

Carrying capacity assessment for the Greek islands of Kalymnos, Kos and Rhodes

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Abstract

Carrying capacity assessment has become an indispensable tool for formulating policy and strategies in the tourist industry worldwide. It is well known that Greece depends heavily on the tourist trade, as this has, in recent years, become the main economic activity in many of the Greek islands. The transformation of local economies from primary and secondary production to tertiary has, over the years, substantially altered the business environment in which such an activity takes place. Many studies have shown that the tourist product is a blend of ecological, social and economic sub-systems, operable in the area of interest. For the Greek Islands, environment, both natural and man made, plays a leading role in the sustainable development of the industry. It is the purpose of this paper to apply the principles of carrying capacity assessment to three Greek islands, differing in their tourist development, in an effort to highlight the importance of such a tool in developing long-term sustainable policies for such communities.

1 Introduction

The World Tourism Organisation (WTO) proposes the following definition of carrying capacity: “The maximum number of people that may visit a tourist destination at the same time, without causing destruction to the physical, economic, socio-cultural environment and an unacceptable decrease in the quality of visitors’ satisfaction” [1].

Today, controlling tourist growth has become a central policy issue for the tourist trade [2] and it is noteworthy that carrying capacity assessment has become an important tool for facilitating planning and developing policy in the industry [3].



Relevant carrying capacity indicators have been developed and categorised into three groups: 1. physical-ecological, 2. infrastructural and 3. Sociological-psychological [4]. It is highly topical to develop and integrate such indicators [5] into the planning process of the Greek tourist business, and more specifically to the island tourist trade, on which the Greek economy depends so heavily upon. It is believed that, through this process, a realistic sustainable scenario for tourist development could be proposed for such areas.

2 Basic population characteristics and employment figures for Kalymnos Kos and Rhodes islands

2.1 Population

As indicated by Table 1 the population of Kos and Rhodes has increased considerably during the period of 1950 – 2001, representing a rise of about 20%. This increase in population is more pronounced for the town of Kos and Rhodes. The population of Kalymnos has increased at a lower rate than the population of the other two islands.

Table 1: Population characteristics (2001) in Kalymnos, Kos and Rhodes.

	Population	Area (km ²)	Density inhabitants/ km ²
KALYMNOS	16.441	110,8	148,38
KOS	30.947	290,2	106,64
RHODES	117.007	1398	83,65

Table 2: Population growth (1951-2001) in Kalymnos, Kos and Rhodes.

	1951	1961	1971	1981	1991	2001	Rate % 1991-2001
KALYMNOS	13.712	14.249	13.281	14.457	15.842	16.441	3,78
KOS	19.076	18.187	16.650	20.350	26.379	30.947	17,32
RHODES	59.807	63.954	66.609	87.833	98.181	117.007	19,17

2.2 Employment

Analyzing the employment figures of these three islands it is obvious that the economies of Kos and Rhodes are based on tourism. This transformation happened in the late 1970s, as a shift from primary and secondary to tertiary production. In Kalymnos the characteristics of employment is different, 40% work in the primary and in the secondary sectors of economy.



Table 3: Employment figures for Kalymnos, Kos and Rhodes.

Region	Year	Primary	Secondary	Tertiary
NATIONAL	1981	29,2%	30,5%	40,4%
NATIONAL	1991	19,6%	25,4%	55,0%
NATIONAL	2001	15,2%	22,9%	61,8%
DODECANESE	1981	13,9%	27,4%	58,7%
DODECANESE	1991	7,9%	23,6%	68,5%
DODECANESE	2001	7,0%	19%	74%
KALYMNOS	2001	16,2%	23,8%	59,8%
KOS	1991	7,8%	23,8%	68,25%
KOS	2001	5,0%	17,0%	78,0%
RHODES	1981	10,2%	25,6%	64,3%
RHODES	1991	6,0%	22,7%	71,3%
RHODES	2001	7,0%	19,0%	74,0%

3 Tourist indicators

3.1 Tourist development

Tourist development in Kos started in the early 1970s. In 1977, the number of hotels in Kos amounted to 17 whereas in 1986 these rose to 182. Tables 4 and 5 describe the increase in tourist infrastructure. In 1979 hotels in Kos provided 3.471 rooms for rent, whereas by 2004 there were 271 with an estimated capacity of about 60,000 beds.

Table 4: Bed capacity in Rhodes related to area and local population.

Municipalities	Inhabitants	Total beds	Bed per residents	Area (Sq Km)	Bed per Sq Km
ARHAGELOS	7.758	1.673	0,21	115,4	14,5
ATTAVIROS	3.214	90	0,02	234,4	0,38
AFANDOU	6.557	8.340	1,27	46,1	180,9
IALYSOS	10.275	17.557	1,70	16,7	1051,3
KALLITHEA	9.979	21.561	2,16	119,8	180,0
KAMIROS	5.315	295	0,05	211	1,4
LINDOS	3.719	9.084	2,44	179	50,7
SOUTH RHODES	4.315	3.770	0,87	379,1	9,9
PETALOUDES	11.858	4.269	0,36	89,3	47,8
RHODES TOWN	54.802	18.327	0,33	19,5	939,8
RHODES TOTAL	117.007	84.912	0,72	1.400	60,6

In Rhodes, tourist development started in the early 1960s in the northern part of the island, known as the “The Northern Triangle”. By 1971, hotels and rooms for rent were estimated to about 20,000. In 2004 this capacity has risen to 120,000. In 1960 there were 27 Hotels in Rhodes, in 1980 164 and now 510.

Kalymnos started developing in the early 1990s, but until recently, has not exceeded 5,000 beds in capacity.

As indicated by table 7 Kos has the largest number of bed capacity per square kilometer, compared to the other two islands.



Table 5: Bed capacity in Kos and Kalymnos related to area and local population.

BED CAPACITY IN KOS					
Municipalities	Inhabitants	Total beds	Bed per residents	Area (Sq Km)	Bed per Sq Km
DIKAIOS	6.094	8.868	1,4	62,6	142,6
HERACLEIDON	6.963	18.045	2,5	157,4	114,6
KOS TOWN	17.890	24.872	1,39	65	383,6
KOS TOTAL	30.947	51.695	1,67	285	181,3
BED CAPACITY IN KALYMNOS					
KALYMNOS	16.500	5.000 [6]	0,30	110,8	45,1

Table 6: Distribution of tourist hospitality enterprises.

	Estimated total tourist capacity in beds	Beds per sq kilometre
KALYMNOS	5.000	45,1
KOS	70.000	241,21
RHODES	120.000	85,8

Table 7: Tourist development in Kalymnos, Kos and Rhodes.

Year	KALYMNOS		KOS		RHODES	
	Units	Beds	Units	Beds	Units	Beds
1935					3	
1960					27	1875
1979-80			17	3.431	164	27.192
1988	24	844	179	13.814	320	40.334
1993	47	1.750	246	23.320	431	60.742
1999	46	1.928	266	31.672	494	71.458
2006	45	1.946	288	41.512	510	74.207

Table 8: Closed hotels in Kalymnos, Kos and Rhodes [7].

KALYMNOS	9
KOS	20
RHODES	76

Table 9: Other tourist capacity (rooms to let and bungalows) development in Kalymnos, Kos and Rhodes.

	KALYMNOS		KOS		RHODES	
	Units	Beds	Units	Beds	Units	Beds
1982						909
1989		594		7.760		11.769
1993	143	1.771	551	10.211	797	33.731
1999	81	699	433	7.581	853	13.489
2004		3.054	482	4.532		14.852

Economic crisis has taken place in tourist enterprises; a lot of hotels have stopped working (Table 8). Today in Kos there are 7 new five-star hotels under construction [8]. They are starting operations in April 2006. Our survey showed that, local authorities could not, as yet, estimate the real capacity.

3.2 Tourist arrivals, related to local population, during high and low season

As indicated by Table 10 the island of Kos has the most arrivals and overnight stays per 100 inhabitants compared to the other two islands.

As indicated by Table 11, total airport arrivals do not compare to hotel arrivals, indicating that other lodgings are operable on the island, such as non-licensed hotels and rooms to let, as well as camping facilities that are not taken into account in the official statistics.

Table 10: Tourists related to residents in 2003 – arrivals in hotels and overnight stays.

	Low season, October arrivals per 100 inhabitants	High season, August arrivals per 100 inhabitants	Low season, overnight stays per day/ 100 inhabitants	High season, overnight stays per day/ 100 inhabitants
KALYMNOS	1,95	118,4	0,1	1,95
KOS	113,5	400,4	38,7	1,16
RHODES	83	183,3	27	54,3

Table 11: Comparison of airport arrivals to hotel arrivals.

	Arrivals in the airports, October	Arrivals in the airports August	Arrivals in hotels and other rooms, October	Arrivals in hotels and other rooms, August
KALYMNOS	-	-	322	2.484
KOS	124.832	149.952	35.137	12.394
RHODES	143.528	298.752	97.403	214.585

Table 12: Hotel arrivals related to local residents.

	Low season, tourists in October	High season, tourists in August	Low season, tourists per 100 inhabitants	High season, tourists per 100 inhabitants
KALYMNOS	400	2.250	2,4	13,6
KOS	53.000	137.000	170	441
RHODES	117.000	256.000	100	218

3.3 Seasonal population

The occupancy at low season for Kalymnos is nearly zero, whereas Kos and Rhodes have a much higher value, indicating that Kalymnos does not have tourist economies of scale. It is thus inferred that the tourist season in Kalymnos is mainly July and August.



Table 13: Total seasonal population (non formal data).

	Residents	Bed capacity	low season population	High season population
		Hotels and other rooms	Hotel occupancy 50%	Hotel -occupancy 100%
KALYMNOS	16.411	5.000	-	21.411
KOS	30.947	70.000	65.947	100.947
RHODES	117.007	120.000	167.007	217.007

3.4 Airport and port arrivals

Table 14: Port arrivals in Kalymnos, Kos and Rhodes.

	1999	2000	2001	2002	2003	2004
KALYMNOS	86.360	90.655	94.316	64.896	77.132	45.363
KOS	207.096	207.096	226.283	105.248	125.249	130.452
RHODES	305.465	320.738	332.889	237.710	201.399	267.007

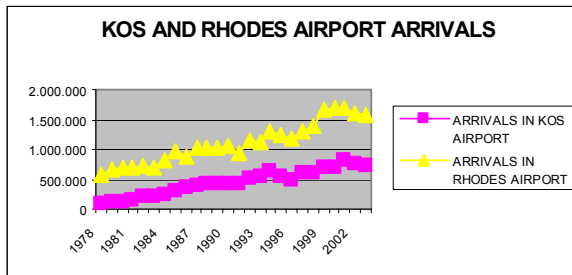


Figure 1: Airport arrivals.

4 Environmental indicators

The south of Rhodes is considered the most environmentally sensitive region of all three islands. This area is now characterized as a saturated region due to the high tourist numbers visiting and the capacity of offered services, leading to the highest concentration experienced on the island.

4.1 Beach impact factor

With this indicator we analyse the pressures facing the coastal environment, as they describe the concentration of people visiting and using the facilities of the coastal area, and especially beaches.

Table 15: Beach impact factor in Kalymnos, Kos and Rhodes.

Municipalities	Beach length(m)	Inhabitants	Hotel beds	Rooms to let (beds)	Total seasonal population	Beach impact factor (people/m of beach)
RHODES [9]						
ARHAGELOS	6	7.758	1.044	629	9.437	1,6
ATTAVIROS	3	3.214	79	11	3.307	1,1
AFANDOU	12	6.557	6.673	1.667	14.909	1,2
IALYSOS	8	10.275	16.606	951	27.840	3,5
KALLITHEA	10	9.979	16.828	4.733	31.550	3,2
KAMIROS	16	5.315	127	168	5.626	0,4
LINDOS	9	3.719	5.516	3.568	12.812	1,4
SOUTH RHODES	35	4.315	3.357	359	8.101	0,2
PETALOUDES	12	11.858	3.357	912	16.139	1,3
RHODES TOWN	5	54.802	16.575	1.752	73.134	14,6
RHODES ISLAND	151	117.007	70.162	14.750	201.919	2,8
RHODES EXCEPT RHODES CITY	146	62.205	53.587	12.998	128.785	1,5
NORTH TRIANGLE	47	93.471	56.682	9.103	163.572	4,3
KOS [10]						
DIKAIOS	8.1	6.094	8.242	626	14.962	1,8
HERACLEIDON	24.3	6.963	14.197	3.848	25.008	1,02
KOS TOWN	6.5	17.890	19.178	5.604	42.672	6,5
KOS TOTAL	38.9	30.947	41.617	10.078	82.642	2,18
KALYMNOS						
KALYMNOS	8	16.500	1.946	2.954	21.500	2,68

North Triangle of Rhodes: Municipalities of Rhodes, Ialysos, Petaloudes, Afandou and Kallithea.

Kalymnos Island, with a total of 8 kilometres of beach, does not face the same pressure on its coastal regions (beach impact factor = 2.68 persons per metre of beach) as the Northern Triangle of Rhodes (4.3) and town of Kos (6.5).

Table 16: Beach impact factor, high and low season.

		KALYMNOS	KOS	RHODES
Tourists per kilometer of beach	High season	625	1799.4	821.9
	Low season	-	899.7	410.9

Table 17: Blue flags in beaches and marinas.

	Beaches	Marinas
KALYMNOS	0	0
KOS	9	1
RHODES	35	0

Rhodes seems to be the island with the highest number of beaches with Blue Flag certification, indicating that serious attempts have been made to protect the environment and possibly increase competitiveness in offered tourist services. Kalymnos, on the other hand, does not have any beaches with Blue Flag certification, a result that agrees well, with other indicators, presented earlier, showing a relatively slow tourist development.



4.2 Natural environment

In Kalymnos, Kos and Rhodes there are no established national parks. Nevertheless, we have three environmentally protected areas, which belong to the “Natura” network. These environmentally protected areas, based on the “Natura” program do not, as yet, have a management scheme and are not governed by a specific establishment or organization. Two of these areas are in Rhodes and one is in Kos.

Table 18: Environmentally protected areas in Kalymnos, Kos and Rhodes.

		Category	Law regulations	Organization for administration
CYPRESS TREE FOREST	RHODES	Protected natural monument	NO	NO
PLANE TREE OF HIPPOCRATES	KOS	Protected natural monument	NO	NO
PROFITIS ILIAS, EPTA PHGES,PETALOUEDES	RHODES	Natura network area	NO	NO
LOUROS COAST, PSALIDI LAKE, DIKAIOS MOUNTAIN, ALYKH	KOS	Natura network area	NO	NO
AKRALYTIS, ARMENISTIS, ATTAVIROS	RHODES	Natura network area	NO	NO

Table 19: Threatened species in Rhodes and total expenditure for the management of protected areas.

FAUNA	Population	Condition	Protection organization	Grants for protection
Rodian deep	100- 150 [13]	Threatened	NO	?
Rodian pony[14]	6 [15]	Threatened	YES	15.000€
Gizani fish [16]	100-150	Threatened	NO	?

The Natura area in Kos Island, houses an important bird area of Greece, the Psalidi wetland area [9]. Many different migratory birds visit this place within the year. This wetland, however, is situated in the suburbs of the town of Kos, which is a main tourist area. As a result, that important ecological area is under threat, and the Municipality of Kos has introduced management schemes to control this tourist area. The regulations that comprise the management options adopted, have been developed and implemented by the Ministry of Environment. It is said that the establishment of a Local Managing Authority will take place in a few months. In Rhodes, one of protected areas is the well-known area called the “Butterfly valley” which is managed by the local municipality. Rhodian deer and little pony from Archangelos are species of special interest to the island and many efforts are underway to ensure that both survive excessive human intervention. The indicators presented below, indicate the number of threatened species in proportion to the total number of native species [10].



4.3 Garbage and waste management

Urban waste management (solid and liquid) on all three islands is characterized by the lack of efficiency. Only the large urban centers fulfill the basic requirements of modern waste management installations. It is interesting to note that other smaller settlements do not even have a complete urban waste collection network.

Table 20: Urban waste and garbage management in Kalymnos, Kos and Rhodes islands.

Municipality	Inhabitants	Urban waste treatment plant	Percentage of waste treated	Availability	Garbage management
ARHAGELOS	3.214	N.R..T.P	None		Dump place
ATAVIROS	6.557	1	30%	3000	Dump place
AFANDU	10.275	N.R..T.P	None		Scrap heap
IALYSOS	9.979	N.R..T.P	None		Place of sanitary burial
KALLITHEA	5.315	N.R..T.P	30%		Place of sanitary burial
KAMIROS	3.719	1			Place of sanitary burial
LINDOS	4.315	1	30%		Scrap heap
SOUTH RHODES	11.858	NO			Scrap heap
PETALOUDES	54.802	YES		8000	Place of sanitary burial
RHODES TOWN	7.758	N.R..T.P	90%	144000	Place of sanitary burial
RHODES GENERAL	117.007	70% of all the island			-
KOS ISLAND	30.947	YES	72%		Place of sanitary burial
KALYMNOS	16.441	NO	0%		Dump place

NRTP: North Rhodes Urban Waste Treatment Plant, Vodi Place

5 Conclusions

In this paper an attempt was made to present selected carrying capacity assessment indicators for three Greek islands that differ in their tourist development, as well as draw some conclusions as to how these indicators can assist in developing sustainable tourist development policies, in island settings.

The data presented in the form of tourist infrastructure indicators, highlights the fact that the municipalities of the town of Rhodes (939,8 beds/Km²), Ialysos (1051,3 beds/Km²) and Kos town (339 beds/Km²) have the higher tourist concentration in terms of accommodation. Comparing these three regions to other municipalities such as that of Kalymnos and other municipalities of Kos and Rhodes, we conclude that the former ones are already saturated, and have no real capacity for further development in accommodating a greater number of visitors. Taking into account other indicators (employment, economy characteristics etc) the conclusion is reached that these saturated areas can progress towards developing quality and alternative tourist services. Areas that are not as yet developed, should not necessarily develop along the same lines as the major tourist attraction areas, but should, at this stage of their development, plan ahead in order that planning and policy development and implementation, lead to a truly competitive and environmentally sound business. In this respect the area of South Rhodes is trying to further develop tourism, by financing cultural and other alternative tourist developments [11].



- It is interesting to note that the economies of Rhodes and Kos are almost exclusively based on tertiary activities, whereas in Kalymnos the economy resembles that of previous years for Rhodes and Kos and consists (by 50%) of both secondary and tertiary production levels. This is also another fact that can support policies leading to a more controlled and environmentally beneficial tourist development of the island of Kalymnos.
- Hotel occupancy indicators for Kos and Rhodes, showing 50% during low season and 100% in the peak periods, combined to the fact that the tourist season in Kalymnos is mainly during the months of August and July, lead us to conclude that the tourist industry should aim at extending the tourist season to include more months, and probably visitors with varied interests and expectations of the beautiful islands [12].
- The fact that domestic and international arrivals in October at Kos (125.000 passengers) compare well to those for Rhodes (144.000 passengers), whereas the numbers for high season are double for Rhodes, (144.000 for Kos and 298.000 for Rhodes), indicate that Kos, through local tourism organizations, has achieved a better balance between high and low season tourist figures, by what seems to be policies and measures aimed at alternative tourist attractions thus achieving a better quality and extended tourist season [13].
- Environmental indicators, indicate that the transformation from a low quality, high numbers tourist trade, to an alternative, high quality one, will not be easy, since waste management systems are insufficient in dealing with urban and solid waste. It is well known that, such inadequacies have serious environmental consequences, and hinder any attempts towards developing a tourist industry based on quality.
- Calculated coastline impact indicators, indicate that the island of Kalymnos (with a total of 8 km of beach) does not face the same pressure on its coastal regions as the Northern Triangle of Rhodes and town of Kos. It is without surprise that these two areas have the highest concentration and visiting rate of tourists in all three islands.
- The increasing public interest in nature and landscape preservation is, today, considered a major positive factor in the tourist development process. It is true that the growing influx of visitors can exert strong pressures on fragile ecosystems [14]. In the Northern part of the island of Rhodes, local inhabitants have been demanding that an alternative tourist development strategy should be implemented in this area. However an area with environmentally sensitive areas should have an effective management scheme [15] and be run under a modern and highly sophisticated regime.

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