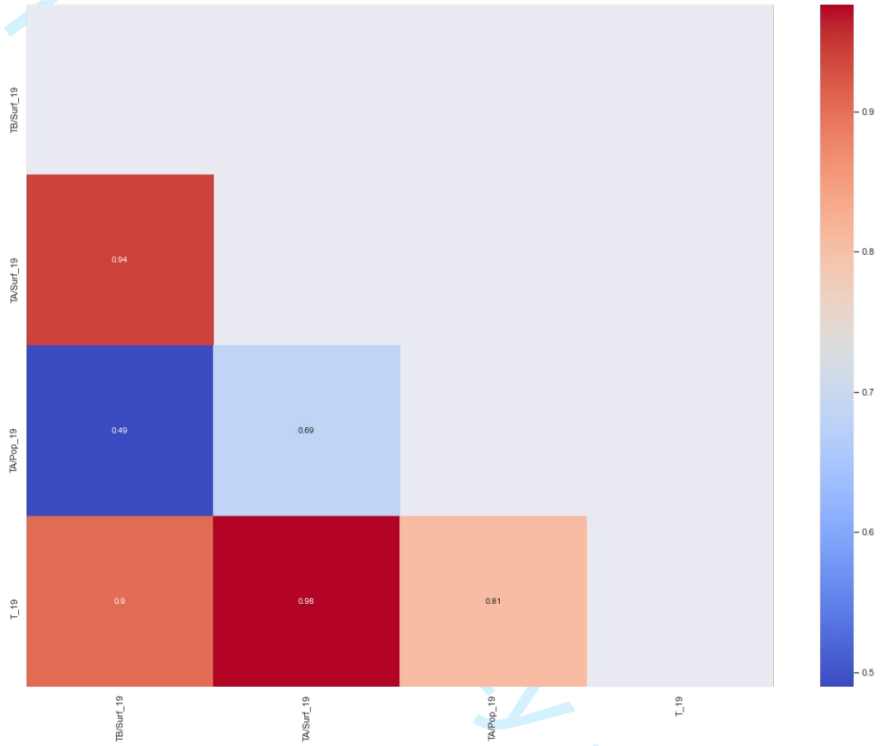


Figure 9: Correlation analysis between individual indicators and the touristification index (2019)

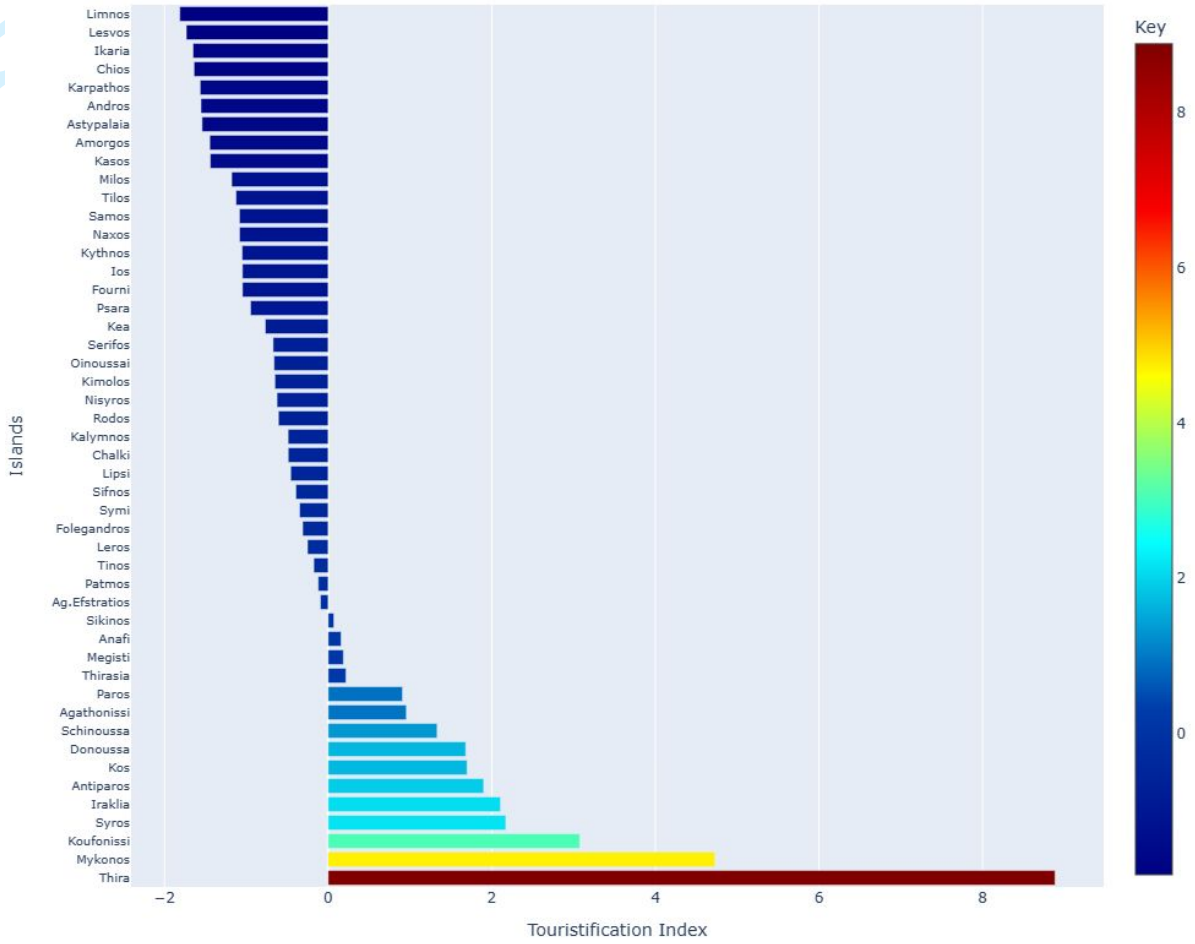


Figure 10: Touristification Index (2012)

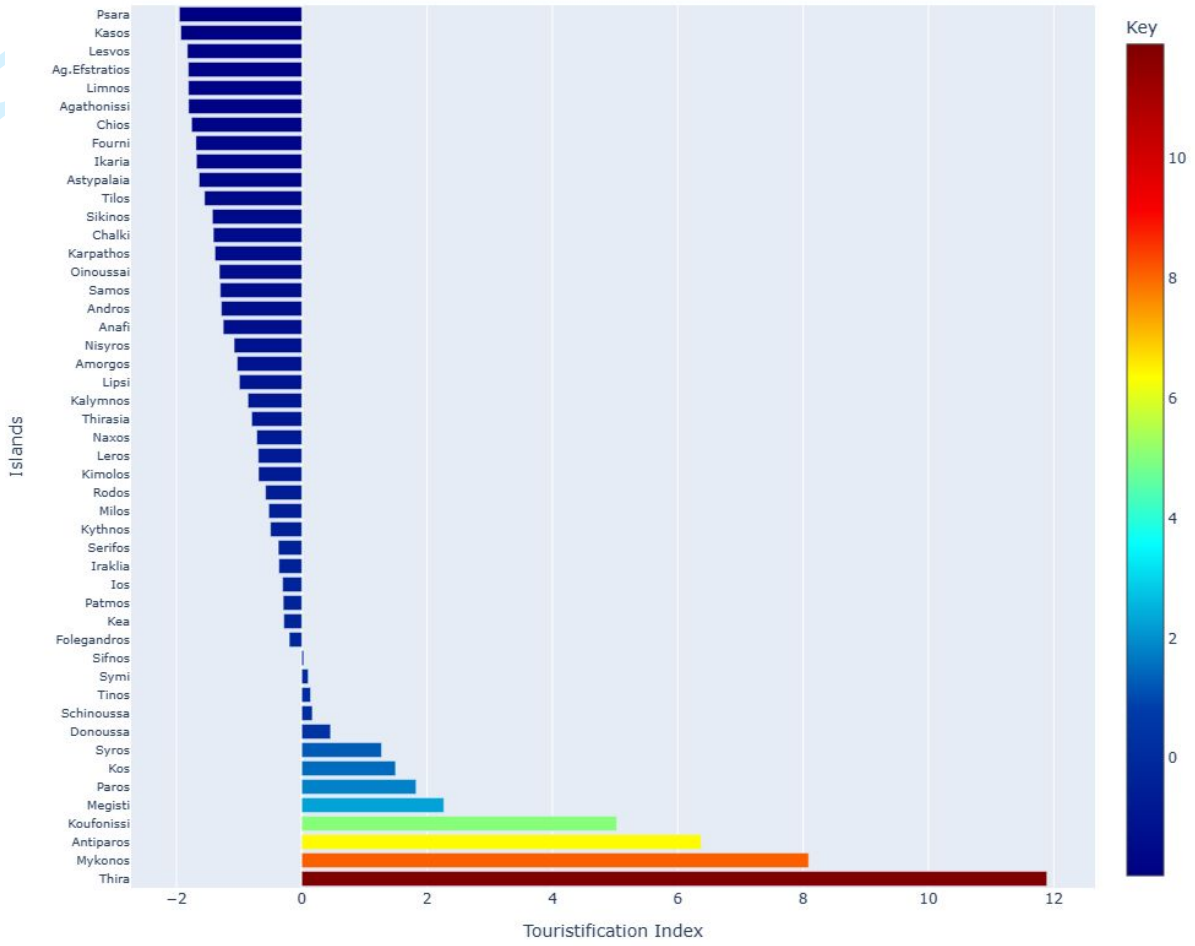


Figure 11: Touristification Index (2019)

Unveiling Touristification Patterns in Greek Islands: A Composite Index Approach

Abstract

Purpose

Many islands are currently undergoing a process of touristification, propelled by the forces of globalisation. The primary objective of this research is to develop a composite index for assessing and monitoring touristification in the south and north Aegean regions of Greece.

Design/methodology/approach

It employs data from the Aegean Observatory Data Report and Exploratory Factor Analysis to select both tourism supply and demand variables in 2011/2012 and 2019. The study highlights the complex interplay between tourism demand and supply in shaping the touristification levels of different islands.

Findings

The findings of the study suggest that touristification on Greek islands is characterised by the perpetuation of existing hierarchical dynamics among popular destinations (Thira and Mykonos), and expansion into previously non-touristic islands. The study categorised touristified islands into three groups: those with international airports, those with domestic airports, and those without direct airport access.

Originality/value

The composite index may serve as a valuable tool for policymakers and planners in identifying destinations that require attention or intervention. Moreover, the composite index adopted in this study has the potential for broader applicability, facilitating comparative analyses and contributing to the body of knowledge on touristification in other island contexts worldwide.

Keywords: Islands, Touristification, Composite Index, Aegean Regions, Tourism Demand and Supply

1. Introduction

Many islands are currently undergoing a process of touristification, propelled by the forces of globalisation, and the intensified competition in the aviation market, which has shortened physical distances and made travel more affordable and accessible (Andrade & Costa, 2020). The insular communities' unique natural and cultural environments, proximity to the sea, and distinctive experiences in the context of islandness further contribute to transforming islands into attractive tourist destinations and sought-after products catering to the demands of tourists and lifestyle migrants seeking short breaks or vacation experiences (Gonzales-Mantilla et al., 2022; Chi & Liu, 2023).

The fast expansion of the tourist sector has significantly contributed to such communities' economies while also sustaining their socioeconomic structure (Ng et al., 2017). For instance, Fei et al. (2021) argue that tourism has emerged as a key economic sector in over 70 island nations, with over 40% of island destinations depending on tourism as a major source of revenue, accounting for more than 20% of their Gross Domestic Product. However, as the popularity of these destinations grows, so do the undesired outcomes associated with touristification. These include displacement, skyrocketing housing prices, changes in the availability and cost of local services, changes in the use of public space, compromised air quality, shifts in neighbourhood dynamics with an influx of tourists, increased night-time activities, and alterations in cultural identity and heritage (Andrade & Costa, 2020; Jover & Díaz-Parra, 2020).

According to Porfido et al. (2023), the early phase of touristification involves the gradual development and manifestation of tourism-related characteristics within a specific territory. Subsequently, the region's economic activities gradually shift towards reliance on the tourism sector. However, these economic and spatial changes may evoke negative implications if not monitored. For instance, the United Nations World Tourism Organisation (UNWTO) (2017) maintains that an unregulated growth in tourist arrivals can undermine the tourism industry's long-term sustainability, thus diminishing its ability to contribute to future GDP.

The manifestation of touristification threats is considered more significant in islands due to their limited carrying capacity, ecological fragility and geographically limited land masses (Lagarias et al., 2023). Ojeda and Kieffer (2020) emphasise the significance of conducting a

territorial analysis to understand the impact of touristification, as the extent of these effects largely relies on the distinctive attributes of each specific territory. Saarinen et al. (2017) propose an approach using indicators to understand how tourism activity evolves within a specific region. The significance of indicators goes beyond merely tracking changes and identifying trends (Volo, 2015). They are also useful for setting targets and anticipating future scenarios (Croes, 2011; Crouch, 2011; Dwyer & Kim, 2003). Often though, and especially when the need arises to compare many destinations and also to monitor change, sets of multiple indicators may prove too complex for an overview. Therefore, the development and use of a composite index becomes valuable, as it allows for a nuanced and systematic analysis of the complexity of interactions and territorial dynamics involved in the process of touristification within a targeted territory. By employing a composite index, one can mathematically aggregate variables to capture chosen dimensions of the phenomenon, often evaluated in isolation (Nardo et al., 2005).

Despite the potential of composite indices, Buitrago & Yñiguez (2021) highlight the absence of widely accepted methodologies for measuring excess tourism, particularly with respect to comparative assessment across regions. Additionally, preventing the onset of touristification, mitigating its negative impacts, or formulating adaptive strategies requires an initial evaluation of the phenomenon (Fedyk et al., 2020). Accordingly, this study seeks to develop a composite index to assess the variations and disparities among Greek islands, highlighting areas of high and low touristification.

The composite index may serve as a valuable tool for policymakers and planners in identifying areas that require attention or intervention. Moreover, the composite index adopted in this study has the potential for broader applicability, facilitating comparative analyses and contributing to the body of knowledge on touristification in other island contexts worldwide.

1.1 Demystifying Touristification

Various concepts have arisen in attempts to characterise the effects of tourism on destinations undergoing significant tourism development. Among these concepts, "overtourism" has gained prominence, particularly concerning urban areas where the influx of visitors exceeds the destination's social, economic, physical, environmental, infrastructure, perceptual, and sociocultural carrying capacity (Swarbrooke, 1999; Ojeda and Kieffer, 2020). However, this concept lacks a standardised framework for measurement (Koens et al., 2018; Muler et al., 2018; Namberger et al., 2019) and has mostly been limited to single sites (Sæþórsdóttir et al., 2020), making it challenging to assess and compare the extent of tourism development across different destinations and limiting objective assessment of the degree of touristification and its impacts.

The term's urban-centric perspective overlooks the effects of touristification in rural, remote and generally less urban areas. Jansen-Verbeke (2009) and Córdoba and García de Fuentes (2003) argue that tourism materialises the effects of globalisation on local spaces. Local spaces may experience similar negative consequences associated with tourism development, but they seem not to be adequately captured within the framework of overtourism. However, recent discussions have begun to address overtourism in the context of non-urban locations (Butler, 2020; Ghaderi) and islands (Lagarias et al., 2023), highlighting the challenges these environments face due to increasing visitor numbers.

Another term commonly used to describe tourism development's impact is "tourism-led gentrification." This term refers to a phenomenon in which the transformation of housing units into vacation rentals or commercial properties leads to an increase in the cost of living and rents within a destination. Thus, local residents are often displaced or compelled to relocate from these areas, making room for higher-income populations to replace them (Co´cola-Gant, 2016; Yrigoy, 2017). However, this definition does not fully capture the broader phenomenon of touristification. For instance, Jover & Díaz-Parra (2020) contend that the definition's concentration on the displacement of local residents fails to capture the nuanced, broader material and symbolic impacts resulting from mass tourism on a specific territory, suggesting the need for a broader conceptualisation. Therefore, they argue that the concept of touristification provides a more nuanced understanding of the transformative processes occurring in destinations undergoing significant overtourism (Milano et al., 2024).

2. Materials and Methods

2.1 The study area

Greece, with approximately 11 million inhabitants, is distinguished by its diverse archipelago of more than 220 inhabited islands. These islands house approximately 15% of the country's population. Its extensive coastline stretches along three prominent seas: the southern Sea of Crete, the western Ionian Sea, and the eastern North and South Aegean Sea (Ballis et al., 2018).

The Greek islands have been a primary destination for tourists, consistently attracting a significant portion of visitors and accommodating a substantial number of overnight stays. For instance, between 2018 and 2021 (Figure 1), the island regions in Greece, specifically South Aegean (Notio Aigaio), North Aegean (Voreio Aigaio), Crete (Kriti) and Ionian Islands (Ionia Nisia), consistently accounted for over 60% of the total nights spent at tourist accommodation establishments in Greece each year. Despite the allure and popularity of Greek island regions among tourists, the extent of touristification still remains elusive.

Figure 1: Nights spent at tourist accommodation establishments.

Data Source: EUROSTAT

Out of the four island regions in Greece, this study focuses on the South Aegean (Notio Aigaio) and North Aegean (Voreio Aigaio) (Figure 2). The former is composed of 39 islands, while the latter is composed of nine island communities (Table I). Accordingly, these regions (N = 48) offer a diverse range of island communities, each with its own distinct characteristics. This diversity provides an opportunity to examine how touristification manifests differently in various island settings.

Figure 2: The study area in its national settings

Table I: List of Islands in the Regions

The selection of the South Aegean (Notio Aigaio) and North Aegean (Voreio Aigaio) regions for this study on touristification in Greek islands is also substantiated by their substantial contribution to the overall tourism industry. In both 2018 and 2019, these regions, collectively, accounted for more than 51.4% and 51.2% of the total establishments, bedrooms, and bed-places in the Greek Island region (Figure 3). These figures highlight the prevalence of a well-established tourism industry in these areas, making them compelling case studies for examining the patterns of touristification in the context of the Greek Islands.

Figure 3: Establishments, bedrooms and bed-places in tourist accommodation.

Data Source: EUROSTAT

2.2 Method

The first section of the analysis was carried out using relevant descriptive and inferential statistics to present an overview of tourism demand and supply across the islands. Furthermore, the construction of a composite index follows a methodological process consisting of seven distinct stages (OECD, 2008; Dobbie & Dail, 2013). The seven stages are as follows:

Development of a Theoretical framework

The initial step in constructing a composite index is establishing a solid theoretical framework that defines the variables to be included (Dobbie & Dail, 2013). This framework provides the conceptual boundaries and objectives of the index, ensuring that it encompasses the pertinent dimensions of touristification. In this regard, the framework proposed in this investigation is based on defining quantitative criteria for measuring touristification by combining tourism supply and demand indicators (Figure 4).

Figure 4: Framework

Source: Authors

According to Song et al. (2012), the arrival of tourists is the most adopted variable for measuring tourism demand. However, tourist demand can vary in terms of its origin, including domestic, inbound, or outbound visitors. Additionally, demand can be categorised based on the mode of transportation or specific tourist attractions. Other relevant variables include bookings or revenue related to accommodation, tourism receipts (or expenditures for outbound tourism), and the duration of stay at the destination or in specific accommodations. On the other hand, the assessment of tourism supply entails evaluating the capacity of lodging establishments, which encompasses a diverse range of accommodation options such as hotels, boarding houses, inns, lodging houses, motels, apartment hotels, tourist villages, and tourist apartments (Provenzano, 2012) and counts of catering and accommodation companies in a destination (Cooper & Hall, 2008). Both tourism demand and supply are relevant for understanding tourism intensity and density in the area under analysis.

Selection of Indicators

In this stage, a careful selection of indicators is made based on their relevance to the phenomenon of touristification and divided into sub-groups in accordance with the theoretical framework presented in the initial stage (OECD, 2008). Therefore, pertinent data from the available data in the Aegean Observatory Data Report, covering the period from 2011/2012 to 2019, was selected. Buitrago and Yñiguez (2021) suggest that instead of relying on absolute indicators, the use of relative indicators that consider tourism dimensions and variables associated with the local population and territory provides a more accurate assessment of touristification. Based on the available reliable data, the selected indicators for analysis are presented in Table II.

Table II: Selected Indicators

Imputation of missing data

Horton and Lipsitz (2001) suggest that incomplete datasets can undermine the reliability and accuracy of research findings, leading to several negative implications, including efficiency losses, increased complexity in data treatment and analysis procedures, and potential bias arising from discrepancies between observed and unobserved data. Soto and Schuschny (2009) propose that artificial imputations can be employed when the missing data constitute less than 15% of the overall available data.

To fill in the missing values, a percentile-based imputation method is employed. It involves determining the percentile of each incomplete observation and identifying other data points within the same percentile range. Subsequently, the missing values are imputed with the average value of the variables corresponding to the identified percentile. This approach provides a more nuanced and context-sensitive imputation, capturing the inherent variability and characteristics of the dataset, ensuring that the dataset is as complete as possible before analysis and reducing the potential bias resulting from missing data.

Data normalisation

To ensure the comparability of indicators, data normalisation is performed. This involves transforming the variables to a common scale or range. Thus, z-scores were computed to standardise the variables:

$$z = (x - \bar{x}) / s$$

Where: z = z-score, x = individual data point, $\bar{x}$ = sample mean and s = sample standard deviation

Using z-scores is considered a robust and suitable approach, particularly when examining the influence of outliers on composite indices. By calculating z-scores, indicators with higher values exert a proportionally greater impact on the final index, allowing for a comprehensive evaluation of their relative contributions (Gialis & Taylor, 2016).

Removal of variables

Prior to constructing composite indicators, it is critical to conduct multivariate analysis to validate the relationships among variables, preventing the risk of selecting variables that lack

substantial connections (OECD, 2008). Following the imputation of missing data, the complete dataset comprising eight indicators (Table II) underwent statistical analysis.

To ensure the quality of the composite index, an explanatory factor analysis (EFA) was conducted, summarising the amount of information contained within the original set of variables and eliminating those that did not significantly contribute to the quality of the index (Soto & Schuschny, 2009). Specifically, variables with a sampling accuracy measure below 0.50, including TB/Pop_11 and TB/Pop_19, were excluded from further analysis. Subsequently, the factor analysis was performed again using the remaining variables with acceptable sampling accuracy measures (Table III). The variables used in the subsequent factor analysis cumulatively account for over 75% (Table IV) of the total explained variance, indicating that the retained indicators are relevant and explanatory (Marôco, 2014). The KMO (Kaiser-Meyer-Olkin) coefficient, which measures sampling adequacy, exhibits a value greater than the minimum threshold of 0.500, indicating a satisfactory level of sampling adequacy. Furthermore, the Bartlett test, employed to assess the homogeneity of variance, reveals a significant correlation among the variables, with a significance level of 0.0001 (Table V).

Table III: Factor Analysis after removal of TB/Pop_11 and TB/Pop_19

Table IV: Component Statistics

Table V: KMO and Bartlett's Test

Weighting

Weighting reflects the relative significance of each variable in contributing to the overall index (García-Sánchez et al., 2015). The allocation of weights within a composite indicator is a flexible process guided by the researcher's criteria. These criteria encompass aspects such as the significance, reliability, and unique properties of each variable (Munda and Nardo, 2009). Consequently, the weights assigned to the variables can differ, reflecting their individual contributions to the composite index (Freudenberg, 2003). In this study, equal weights were assigned to both tourism demand and supply indicators based on the assumption that these two aspects are interconnected and mutually significant in understanding touristification.

This approach was not intended to oversimplify the phenomenon but to acknowledge the inherent interrelationship between tourism demand and supply. Thus, assigning unequal weights could result in an incomplete or biased assessment of the phenomenon.

Aggregation

The final stage involves aggregating the normalised and weighted variables to create the composite index. Various aggregation methods, such as linear, geometric mean, or weighted averages, can be employed depending on the variables' nature and the index's desired interpretation (OECD, 2008). In this study, linear aggregation is considered appropriate in constructing the composite index because tourism demand and supply are complementary components of the tourism system. They represent different facets of the same phenomenon and contribute to understanding touristification. Therefore, linear aggregation allows for a representation of their combined influence by considering their additive effects. The index calculated in 2012, was denoted as T_11a. The index calculated in 2019 was labelled as TI_19.

After aggregating the variables, a correlation analysis was performed to examine their relationship with the touristification index.

3. Results and Discussion

3.1 An Overview of Tourism Activity in the South and North Aegean Regions

Tourist Arrival

In 2012 (Figure 5), the top 10 islands by volume of arrivals included Rodos (2,148,245), Kos (1,139,491), Thira (835,943), Mykonos (646,795), Paros (593,764), Tinos (410,321), Lesvos (387,741), Naxos (337,594), Chios (295,053), and Syros (290,787). Conversely, the bottom 10 islands with the lowest number of arrivals were Kasos (9,679), Sikinos (9,181), Chalki (8,505), Psara (8,203), Iraklia (7,792), Tilos (7,642), Ag.Efstratios (5,372), Megisti (4,650), Agathonissi (3,920), and Thirasia (297).

Certain changes were observed in the rankings in 2019. Rodos remained in the first position with a significant increase in total arrivals, reaching 2,980,217 (Figure 5). Thira (2,166,296) and Kos (1,595,654) switched positions, with Thira moving up to second place. Mykonos (1,565,558) and Paros (1,095,564) maintained their respective positions in the top 10. While Naxos (592,186), Tinos (500,681), Lesvos (391,992), and Syros (369,756) retained their

positions among the top 10 islands in terms of tourist arrivals, Chios was replaced by Antiparos (353,120). Concerning the bottom 10 islands, Iraklia (13,283), Thirasia (12,737), Sikinos (10,964), Chalki (10,924), Kasos (8,343), Psara (8,222), Ag.Efstratios (7,220), and Agathonissi (4,613) continued to represent the islands with the lowest number of visitors. Furthermore, Anafi (13,598) and Fourni (8,739) emerged as new additions to the list of least visited islands.

Rodos, Kos, Thira, Mykonos and Paros enjoyed consistent popularity among tourists throughout the studied period, with tourist arrival volume ranging from 303.45 - 1097.87% of the average (Table VI). While these islands maintained their positions as top destinations, peripheral and relatively small islands, particularly Thirasia (4188.55%) and Megisti (1234.04%), experienced substantial increases in tourist arrivals between 2012 and 2019 (Table VI). The surge in tourist arrivals in Thirasia can be attributed to its geographical proximity to Thira (previously identified as a primary destination).

A small influx of tourists can create challenges in non-urban areas, where the number of visitors may far exceed what local communities desire or anticipate, especially if they have previously experienced only limited levels of tourism (Butler, 2020). Therefore, such explosive growth in Thirasia, if unanticipated, desired or left unmanaged, poses potential social, cultural and environmental challenges to the island despite being marginal in absolute tourist arrival volume.

The findings also reveal that, with the exception of Fourni (-44.26%), Kasos (-13.80%), and Chios (-5.87%), all the islands in the region experienced an increase in tourist arrivals during the period from 2012 to 2019. This observation suggests that most of the islands remained attractive to tourists and continued to thrive as destinations.

Figure 5: Tourist Arrival (2012 and 2019)

Accommodation Beds

In 2012 (Figure 6), the distribution of accommodation beds across the islands revealed that Rodos (165,800), Lesvos (100,994), Kos (71,771), Chios (55,527), Samos (54,203), Thira (50,616), Naxos (43,742), Paros (39,464), Mykonos (33,081), and Syros (26,941) are the top 10 destinations in terms of bed capacity (Figure 3). Notably, nine (Rodos, Lesvos, Kos, Thira, Mykonos, Paros, Naxos, Chios and Syros) out of the top 10 islands ranked high in terms of tourist arrivals.

On the other hand, the bottom 10 islands in terms of accommodation beds were Sikinos, Thirasia, Oinoussai, Koufonissi, Ag.Efstratios, Schinoussa, Psara, Iraklia, Donoussa, and Agathonissi, with recorded figures of 1,133, 819, 783, 766, 521, 477, 433, 375, 375, and 139 beds, respectively. Unsurprisingly, six (Sikinos, Thirasia, Ag.Efstratios, Psara, Iraklia, Agathonissi) out of ten of these island destinations ranked low in terms of tourist arrivals in 2012. As expected, destinations with higher tourist arrivals tend to have a greater number of accommodation beds, while less popular destinations exhibit lower bed capacities.

Among the top 10 islands with the highest number of accommodation beds in 2019, Rodos emerged as the leader with 181,038 beds, followed by Lesvos (100,264), Kos (78,811), Thira (64,266), Chios (55,866), Samos (53,697), Naxos (48,365), Mykonos (47,153), Paros (45,856), and Syros (29,983). With accommodation infrastructure far exceeding the average (Table VI), eight out of these top 10 islands, namely Rodos, Lesvos, Kos, Thira, Naxos, Mykonos, Paros, and Syros, also ranked among the top 10 islands with the most tourist arrivals. On the other end of the spectrum, the bottom 10 islands in terms of accommodation beds were identified as Anafi (1,260), Megisti (1,223), Thirasia (813), Oinoussai (783), Iraklia (764), Schinoussa (662), Donoussa (627), Ag.Efstratios (533), Psara (461), and Agathonissi (145). Six of these islands, namely Anafi, Thirasia, Iraklia, Ag.Efstratios, Psara, and Agathonissi, also coincide with the bottom 10 islands with low tourist arrivals.

The coexistence of similar patterns in rankings for both accommodation beds and tourist arrivals across multiple islands indicates a reciprocal relationship between tourism demand and supply, driven by accumulated advantages in infrastructure and brand recognition. For instance, the strong positive correlation between tourist arrivals and accommodation beds over the study periods (Figure 7) suggests that increased tourism demand, represented by

higher visitor numbers, is met with a corresponding increase in the supply of accommodation beds. In other words, the sector adapts to accommodate the influx of tourists. While this expansion may support economic growth and employment opportunities, it also raises concerns about the carrying capacity of the islands. Furthermore, the correlation between demand (tourist arrivals) and supply (accommodation beds) in the tourism sector, particularly in islands with high tourist arrivals, suggests that tourism is a strong economic activity on the islands. However, this raises concerns requiring careful monitoring to avoid potential negative implications (Porfido et al., 2023). The increased influx of tourists may lead to overcrowding, congestion, and strain on local infrastructure and services. Environmental impacts, such as increased energy consumption, waste generation, and pollution, may also arise. Moreover, local communities' social and cultural fabric can be disrupted, and issues such as loss of authenticity and conflicts between tourists and residents may emerge.

Figure 6: Total accommodation beds (2012 and 2019)

Figure 7: Correlation Heatmap (Total arrivals and Total accommodation beds, 2012 and 2019)

3.2 The Touristification Index

The result (Figure 8) of the correlation analysis between the variables and the touristification index indicates that the tourism supply variable (TB/Surf_11) and the tourism demand variable (TA/Pop_11 and TA/Surf_11) exhibit positive correlations with the 2012 touristification index (T_11a). The variable representing tourism supply, namely TB/Surf_11 (0.80), was highly positively correlated with the touristification index. This suggests that as the number of accommodation beds relative to the surface area increases (tourism density), there is a corresponding rise in the level of touristification. On the other hand, the tourism demand variable TA/Surf_11 exhibits a positive correlation coefficient of 0.88 with the touristification index. This suggests that as the demand for tourism, represented by the ratio of tourist arrivals to the surface area, increases, there is a corresponding positive impact on the level of touristification. The higher the concentration of tourists per unit of surface area, the more pronounced the level of touristification. Furthermore, TA/Pop_11 (0.21) displays a smaller positive correlation coefficient of 0.21 with the touristification index. This suggests a relatively weaker association between the ratio of tourist arrivals to the population and the level of touristification in 2012. This weaker correlation coefficient could be attributed to various factors, such as variations in population size and its influence on tourism patterns or the presence of other significant determinants of touristification not captured by this particular variable.

In 2019, the correlation analysis (Figure 9) indicated a strong positive correlation between the touristification index (T_19) and the tourism demand (TA/Pop_19) and supply (TB/Surf_19 and TA/Surf_19) variables. Specifically, the coefficient for TA/Pop_19 is 0.81, for TB/Surf_19, it is 0.90, and for TA/Surf_19, it is 0.98. These findings highlight the significance of both tourism demand and supply in driving the phenomenon of touristification. The disparity in correlation strength between TA/Pop_11 (0.21) and TA/Pop_19 (0.81) in relation to the touristification index of 2012 and 2019, respectively, can be explained by the time gap

between 2012 and 2019. While both TB/Pop_11 and TA/Pop_19 measure tourism demand in terms of visitor-to-population ratios, the relative significance of these factors in determining the level of touristification might have changed between 2012 and 2019. This could be due to shifts in the factors driving tourism demand, such as changes in tourist behaviour, destination-specific characteristics, or economic conditions, which could have influenced the relationship with the touristification index differently in each period. Therefore, the correlation coefficients may not provide a comprehensive picture of the underlying causal relationships.

Figure 8: Correlation analysis between individual indicators and the touristification index (2012)

Figure 9: Correlation analysis between individual indicators and the touristification index (2019)

3.3 The Touristified Islands

The touristification index in 2012 reveals that Thira, Mykonos, Koufonissi, Syros, Iraklia, Antiparos, Kos, Donoussa, Schinoussa, and Agathonissi were the top 10 most touristified islands (Figure 10). In 2019 (Figure 11), the top 10 most touristified islands were identified as Thira, Mykonos, Antiparos, Koufonissi, Megisti, Paros, Kos, Syros, Donoussa, and Schinoussa. It could be observed that Thira and Mykonos were not only recorded as the top two touristified destinations in both 2012 and 2019 but also witnessed a substantial increase in their touristification levels by 2019. Additionally, Koufonissi, Antiparos, Kos, Syros, Donoussa, and Schinoussa were present in both years. These islands may also be considered as consistently touristified destinations, although their specific positions within the top 10 have fluctuated over time.

Furthermore, there are islands that entered or exited the top 10 list between 2012 and 2019. Megisti and Paros, for example, were not in the top 10 in 2012 but made their way into the list in 2019, indicating an increase in their levels of touristification. On the other hand, Iraklia and Agathonissi were present in the top 10 in 2012 but dropped out in 2019, suggesting a potential decline in their touristification levels. This corroborates the findings of Ballis et al. (2018), who suggest that international media coverage regarding the deteriorating infrastructure in popular Greek islands is prompting tourists to explore other, less touristic and less developed islands in Greece.

The consistent ranking of Thira and Mykonos as the top two tourist destinations in both 2012 and 2019 reinforces the findings of Karagiannis and Thomakos (2020), who also identified these islands as leading tourist hotspots in Greece, facing significant pressures from tourism activities (Spilanis and Vayanni's, 2003; Vandarakis et al., 2023). They further argue that foreign investors show a strong interest in developing upscale and luxurious tourism facilities on the islands of Mykonos and Thira. This may be seen as a response to these destinations' existing tourism demand and supply dynamics. From a tourism demand perspective, Spilanis and Vayanni (2003) contend that these islands have established themselves as popular and highly sought-after tourist destinations. Therefore, foreign investors may want to exploit this demand by developing high-end tourism complexes catering to affluent tourists. On the supply side, these islands possess certain characteristics that make them attractive to tourists. For instance, Tsouka et al. (2018) maintain that air transportation serves as the primary means of transportation for foreign tourists, with airports serving as the country's international entry points. Therefore, alongside their natural and cultural attractions, such as stunning beaches, historical sites, and picturesque landscapes, these islands have well-developed infrastructure, including international airports, ports, and transportation networks, facilitating easy tourist access. Like the aforementioned islands, Kos may have experienced consistent touristification because of its international airport. Notably, Ballis et al. (2018) highlight that Kos is a top island destination in Greece and a significant proportion of tourists choosing Kos as their destination opts for direct flights, underscoring the role of an international airport in driving touristification levels. Furthermore, they argue that domestic airports may also drive tourist volume. For example, the runway extension project in Paros, undertaken in 2016 to increase the runway length from 710 meters to 1,400 meters, has already doubled tourist arrivals by

air recorded as of September 2018. Therefore, the relatively high levels of touristification observed in Syros, Paros, and Megisti may be linked to the presence of airports that facilitate domestic flights.

Despite the prevailing notion that the presence of airports is a significant driver of touristification levels, certain islands without direct airport access, including Iraklia (in 2012), Donoussa, Schinoussa, and Koufonissi, have demonstrated relatively higher levels of touristification compared to Naxos, which has an airport (It is worth noting that the closest airport and seaport to these islands is located in Naxos). Admittedly, this observation is not an attempt to downplay the role of Naxos as the main transportation hub for these islands but to indicate the need for a deeper examination to uncover the underlying factors contributing to touristification. For instance, the case of Antiparos (2012 and 2019), an island without direct airport access, and Paros (2019), which has the nearest airport to Antiparos. Both islands experienced relatively higher levels of touristification. This suggests that the proximity of non-airport islands to those with airports may also play a pivotal role in determining the touristification levels of the former. For example, tourists visiting Naxos and Paros may be enticed by the opportunity to explore nearby islands, which are easily accessible through day trips or short ferry rides.

Furthermore, islands without direct airport access may attract a specific segment of tourists seeking tranquillity and a sense of exclusivity. Spilanis and Vayanni (2003) contend that despite tourism not being a primary economic driver, small islands such as Antiparos and Koufonissi are experiencing notable pressures. The case of Agathonissi, alongside other touristified non-airport islands, suggests that the absence of an airport on these islands does not necessarily hinder tourist arrivals. Ferry connections may have facilitated easier access to these non-airport islands, contributing to their increased touristification levels. Generally, the touristified islands can be categorised into three groups: those with international airports, those with domestic airports, and those without direct airport access.

Also worthy of mention are islands that experienced a significant downward shift (≥15 positions) or fell from the top 15 to rank 25+ (Table VI). These include Nysyros, Agathonissi, Sikinos, Anafi, Tilos and Ag. Efstratios. These islands may be categorised as islands with declining touristification. According to Belias et al. (2018), a successful transformation has occurred in many Greek destinations, wherein they have transitioned towards sustainable

and alternative tourism. Therefore, the relative decrease in the touristification levels of these islands may be interpreted as a reflection of the successful transition towards sustainable and alternative tourism. Nonetheless, a group of islands experienced an increase in their rankings over the studied period.

Figure 10: Touristification Index (2012)

Figure 11: Touristification Index (2019)

Table VI: Touristification Rank

4. Conclusion and Future Research Directions

This study develops a composite index for monitoring and benchmarking touristification in Greek islands. To achieve this, an exploratory factor analysis (EFA) is employed as an objective method to identify and select the most significant indicators related to touristification. These selected indicators, encompassing both tourism supply and demand aspects, are then combined to form the composite touristification index. The findings of the study suggest that touristification on Greek islands is characterised by the perpetuation of existing hierarchical dynamics among popular destinations (Thira and Mykonos) and expansion into previously non-touristic islands. Therefore, there is a need for routine monitoring to identify islands that may be experiencing or prone to potential adverse consequences arising from excessive tourism growth and take appropriate measures to prevent them.

The study further highlights the complex interplay between tourism demand and supply in shaping the touristification levels of different islands, with smaller and less renowned islands like Koufonissi, Iraklia, Donoussa, and Schinoussa ranking among the top 10 touristified destinations, alongside more popular tourist destinations. While airports remain significant drivers of touristification, it is crucial to consider other factors such as island characteristics, proximity to neighbouring islands with airports, and the specific preferences of tourists. By examining these dynamics, planners and policymakers can develop more comprehensive strategies to promote sustainable tourism development, considering the unique strengths and potentials of each island and the interconnectedness of the tourism offerings in the region.

The method adopted in this study has the potential for broader applicability, facilitating comparative analyses and contributing to the body of knowledge on touristification in other island contexts worldwide. However, it is important to acknowledge several limitations in the methodology and data used in this study. First, the use of a relatively small number of variables may not fully capture the complexity and multidimensionality of the touristification process. Future studies should consider incorporating additional variables covering other important dimensions (environmental impact, cultural preservation, gentrification, community well-being, etc.) of touristification to provide a more comprehensive overview. These data were not included in the composite index due to data availability constraints.

Second, there are missing values for some variables. Although the study applied a percentile-based imputation method to address missing data, it is important to acknowledge that the imputed values are estimations and may not accurately reflect the true values. This could potentially affect the ranking of touristification levels for certain islands. Third, the use of different time periods for population data (2011) and tourism-related data (2012) introduces a time gap that may impact the accuracy and relevance of the findings. Changes in population dynamics and tourism patterns between these years may not be fully captured, potentially affecting the assessment of touristification levels. Future studies should aim to use synchronised data from the same time period to ensure the temporal alignment of variables. Despite these limitations, the study demonstrates efforts to overcome challenges in data availability and enhance the robustness of the findings.

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Table I: List of Islands in the Regions

South Aegean Islands					
Agathonissi	Astypalaia	Kalymnos	Karpathos	Kasos	Kos
Lipsi	Leros	Megisti	Nisyros	Patmos	Rodos
Symi	Tilos	Chalki	Amorgos	Anafi	Andros
Antiparos	Donoussa	Iraklia	Thira	Thirasia	Ios
Kea	Kimolos	Koufonissi	Kythnos	Milos	Mykonos
Naxos	Paros	Serifos	Schinoussa	Sikinos	Sifnos
Syros	Tinos	Folegandros			
North Aegean Islands					
Ag.Efstratios	Lesvos	Limnos	Ikaria	Fourni	Samos
Chios	Oinoussai	Psara			

Table II: Selected Indicators

Indicators	Code	Description	Dimension
Total Beds (2012) /Island Population (2011)	TB/Pop_11	Tourism Intensity	Tourism Demand
Total Beds (2019) /Island Population (2019)	TB/Pop_19	Tourism Intensity	Tourism Demand
Total Beds (2012)/Surface Area	TB/Surf_11	Tourism Density	Tourism Supply
Total Beds (2019)/Surface Area	TB/Surf_19	Tourism Density	Tourism Supply
Tourist Arrivals (2012)/Surface Area	TA/Surf_11	Tourism Density	Tourism Demand
Tourist Arrivals (2019)/Surface Area	TA/Surf_19	Tourism Density	Tourism Demand

Tourist Arrivals (2012)/Population (2011)	TA/Pop_11	Tourism Intensity	Tourism Demand
Tourist Arrivals (2019)/Population (2019)	TA/Pop_19	Tourism Intensity	Tourism Demand

Table III: Factor Analysis after removal of TB/Pop_11 and TB/Pop_19

		TBSurf_11	TASurf_11	TAPop_11	TBSurf_19	TASurf_19	TAPop_19
Anti-image Covariance	TBSurf_11	.026	.012	.046	-.015	.005	-.013
	TASurf_11	.012	.045	.039	-.012	-.008	-.046
	TAPop_11	.046	.039	.651	-.017	-.025	-.068
	TBSurf_19	-.015	-.012	-.017	.011	-.010	.025
	TASurf_19	.005	-.008	-.025	-.010	.041	-.054
	TAPop_19	-.013	-.046	-.068	.025	-.054	.246
Anti-image Correlation	TBSurf_11	.734[a]	.366	.351	-.863	.160	-.168
	TASurf_11	.366	.810[a]	.231	-.557	-.195	-.441
	TAPop_11	.351	.231	.540[a]	-.198	-.155	-.169
	TBSurf_19	-.863	-.557	-.198	.667[a]	-.458	.477

	TASurf_19	.160	-.195	-.155	-.458	.838[a]	-.540
	TAPop_19	-.168	-.441	-.169	.477	-.540	.632[a]

Table IV: Component Statistics

Component	SS Loadings	% of Variance	Cumulative %
1	4.370	62.427	65.427
2	1.242	17.745	80.171

Table V: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.736
Bartlett's Test of Sphericity	Approx. Chi-Square	453.277
	df	21
	Sig.	.001

Table VI: Touristification Rank

Islands	Acc. Bed (% change)	Tourist Arrival (% change)	Rank 2011	Rank 2019	Change in Rank	% of average 11 (Tourist Arrival)	% of average 19 (Tourist Arrival)	% of average 11 (Acc. Bed)	% of average 19 (Acc. Bed)
Thira	26.97	159.14	1	1	-	427.21	700.43	276.05	320.57
Mykonos	42.54	142.05	2	2	-	330.55	506.19	180.42	235.21
Koufonissi	139.82	93.42	3	4	↓	17.33	21.21	4.18	9.16
Nisyros	-1.45	107.76	4	30	↓	5.14	6.76	27.41	24.71
Kos	9.81	40.03	5	7	↓	582.34	515.92	391.43	393.13
Iraklia	103.73	70.47	6	18	↓	3.98	4.29	2.05	3.81
Donoussa	67.2	101.39	7	9	↓	5.33	6.79	2.05	3.13
Antiparos	14.74	103.16	8	3	↑	88.83	114.17	30.89	32.42
Schinoussa	38.78	82.17	9	10	↓	5.31	6.12	2.60	3.30
Syros	11.29	27.16	10	8	↑	148.61	119.55	146.93	149.56
Folegandros	9.73	51.49	11	14	↓	17.41	16.69	16.25	16.31
Paros	16.2	84.51	12	6	↑	303.45	354.23	215.23	228.74
Sikinos	19.15	19.42	13	37	↓	4.69	3.54	6.18	6.73
Agathonissi	4.32	17.68	14	43	↓	2.00	1.49	0.76	0.72
Rodos	9.19	38.73	15	22	↓	1097.87	963.59	904.25	903.06
Anafi	5.88	12.86	16	31	↓	6.16	4.40	6.49	6.29
Megisti	2.77	1234.04	17	5	↑	2.38	20.06	6.49	6.10
Thirasia	-0.73	4188.55	18	26	↓	0.15	4.12	4.47	4.06
Symi	3.42	33.62	19	12	↑	71.04	60.06	24.74	23.40
Ios	4.24	50.69	20	17	↑	48.15	45.91	43.22	41.21
Tilos	2.82	124.8	21	38	↓	3.91	5.55	18.35	17.26
Tinos	11.02	22.02	22	11	↑	209.70	161.89	137.04	139.16
Lipsi	21.23	30.41	23	28	↓	7.12	5.87	7.78	8.63

Sifnos	17.42	57.59	24	13	↑	44.01	43.88	54.71	58.75
Chalki	8.62	28.44	25	36	↓	4.35	3.53	9.62	9.56
Serifos	6.06	54.83	26	19	↑	26.83	26.28	43.85	42.53
Ag.Efstratios	2.3	34.4	27	45	↓	2.75	2.33	2.84	2.66
Karpathos	4.93	39.59	28	35	↓	55.29	48.82	106.36	102.08
Kalymnos	1.23	26.07	29	27	↑	79.22	63.19	82.00	75.92
Leros	-1.33	43.92	30	24	↑	30.16	27.46	49.84	44.98
Naxos	10.57	75.41	31	25	↑	172.53	191.47	238.56	241.26
Samos	-0.93	10.5	32	33	↓	145.31	101.59	295.61	267.85
Kea	20.17	9.35	33	15	↑	66.72	46.16	50.67	55.69
Kythnos	9.33	56.25	34	20	↑	30.66	30.31	40.51	40.50
Kimolos	8.98	46.3	35	23	↑	16.26	15.05	15.13	15.08
Patmos	11.93	43.62	36	16	↑	29.29	26.62	26.79	27.43
Milos	15.74	100.11	37	21	↑	64.08	81.13	65.66	69.51
Oinoussai	0	17.97	38	34	↑	8.43	6.29	4.27	3.91
Kasos	3.66	-13.8	39	47	↓	4.95	2.70	14.59	13.84
Psara	6.47	0.23	40	48	↓	4.19	2.66	2.36	2.30
Fourni	-4.01	-44.26	41	41	-	8.01	2.83	13.20	11.59
Amorgos	0.93	77.53	42	29	↑	26.66	29.94	34.00	31.39
Andros	13.31	7.49	43	32	↑	135.77	92.33	106.28	110.14
Astypalaia	3.1	74.96	44	39	↑	8.77	9.71	20.57	19.39
Ikaria	0.73	25.55	45	40	↑	39.61	31.46	84.40	77.76
Chios	0.61	-5.87	46	42	↑	150.79	89.80	302.83	278.67
Lesvos	-0.72	1.1	47	46	↓	198.16	126.74	550.80	500.14
Limnos	1.84	31.88	48	44	↑	58.57	48.86	129.27	120.41