

CO-EVOLVE

Promoting the co-evolution of human activities
and natural systems for the development of
sustainable coastal and maritime tourism

Deliverable 3.4.2

Review and analysis of carrying capacity approaches

Activity 3.4

Threats to co-evolution in touristic areas -
Mediterranean scale: Touristic fluxes and
carrying capacity

WP3

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1. *Introduction*

As the analysis of 3.4.1 has revealed, the Carrying Capacity (CC) concept still allows for various definitions according to the scope under which tourism sustainability is approached. The multidimensional nature of the TCC that crosses various scientific fields such as, environmental studies, economics, social and policy sciences and planning has facilitated in a sense the interest of scholars and practitioners of different scientific backgrounds and has resulted to the development of various conceptual models of TCC.

Despite the undisputable usefulness of these conceptual models in approaching TCC, there is still a lot to be done in order for TCC to be addressed in a systematic and practical context. According to Coccossis and Mexa (2004) this will be achieved only after consolidating TCC in real management and planning practices. Especially for coastal and marine space, both ICZM and MSP provide the necessary context for the utilization of TCC concept towards a more sustainable management of tourism development. To this end, the present report seeks to reveal the potential of integrating TCC assessments in local management and spatial plans of coastal regions. In Section 2, the rationale behind various TCC empirical assessments is analyzed.

In Section 3, the previous efforts of integrating TCC assessments in local plans are presented. Section 4 builds on the findings of the two previous sections in order to provide recommendations for enriching local plans with TCC assessments taking into account the particularities of different coastal areas (mass tourism areas, protected areas, urbanized areas etc). Particular attention is given to the focus areas of Co-Evolve in identifying their main particularities which in turn may render a tailored made approach essential. In addition, the recommendation takes into account the system of indicators developed in Deliverable 3.16 as a useful basis for indicators directly linked to TCC.

2. Empirical Tourism Carrying Capacity Assessments

Building further on the introductory analysis of 3.4.1 (see Chapter 2) regarding Carrying Capacity Assessments (CCA), the analysis of the present section seeks to highlight some past empirical applications of CCA in order to facilitate the operationalization of the concept towards the confrontation of problems and challenges that tourist destinations are dealing with. Before presenting the case studies, it is useful to distinguish two basic types of CC that appear in international literature. The first refers to the capacity of tourist destinations and their limits in accepting fluxes before the negative impacts start to affect the host communities and the second to the negative impressions caused to tourists after a limit of tourist fluxes is exceeded (Saveriades, 2000; Coccossis and Mexa, 2004). Suffice to say, the first approach situates the CC issue on the supply side of the tourism product whilst the second concentrates on the demand side.

Bearing in mind that sustainability is a multidimensional framework, there are also different kind of Carrying Capacities which are adjusted to the various components of the sustainability concept. International literature recognizes the following types of Carrying Capacity (Swarbrooke, 1999).

1) Physical Carrying Capacity. This metric regards the maximum number of tourists a place can accommodate over a particular time. Cifuentes (1992) proposed formula in order to assess PCC which takes into account the available space of a host area, the available space per user and the number of daily users. PCC is extracted by equation 1:

$$PCC = \frac{A}{A_u} * R_f \quad (1)$$

Where:

- A = Available Area for users
- A_u = Available Area per user
- R_f = Rotation Factor (number of visits/day)

Considering that the CC of a host area is also affected by other socioeconomic, biological and environmental factors, the PCC has been further modified in order to encompass the effect of corrective factors deriving from the particular characteristics and special conditions of the host area (Ceballos-Lascurain, 1996; Tran et al. 2007). A metric encompassing the effect of n corrective factors (Cf) is the Real Carrying Capacity which is derived by Equation 2:

$$RCC = PCC * (Cf_1 * Cf_2 * ... * Cf_n) \quad (2)$$

In addition, Cf values are extracted from Equation 3:

$$Cf_i = 1 - \frac{LM_i}{TM_i} \quad (3)$$

Where,

LM_i = Limiting Magnitude of Variable i
 TM_i = Total Magnitude of Variable i

Finally, CC is also affected by managerial limitations. In order for CC assessment to account for such limitations, the concept of Effective Carrying Capacity (ECC) has been developed.

The ECC is estimated through Equation 4:

$$RCC = PCC * (Cf_1 * Cf_2 * ... * Cf_n) \quad (4)$$

2) Economic Carrying Capacity. Economic CC refers to the maximum tourist flows a place can accommodate before negative effects on other sectors of the economy start to emerge. Undoubtedly, a sharp increase in tourist flows could result to the uprising of a tourism driven “Dutch Disease”. This situation is observed in destinations where uncontrolled tourism development leads to undesirable results and compromises the potential of other economic sectors. For example, tourism development may lead to higher land prices, less free space for the development of other activities, degradation of natural resources, labor shifts from other economic sectors etc. (Capo et al. 2007).

3) Social Carrying Capacity. Social capacity has two dimensions. The first refers to the CC of local residents expressed as their tolerance against tourism development and the second, called as Perceptual CC to the CC of tourists, expressed as their perceptual tolerance against overcrowding phenomena.

4) Environmental Carrying Capacity. This kind of capacity refers to the maximum number of tourists a place can accommodate before negative impacts start to be observed in the environment or the ecosystem.

5) Infrastructure Carrying Capacity. This type of CC refers to the maximum number of tourists that can be accommodated by the given infrastructures of a destination.

Table 1 summarizes some previous empirical CC assessments conducted in coastal space.

Table 1: Empirical Applications of Tourist Carrying Capacity Assessments

Year	Authors	Place	Method	Carrying Capacity Dimensions	Tourism Form
1993	Dixon et al.	Bonaire Marine Park, Netherlands Antilles	Survey, Photoanalysis	Environmental	Dive Tourism in Marine Protected Areas
2000	Saveriades	Ayia Napa, Protaras, and Paralimni (Cyprus)	Survey on indigenous population (00 personal interviews)	Social (Local Population)	Beach Tourism
1997	De Ruyck et al.	Three South African sandy beaches (Hobie Beach, King's Beach, Joost Park)	Survey on beach users	Social (Tourists)	Beach Tourism
2007	Bestard and Nadal	Balearic Island (Spain)	Survey and Discrete Logit Analysis	Social (Local Population)	General
2008	Lopez-Bonilla and Lopez-Bonilla	Cadiz, Cordoba, Huelva and Seville (Spain)	Survey	Social (Tourists)	Beach Tourism vs Inland Tourism
2007	Tran et al	Phong Nha-Ke Bang and Dong Hoi, Quang Binh Province (Vietnam)	Physical carrying capacity and Effective Real Carrying Capacity	Physical	Beach Tourism, Ecotourism
2008	Roca et al.	Catalonia (Spain)	Survey, Index, Correlation Analysis	Physical, Social (Tourists)	Beach Tourism
2011	Santana-Jiménez and Hernández	Tenerife, Gran Canaria, Lanzarote, Fuerteventura, La Palma Canary Islands (Spain)	Panel Data Regression	Social (Tourists)	Beach Tourism, Sightseeing
2013	Navarro Jurado et al.	Costa del Sol (Spain)	Survey, Index, Discriminant analysis	Social (Tourists)	Beach Tourism
2016	Iliopoulou-Georgoudaki et al	Ilida (Greece)	Indicators System	Social (Locals), Economic, Environmental	Beach Tourism, Natural and Cultural Tourism
2017	Dvaskas	Coastal Croatia	System Dynamics	Environmental and Social (Tourists)	Beach Tourism

As for Social TCC, Saveriades (2000) assessed social carrying capacity with reference to local population. More precisely, 100 personal interviews were conducted in three coastal Cypriot provinces in order for the author to extract the locals' attitudes against tourism development, the tourist-host inter-relationships and the effects of tourism in local societies. Saveriades (2000) used the Contact Ratio concept as a quantitative threshold of Social TCC and associated it with the responses of locals regarding their perceptions towards tourism development. The conclusion was that although the limits of host region seem sometimes to

be overpassed, as some places in summer get overcrowded, locals still support further tourism development. Based on this finding, it was assumed that TCC could not be approached in a strict static quantitative framework but should be considered as a dynamic concept for which the tolerance thresholds should be reviewed systematically under the collaboration of local communities.

Moreover, De Ruyck et al. (1997) assessed the Social CC of three beaches in South Africa. Based on a brief questionnaire authors conducted a survey to beach users in order to extract their crowding perception which was further used as means of approaching perceptual TCC. Authors concluded that although crowding perception is affected by the level of beach occupancy, there are still other external factors, such as facilities adequacy and crowd-attracting activities, which may increase the tolerance of users against overcrowding.

Lopez-Bonilla and Lopez-Bonilla (2008) conducted an evaluation of Social TCC in four provinces of the Spanish region of Andalusia based on tourists' perceptions. Research considered two provinces, Cadiz and Huelva where the "sun and beach" tourism model prevails and the non-coastal provinces of Sevilla and Cordoba. In total, 610 tourists were interviewed during the whole year regarding their perceptions towards the quality of tourism related services. Authors concluded that the perceptual TCC varies over the year and thus seasonality should be considered as a concept remarkably affecting the perceptual TCC of tourists.

In addition, Santana-Jiménez and Hernández (2011) approached Social CC by conducting a panel data regression analysis in order to capture the effect of population density on the demand for tourism services of two European markets (UK and Germany) regarding five islands of the region of Canary Islands. Authors noticed that German tourists were more sensitive to population density than English. Moreover, sensitivity levels varied across the different islands presenting higher levels for the islands that offer additional leisure options, differentiating in a sense from the general sun and sea model. This finding portrays that perceptual TCC for the Canary Islands seems to be higher for beach tourism than for other forms of tourism.

Bestard and Nadal (2007) assessed the variations of locals' tolerance against tourism development according to various socioeconomic and demographic characteristics. Authors conducted a survey to different districts of Balearic Islands where residents were asked to provide their perceptions towards different dimensions and impacts of tourism together with some information about their socioeconomic profile. In order to record locals' perceptions towards tourism, respondents were provided with a questionnaire and were prompted to use a Likert scale for their responses. The gathered data was entered into an ordered logit model in order to capture the personal characteristics that affect locals' tolerance against tourism

development. Analysis revealed that locals engaged in tourism activities present higher tolerance levels whilst the same is valid for residents of highly visited districts. Authors attribute this finding on the locals' acknowledgement regarding social and economic benefits of tourism.

Navarro Jurado et al. (2013) estimated the Social CC for the Costa del Sol area in Malaga, Spain. Authors conducted a survey during the summer collecting responses to a questionnaire divided in four parts. The first part referred to the personal characteristics of the respondents, the second to their activity during their stay (trip duration, daily expenses etc.), the third to their perception towards the quality of the destination (noise, authenticity etc.) and the fourth to their perceptions towards overcrowding. The responses to the third part of the questionnaire were given by using a 5-scale option ranging from total disagreement to total agreement. In order to develop a metric for Perceptual CC, the authors constructed an index called "current risk population" which was estimated as a combination of the responses regarding "perception of crowding" and "tourist's attitude toward possible overcrowding". Authors initially figured out that the Perceptual CC for Costa del Sol was not exceeded, as only 27% of respondents stated to perceive the destination as overcrowded. In addition, "current risk population" was estimated at 20% and so the authors concluded that only 20% of the total visitors have reached their carrying capacity levels.

Dvarskas (2017) used a System Dynamics approach in order to model the effect of using beaches for recreational uses over water ecological conditions and subsequently over the utility of beach users in Croatian coasts. To do so, Dvarskas (2017) developed two partial models. The first captures the environmental carrying capacity of beach use by estimating a threshold of good water status. The second captures the preferences of users regarding beach choice based on different beaches water quality.

Regarding Physical CC, Tran et al. (2007) assessed the physical capacity of Phong Nha and Dong Hoi tourism sites in the Vietnamese coastal province of Quang Binh. Authors estimated the Physical CC (PCC) and merged the Real Carrying Capacity (RCC) and Effective Carrying Capacity (ECC) into a single metric named Effective Real Carrying Capacity (ERCC) by imposing infrastructure and management limiting factors directly on RCC. Multiple TCC were estimated for different sites. For the Phong Nha national park, authors estimated the TCC for Cave sightseeing, ecotourism forest hiking in the National Park, Cable car riding whereas for the Dong Hoi site they calculated the maximum number of tourists for visiting the beach, sand bar sightseeing and ostrich farmer tour.

Roca et al. (2008) assessed the physical and social CC of six beaches at north-eastern region of the Catalan coast. For estimating the Physical CC authors conducted relevant observations and estimated the beaches' density as the ratio of available beach to total

users. Then they compared the results with other carrying capacity thresholds that were previously found by similar researches regarding Mediterranean beaches. The social CC was extracted by analyzing the results of questionnaires that were given to randomly selected beach users. In the first part of the questionnaire respondents were called to rate the beaches on the basis of four categories of characteristics, namely physical and morphological aspects, environmental characteristics, facilities, and design and comfort. In the second part, respondents provided some personal information. By cross-tabulating the results of the Physical and Social CC authors concluded that although user satisfaction is being reduced as overcrowding problems start to emerge, yet there are other characteristics of the beach that affect the users' satisfaction. This is extracted from the fact that respondents gave a high rate to two beaches in which sand availability was amongst the lowest of the considered beaches.

In addition, Dixon et al (1993) assessed the Environmental CC of Bonaire Marine Park in the Netherlands Antilles for scuba diving purposes. Through a survey to users of the Park and a photoanalysis, the authors recorded divers' perspectives regarding the condition of the park. Then they correlated the reefs quality with the number of dives per site per year. Authors estimated that ECC per site ranges between 4,000 and 6,000, which is translated to a maximum of 190,000- 200,000 dives per year for the whole park.

Finally, Iliopoulou-Georgudaki et al. (2016) have provided a holistic approach to TCC by developing a system of indicators with social, economic and environmental dimensions. Applied to the coastal municipality of Ilida, authors considered not only coastal tourism but also other forms of tourism such as natural and cultural. The authors did not estimate thresholds for TCC but relied on reference conditions, by incorporating Limits of Acceptable Change framework into analysis. With the assistance of local stakeholders, the authors provided the state of 18 tourism related attributes regarding their impact and importance through the use of a Leopold Matrix. By doing so, TCC has been regarded as a dynamic process which certainly should be reviewed regularly through a monitoring and evaluation framework.

3. *Applications of TCC in tourism destinations*

Tourism Carrying Capacity assessment has become a valuable decision-making tool for tourism destinations in achieving balance between economic, social and environmental factors. As highlighted in previous analysis, several studies have been conducted in order to redefine the direction of tourism development in tourism destinations, using TCC assessment and developing different development scenarios to indicate the most sustainable option (PAP/RAC, 2003).

However, the incorporation of TCC studies in development plans and actual implementation of the respected recommendations is a complex procedure that demands high level of public participation in order to be understood and accepted by all interested parties. As highlighted by PAP/RAC (2003), carrying capacity assessments are significantly more effective when conducted within Integrated Coastal Zone Management process and the respected recommendations are followed by planners and decision makers who influence tourism development. In the few cases where CCA studies have been conducted within the framework of ICZM, their recommendations have been adopted and integrated into development plans. On the other hand, most independent studies with little or no relation to the overall planning process have rarely been actually implemented. Examples of TCC studies integrated into planning structures and ICZM process are presented below (Coccossis et al., 2002; PAP/RAC, 2003).

In 1993 the Mediterranean Action Plan in cooperation with the Greek national and local authorities launched a CCA case study for the island of Rhodes, which is considered as an important milestone for the finalization of PAP methodology for Carrying Capacity Assessment and the development of PAP guidelines for CCA in Mediterranean coastal zones. The study was carried out under the “Coastal Area Management Program” for the island of Rhodes (Coccossis et al., 2002; PAP/RAC, 2003).

The analysis of the CCA study in Rhodes included two innovative steps; first, it introduced three groups of indicators (spatial-ecological, socio-cultural and economic) for measuring CCA, following the guidelines of UNEP and WTO; second, the study elaborated on two equally development scenarios in the context of intensive but controlled tourism development. The scenarios were the following (PAP/RAC, 2003):

- Intensive tourism development
- Small scale tourism development
- Controlled tourism development

The second scenario was considered unrealistic because of the strong dependence of the island on tourism industry while the first was considered to extend the tourism saturated model of the northern part of Rhodes and produce small economic benefits. Therefore, the

third scenario was chosen as the only possible sustainable option. The maximum level of tourism usage was determined on the basis of tourism business intensity, tolerance of tourists and constraints related to economic and socio-cultural aspects (PAP/RAC, 2003).

The process included the following steps (Coccossis et al., 2002):

- Identification of key problems
- Identification of constraints
- Definition of qualitative determinants
- Definition of quantitative determinants including Physical Carrying Capacity, Ecological Carrying Capacity and Socio-Economic Carrying Capacity
- Identification of key constraint (migrant labor in this case)
- Formulation of alternative hypothesis for the population growth for the period 2000 - 2010
- Calculation of selected indicators (number of beds, arrivals, receipts, ratio of tourists/local population and average tourist expenditure)
- Selection of desirable option

It should be noted that the assessment of carrying capacity was - in this case - considered as part of the broader process of sustainable tourism planning and therefore incorporated the expectations and subjective assessments of the stakeholders involved in the case study area. Questionnaires were circulated to major stakeholders involved and workshops were organized to discuss the sustainability criteria and elaborate on concrete actions for the development of a Sustainability Plan for the area (Coccossis et al., 2002).

In the same context, CCA in Fuka-Matrouh (Egypt) was launched in 1996 as part of the Coastal Area Management Programme (CAMP) of MAP. The study was concluded in 1999 and included three basic groups of indicators: physical-infrastructure, socio-demographic and political-economic. The innovation added to the methodology followed was the data synthesis chapter which included the key elements identified as crucial in data analysis (in this case water supply, management and protection issues as well as lack of land use planning policies). The CCA study in Fuka-Matrouh introduced socio-economic and cultural parameters in CCA which led to the recognition of the study as a structural model of CCA according to PAP guidelines (PAP/RAC, 2003).

The CCA study presented three possible scenarios (PAP/RAC, 1999):

- Tourism development without restrictions and control based on domestic large and small scale investments
- The option of free transfer to commercial interests for overall development predominantly by foreign entrepreneurs
- Alternative tourism option

All three scenarios were rejected either as unsustainable or unrealistic and, therefore, a fourth scenario was proposed as the only feasible option. The *Sustainable Tourism Development* scenario was based on a tourism product designed to attract domestic and international market and extend tourist season (PAP/RAC, 1999; Coccossis et al., 2002). The CCA was further elaborated on three main categories of parameters (Figure 1). Apart from the physical parameters which defined high carrying capacity levels, the other two groups of parameters - socio-cultural and political-economic – posed important constraints. However, on the basis of data analysis and assumed ratio of local population/hosts to visitors/guests during the peak season/day of 3/1 – 2.5/1, the final estimation of maximum accommodation capacity of the entire area was calculated between 80,000 to 100,000 beds in total (PAP/RAC, 1999).

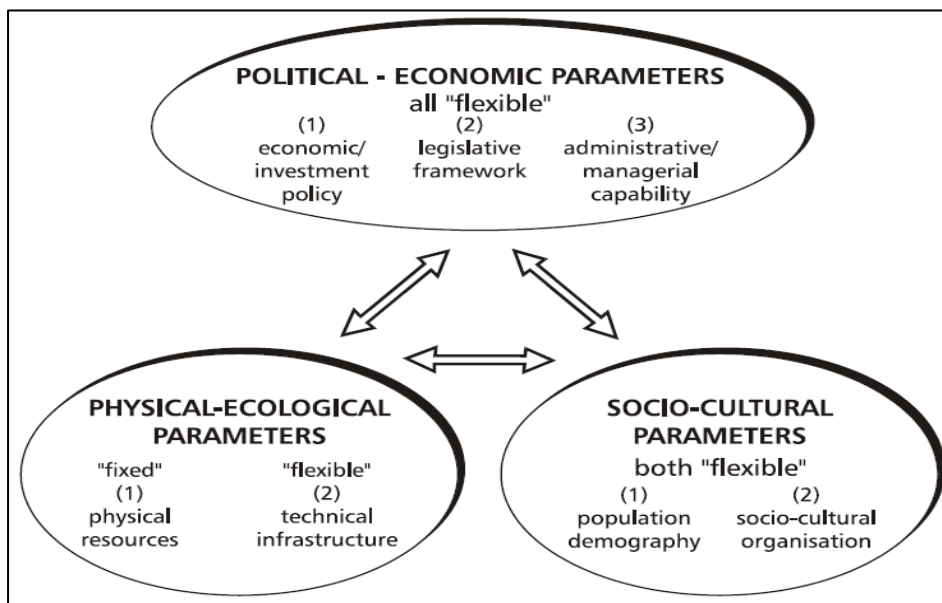


Figure 1: Parameters of the Sustainable Tourism Development Scenario

PAP/RAC, 1999

Following previous experience, the National Tourism Organization of Malta with the advisory support of PAP completed a comprehensive CCA study for the whole territory of Malta in 2001. The main scope of the study was to determine the future framework for tourism development in the period 2000-2010. The main goal was to indicate the most sustainable scenario for tourism development in Malta, taking into consideration the limiting factors imposed by environmental, socio-cultural and economic constraints. The study identified the constraints related to tourism development (strong dependence on foreign earnings, limited land resources and water supply among others) and developed four different possible scenarios (Coccossis et al., 2002; PAP/RAC, 2003):

- free development scenario
- limited growth scenario
- no growth scenario
- up- market scenario

The CCA Committee decided that the limited growth scenario was to be followed in the next decade and set out specific guidelines in the framework of tourism development policy (PAP/RAC, 2003).

In the same context, a TCC study was also developed for Baška Voda area within the framework of Integrated Coastal Zone Management in Croatian coastal zone. Baška Voda is situated 50 km south-east of Split and recorded 1.55 million tourists and 8.3 million overnight stays in 2006. A 12% increase in the number of tourists and 11% increase in overnight stays were recorded in 2007. The study highlighted that although the county accounted for more than 17% in the total Croatian capacities, the overnight stays figures accounted for only 14.7% of the total Croatian overnight stays, indicating that the County's tourism capacities are under-utilized (Satta et al., 2008).

The CCA was conducted in the scope of an integrated analysis for the bathing areas of Baška Voda, including: a) perception of beach users; b) expert analysis of the beaches; and c) calculation of the beach carrying capacity. Carrying capacity was measured in the bathing areas of Baška Voda, taking into consideration the physical-ecological, socio-demographic and political-economic parameters. The physical carrying capacity was calculated based on the type of the beach (differentiation between urban, village, rural and remote beaches) and expert analysis. Optimum carrying capacity and maximum tolerable carrying capacity were calculated, indicating that beach carrying capacity was largely exceeded on all the beaches (Figure 2) (Satta et al., 2008).

Carrying capacity for urban beaches				
	Nikolina	Uranija	Podluka-Ikovac	Total
Beach type	Urban	Urban	Urban	
Total beach surface (m ²)	14,700 (780×18.84)	7,400 (620×11.9)	7,980 (570×14)	30,080
Safety strip (m ²)	1,560 (780×2)	620 (620×1)	570 (570×1)	
Emergency strips (m ²)	160 (20×3 + 15×3 + 20×3)	165 (40×3 + 15×3)	48 (12×3 + 4×3)	
Car space available	300	150	300	
Considered beach surface	12,980	6,615	7,362	26,957
Optimum carrying capacity	7.5–15	7.5–15	7.5–15	
Calculated carrying capacity	865–1,731 (1,050) ¹⁷	441–882 (525)	491–982 (1,050)	1,797–3,595 (2,625)

Carrying capacity for village beaches			
Beach name	Considered beach surface	Village beach carrying capacity	Calculated carrying capacity
Nikolina	12,980	5 – 7.5	1,731 – 2,595
Uranija	6,615	5 – 7.5	882 – 1,323
Podluka-Ikovac	7,362	5 – 7.5	982 – 1,472
Total			3,595 – 5,390

Maximum tolerable carrying capacity			
Beach name	Considered beach surface	Maximum tolerable carrying capacity	Calculated carrying capacity
Nikolina	12,980	3.5 – 5	2,595 – 3,708
Uranija	6,615	3.5 – 5	1,323 – 1,890
Podluka-Ikovac	7,362	3.5 – 5	1,472 – 2,103
Total			5,390 – 7,701

Figure 2: Carrying capacity assessment in Baška Voda

Satta et al., 2008

Similarly, the assessment of ecological carrying capacity of the beaches was mainly based on water quality indicators, which showed good bathing quality within the acceptable limits of the ecological carrying capacity. Litter analysis produced similar results, although improvements in litter management were considered necessary in order not to exceed the ecological carrying capacity of the beaches in the future (Satta et al., 2008).

In terms of social carrying capacity assessment, it was carried out through a questionnaire survey that indicated a lack and bad quality of facilities but not overall crowdedness. The general conclusion from the overall dissatisfaction level was that social carrying capacity was exceeded, more or less, in all bathing areas (Satta et al., 2008).

Finally, the study concluded that beach carrying capacity was largely exceeded in all bathing areas. The TCC acted as a starting point in defining the Strategic Plan for Sustainable Beach Management. Based on the TCC study and after setting out sustainable beach management objectives, four different scenarios were produced (Satta et al., 2008):

- Baseline scenario
- Restricted beach use
- Beach management favoring intensive mass-tourism development
- Moderate beach use

The Moderate Beach Use Scenario was selected as the one that better corresponds to beach management and sustainable tourism development objectives. The scenario was modified in order to harmonize tourism growth with the needs of both tourists and local population. In terms of beach TCC, the optimum CC was considered impossible to achieve without drastic measures that would not be sustainable in the long term. It was, therefore, modified to increase the current beach surface, only as much as needed, in order to secure a minimum carrying capacity of 5 m² per user (given a number of 10,000 visitors at a given time) (Satta et al., 2008).

4. Operationalizing TCCA for Coastal Destinations

In Figure 1 the rationale of incorporating TCCA in local planning frameworks is presented. The logic behind planning and TCCA integration is that in order for tourism development to be realized in a sustainable context, the destinations' tourism resources should be exploited at the most effective level. Taking into account that tourism activities as well as other coastal activities are utilizing common shared resources, the co-evolution of activities should take place under a controlled context in order for any conflicts and negative externalities to be avoided. Based on this target, the development of each coastal and maritime activity should promote the reduction of conflicts and pressures to the local ecosystem. In this context, CCA could form a base for realizing the desired controlled and sustainable co-evolution of uses.

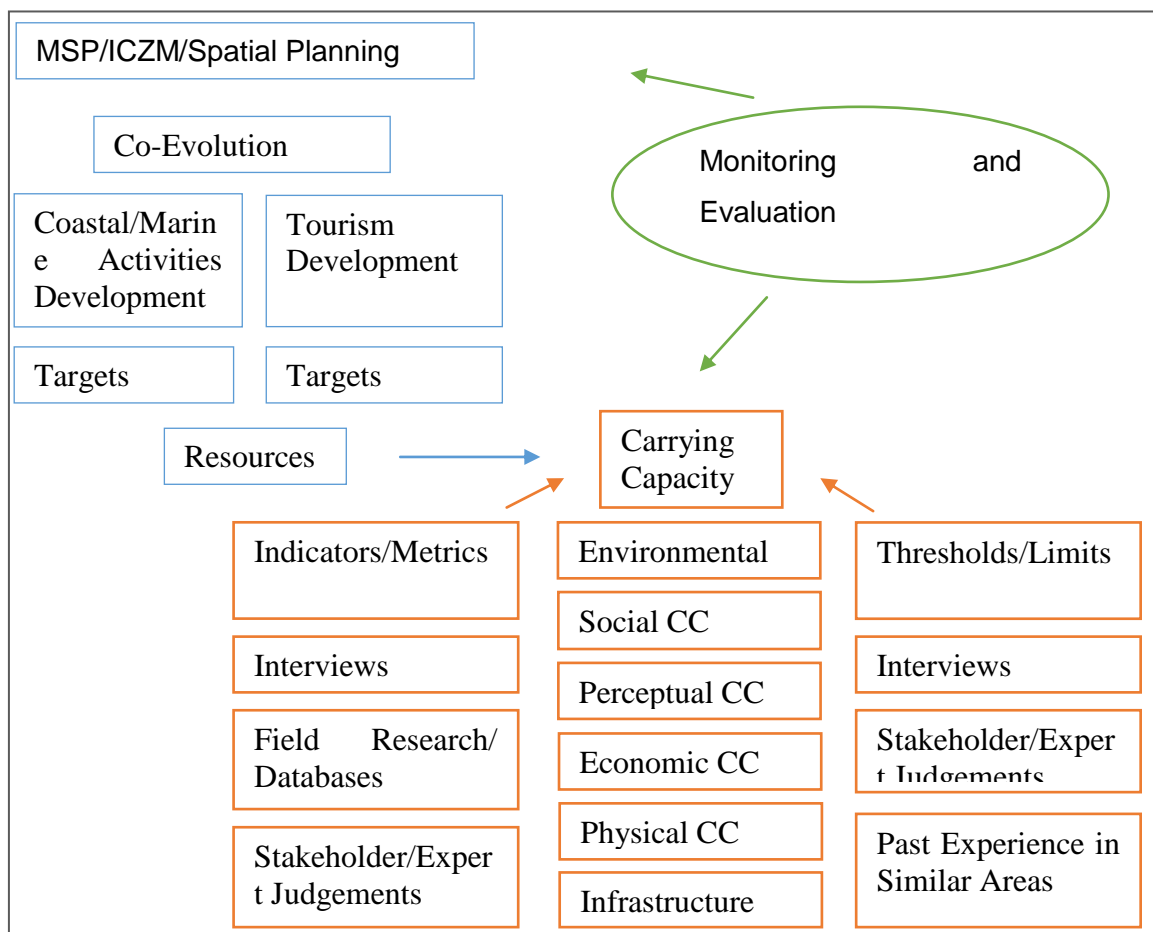


Figure 3: Proposed Tourism Carrying Capacity Assessment Framework for Coastal Destinations

Own elaboration

As far as tourism is concerned, TCCA could prove to be an effective means for setting the limits of further tourism development, taking into account the availability of both tourism and common shared resources. Therefore, a comprehensive assessment framework should be

developed and followed in each destination. The framework should integrate all aspects of tourism sustainability, meaning all six dimensions of TCC should be taken into account. Moreover, the metrics/indices for assessing TCC should be defined for each dimension. Previous analysis revealed that there are three main methods for setting the quantitative or qualitative method of assessment. The first refers to the extraction of data through dedicated surveys. This kind of approach is mainly used in Social/Perceptual and Economic TCC Assessments for which the perceptions of users and locals are important. The second approach uses strictly quantitative data acquired either by relevant databases or by onsite empirical surveys. This kind of approach is mainly adopted in Environmental, Physical and Infrastructure TCC Assessments for which quantitative data can effectively describe the state of tourism related activities and the levels of resources utilization/degradation. Finally, a third approach that could be adopted by all TCC Assessments is based on experts' or stakeholders' judgment.

Regardless of the method used to conduct the TCCA, a critical issue towards an effective assessment is the definition of the CC thresholds. Current practices and previous efforts have used three different approaches for setting the thresholds for CC. The first method is taking into account the perceptions of users and locals. Within this context and given the selected metrics for quantifying CC, the levels of tolerance are extracted through interviews and personal surveys. The second approach uses the experts'/stakeholders' judgments as the accepted level for each metric/indicator set under a consultation process. Finally, the third approach utilizes the results of previous studies on destinations with similar characteristics and adapts them to the considered destinations.

Having selected the TCCA method, the challenge for an effective outcome is to ensure that the TCCA results will be utilized in order to feed the general management and planning processes of the destination such as spatial plans, MSP, ICZM etc. In addition, having in mind that the conditions under which tourism development is taking place change over time and that some of the tourism generated impacts are realized in the long term, TCCA should entail a dynamic character, ensuring that it can be adjusted on future needs and challenges. In order to achieve this target TCCA should be enriched with a comprehensive monitoring and evaluation system directly linked to the respective system of the local general planning framework.

Having in mind the preceding points regarding the integration of TCCA into wider planning processes, the following analysis builds further on the indicators of D3.16.2 in order to propose a system of metrics that could form the basis for a systematic assessment of all the different types of TCC at the pilot areas of CO-EVOLVE. The system of metrics for TCCA is divided into the five corresponding types of tourism:

a) Beach Tourism

In such areas the “sun and sea” tourism model usually prevails and mass tourism phenomena are observed in highly developed destinations. This kind of tourism model comes up with negative externalities that affect all dimensions of sustainability. Thus, it is advisable that all TCCA are adapted in order to monitor the touristic development and its impacts. Since beaches constitute the main resource for the development of such kind of tourism model, particular attention should be paid to the management of beaches in order for any overcrowding phenomena to be avoided and negative impacts on the environmental quality of beaches to be mitigated. Table 2 presents some indicative metrics for establishing a TCCA framework in beach tourism destinations.

b) Urban/cultural tourism

Urban and cultural tourism has become a growing and profitable market in the last decades, demonstrating high proportion of daily visitors and expenses. However, urban growth and tourism overflows create congestion and commercialization phenomena that may pose severe threats to the sustainability of such tourism models. Preservation of cultural heritage and city restoration are among the top priorities in urban destinations. TCCA studies should, therefore, emphasize in regular measuring and monitoring of related indicators as well as accessibility issues, services and accommodation. Thresholds should be defined in order to mitigate the risk of city and cultural heritage deterioration and congestion phenomena. Table 3 presents some indicative metrics for establishing a TCCA framework in urban/cultural tourism destinations.

c) Cruise tourism

Cruising is a constantly developing and demanding industry with significant impacts on tourism destinations, including both benefits and risks. Sustainability issues are associated with the operation of the ships themselves as well as the destinations' capacity to accommodate such tourism model. Since destinations have little influence on ships arrivals and length of stay, TCCA studies should focus on the acceptable stress levels that may be posed to each destination with emphasis on environmental indicators, physical capacity and infrastructure potential. Table 4 presents some indicative metrics for establishing a TCCA framework in cruising destinations.

d) Recreational boating

Recreational boating is a growing and competitive market associated with significant economic benefits for the corresponding destinations, especially in the super yacht segment. Similar to cruising destinations, sustainability issues may arise either from the operation of the yachts themselves or the destinations' capacity to sustain this particularly demanding tourism model. Thresholds should be defined in order to mitigate the risk of environmental degradation related to yachts operation and not to exceed the physical capacity of each destination. Since it is a very competitive and demanding market, special attention should be given to interlinked economic activities and infrastructure services. Table 5 presents some indicative metrics for establishing a TCCA framework in recreational boating destinations.

e) Nature/ecotourism

The main challenge in this type of tourism model is the preservation, protection and promotion of the ecosystems that define the destinations themselves. In such cases, measuring and monitoring tourism flows and physical capacity are of vital importance for the sustainability of the destinations. TCCA studies should define thresholds in order to mitigate the risk of environmental degradation, mainly focusing on recording changes in the ecosystems (ecological values, tourist management levels etc.). The active participation and agreement of local communities in the management of ecotourism on a regular basis is also fundamental to define the level of ecotourism activities and assess potential impacts. Table 6 presents some indicative metrics for establishing a TCCA framework in nature/ ecotourism destinations.

Table 2: Proposed Metrics for TCCA in beach/maritime tourism destinations

Carrying Capacity	Proposed Indicators	Description of Basic Estimation Methods and notes on Indicators
Physical Carrying Capacity	Indicators from 3.16.1 D1.B4 Number of persons per hectare (or square meter) on the beach (for annual averages, and peak day, peak month) D1.C1 Total km of beaches (and free beaches relative to total km of beaches) Additional Indicators Maximum capacity of site of interest (No of tourists/(per site) or (per hectare)) No of days for which weather conditions allow the use of the place of interest (No of days/Year)	Estimation of Physical Carrying Capacity, Real Carrying Capacity, Effective Carrying Capacity could be based on the formulas described in Section 2. Carrying capacity assessment should be conducted in places of interest for which overcrowding phenomena arise or are expected to arise. In order to estimate the three types of Physical Carrying Capacity, data on site capacity, tourist flows and other limiting factors (resource management, weather conditions etc.) should be extracted. The proposed indicators may be used as a basis for acquiring the essential data for estimating PCC. In addition, more indicators could be employed by each destination according to its particular characteristics and challenges.
	Indicators from 3.16.1 C. B1.3 Relative contribution of tourism to the destination's economy per year (% GDP) C.B3.1 Direct tourism employment as % of total employment in the destination per year C.B3.2 % of jobs in tourism that are seasonal C.B4.1 % of locally produced food, drinks, goods and services sourced by the destination's tourism enterprises Additional Indicators Relative contribution of sectors to the destination's economy per year (% GDP) Direct employment as % of total employment in the destination per sector and per year Average Coastal Land Prices per year (€ per year)	Estimation of Economic Carrying Capacity could be conducted with the use of surveys or with the use of longitudinal economic data for all the sectors of the local economy. In destinations where tourism activities lie at the core of the economy, negative externalities to other economic sectors are very possible to be observed. These situations are expected to come up especially in destinations where the sun and sea model prevails. Thus, for destinations where beach tourism is highly developed ECC should be assessed and reviewed in a systematic context. The proposed indicators are expected to capture the relative performance of local economic sectors in a dynamic context. By doing so, the possible negative externalities of tourism on other sectors performance could be revealed. Then it is on the local community to define the threshold for tourism development.
Social Carrying Capacity	Indicators from 3.16.1 C.A2.1 % of tourists and same-day visitors that are satisfied with their overall experience in the destination C.C1.1 Number of tourists/visitors per 100 residents C.C1.2 % of residents who are satisfied with tourism in the destination (per month/season) C.C4.1 % of residents that are satisfied with the impacts of tourism on the destination's identity	Estimation of Social Carrying Capacity and Perceptual Carrying Capacity could be conducted with the use of dedicated surveys. In order for Social Carrying Capacity to be reviewed in a logical timeframe it is advisable that surveys are conducted periodically in an annual basis. This procedure may prove to be helpful towards the definition of SCC thresholds. The proposed indicators may be used in order to form the structure of the surveys and extract the essential metrics for the longitudinal analysis of Social Carrying Capacity

Environmental Carrying Capacity	<p>Indicators from 3.16.1</p> <p>C.D3.1 Waste production per tourist night compared to general population waste production per person (kg)</p> <p>Di. B3 Level of contamination per 100 ml (fecal coliforms, campylobacter)</p> <p>D1.C2 % of beaches awarded the Blue Flag</p> <p>Additional Indicators</p> <p>Litter collection per beach or coast (Kgs per hectare)</p>	<p>Environmental Carrying Capacity should rely on real data and observations. Nevertheless, perception of users and residents/stakeholders towards environmental state of the destinations may also be used in a complementary context.</p> <p>In beach tourism destinations, particular attention should be paid to the state of beaches and their waters. Thus metrics should target on the environmental quality of both coast and marine space.</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>
Infrastructure Carrying Capacity	<p>Indicators from 3.16.1</p> <p>C.B2.2 Occupancy rate in commercial accommodation per month and average for the year</p> <p>C.D4.1 % of sewage from the destination treated to at least secondary level prior to discharge</p> <p>C.D5.1 Water consumption per tourist night compared to general population water consumption per resident night</p> <p>C.D6.1 Energy consumption per tourist night compared to general population energy consumption per resident night</p> <p>Additional Indicators</p> <p>% occupancy in tourism sites.</p> <p>Daily traffic per day.</p>	<p>Infrastructure Carrying Capacity should take into account all infrastructures associated with tourism activities either directly or indirectly.</p> <p>The aim of Infrastructure Carrying Capacity assessment is to quantify and control the additional pressure that tourism puts on the utilization of existing infrastructures.</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>

Table 3: Proposed Metrics for TCCA in urban/cultural tourism destinations

Carrying Capacity	Proposed Indicators	Description of Basic Estimation Methods and notes on Indicators
Physical Carrying Capacity	Indicators from 3.16.1 Dii.B1. Total number of tourists per square Km in key sites (crowding/spatial distribution) Dii.A5. % of key sites operating all year Additional Indicators Intensity of use – peak period (persons/hectare)	Estimation of Physical Carrying Capacity, Real Carrying Capacity, Effective Carrying Capacity could be based on the formulas described in Section 2. Carrying capacity assessment should be conducted in places of interest for which overcrowding phenomena arise or are expected to arise. In order to estimate the three types of Physical Carrying Capacity, data on site capacity, tourist flows and other potential limiting factors (spatial distribution, crowding) should be extracted. The proposed indicators may be used as a basis for acquiring the essential data for estimating PCC. In addition, more indicators could be employed by each destination according to its particular characteristics and challenges.
	Indicators from 3.16.1 C. B1.3 Relative contribution of tourism to the destination's economy per year (% GDP) C.B3.1 Direct tourism employment as % of total employment in the destination per year C.B4.1 % of locally produced food, drinks, goods and services sourced by the destination's tourism enterprises Dii.A1. Number of tourism-related MSMEs operating in the destination Additional Indicators Direct employment as % of total employment in the destination per sector and per year	Estimation of Economic Carrying Capacity could be conducted with the use of surveys or with the use of longitudinal economic data for all the sectors of the local economy. In destinations where tourism activities lie at the core of the economy, negative externalities to other economic sectors are very possible to be observed. In urban/cultural destinations, special attention should be given in hotspots where mass tourism arrivals are observed. The proposed indicators are expected to capture the relative performance of local economic sectors in a dynamic context. By doing so, the possible negative externalities of tourism on other sectors performance could be revealed. Then it is on the local community to define the threshold for tourism development.
Social Carrying Capacity	Indicators from 3.16.1 C.A2.1 % of tourists and same-day visitors that are satisfied with their overall experience in the destination C.C1.2 % of residents who are satisfied with tourism in the destination (per month/season) C.C3.3 % of tourist attractions that are accessible to people with disabilities and/or participating in recognized accessibility information schemes C.C4.1 % of residents that are satisfied with the impacts of tourism on the destination's identity C.C4.2 % of the destination's events that are focused on traditional/local culture and heritage	Estimation of Social Carrying Capacity and Perceptual Carrying Capacity could be conducted with the use of dedicated surveys. In order for Social Carrying Capacity to be reviewed in a logical timeframe it is advisable that surveys are conducted periodically in an annual basis. This procedure may prove to be helpful towards the definition of SCC thresholds. The proposed indicators may be used in order to form the structure of the surveys and extract the essential metrics for the longitudinal analysis of Social Carrying Capacity.

Environmental Carrying Capacity	<p>Indicators from 3.16.1</p> <p>C.D1.2 % of tourists and same-day visitors using local/soft mobility/public transport services to get around the destination</p> <p>C.D3.1 Waste production per tourist night compared to general population waste production per person (kg)</p> <p>Dii.C3. % of district under protection</p> <p>Dii.C4. % of sites under a management and monitoring system for protection of cultural sites</p> <p>Additional Indicators</p> <p>Garbage disposal and control at cultural heritage sites</p>	<p>Environmental Carrying Capacity should rely on real data and observations. Nevertheless, perception of users and residents/stakeholders towards environmental state of the destinations may also be used in a complementary context.</p> <p>In urban/cultural destinations, particular attention should be paid to preservation of cultural heritage, city restoration and congestion control. The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>
Infrastructure Carrying Capacity	<p>Indicators from 3.16.1</p> <p>C.D4.1 % of sewage from the destination treated to at least secondary level prior to discharge</p> <p>C.D5.1 Water consumption per tourist night compared to general population water consumption per resident night</p> <p>C.D6.1 Energy consumption per tourist night compared to general population energy consumption per resident night</p> <p>Additional Indicators</p> <p>% occupancy in tourism sites.</p>	<p>Infrastructure Carrying Capacity should take into account all infrastructures associated with tourism activities either directly or indirectly. The aim of Infrastructure Carrying Capacity assessment is to quantify and control the additional pressure that tourism puts on the utilization of existing infrastructures.</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>

Table 4: Proposed Metrics for TCCA in cruising destinations

Carrying Capacity	Proposed Indicators	Description of Basic Estimation Methods and notes on Indicators
Physical Carrying Capacity	<p>Indicators from 3.16.1</p> <p>Diii.A4. Number of ship visits per year (by month)</p> <p>Diii.A5. % annual ship visits arriving in peak month/ season</p> <p>Diii.C1. Maximum capacity of docking facilities (number)</p> <p>Additional Indicators</p> <p>% Use of current shore docking capacity</p>	<p>Estimation of Physical Carrying Capacity, Real Carrying Capacity, Effective Carrying Capacity could be based on the formulas described in Section 2.</p> <p>Carrying capacity assessment should be conducted in places of interest for which overcrowding phenomena arise or are expected to arise. In order to estimate the three types of Physical Carrying Capacity, data on site capacity, tourist flows and other potential limiting factors should be extracted.</p> <p>The proposed indicators may be used as a basis for acquiring the essential data for estimating PCC. In addition, more indicators could be employed by each destination according to its particular characteristics and challenges.</p>
Economic Carrying Capacity	<p>Indicators from 3.16.1</p> <p>C.B1.3 Relative contribution of tourism to the destination's economy per year (% GDP)</p> <p>Diii.A2. Total jobs directly attributable to cruise industry</p> <p>Diii.A7. Total and average port fees and charges received per ship visit</p> <p>Diii.A8. Average spending per cruise ship visitor (€)</p>	<p>Estimation of Economic Carrying Capacity could be conducted with the use of surveys or with the use of longitudinal economic data for all the sectors of the local economy.</p> <p>In destinations where tourism activities lie at the core of the economy, negative externalities to other economic sectors are very possible to be observed. In cruise destinations where the economic benefits are of major importance, ECC should be assessed and reviewed in a systematic context.</p> <p>The proposed indicators are expected to capture the relative performance of local economic sectors in a dynamic context. By doing so, the possible negative externalities of tourism on other sectors performance could be revealed. Then it is on the local community to define the threshold for tourism development.</p>
Social Carrying Capacity	<p>Indicators from 3.16.1</p> <p>C.A2.1 % of tourists and same-day visitors that are satisfied with their overall experience in the destination</p> <p>C.C1.2 % of residents who are satisfied with tourism in the destination (per month/season)</p> <p>C.C4.1 % of residents that are satisfied with the impacts of tourism on the destination's identity</p> <p>Diii.A9. Peak day passengers discharged (total number, ratio of passengers discharged to local population)</p>	<p>Estimation of Social Carrying Capacity and Perceptual Carrying Capacity could be conducted with the use of dedicated surveys.</p> <p>In order for Social Carrying Capacity to be reviewed in a logical timeframe it is advisable that surveys are conducted periodically in an annual basis. This procedure may prove to be helpful towards the definition of SCC thresholds.</p> <p>The proposed indicators may be used in order to form the structure of the surveys and extract the essential metrics for the longitudinal analysis of Social Carrying Capacity</p>
Environmental Carrying Capacity	<p>Indicators from 3.16.1</p> <p>Diii.B5. Number of discharge violations (Ballast water)</p> <p>Diii.B6. Level of contamination of seawater per 100ml (heavy metals)</p>	<p>Environmental Carrying Capacity should rely on real data and observations. Nevertheless, perception of users and residents/stakeholders towards environmental state of the destinations may also be used in a</p>

Infrastructure Carrying Capacity		<p>complementary context.</p> <p>In cruising destinations, special attention should be paid to metrics related to the operation of the ships and water quality records.</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>
	<p>Indicators from 3.16.1</p> <p>Diii.B1.Volume of fresh water on-loaded at port (m³)</p> <p>Diii.B2.Volume of waste accepted for disposal (solid, liquid) at port (m³)</p>	<p>Infrastructure Carrying Capacity should take into account all infrastructures associated with tourism activities either directly or indirectly.</p> <p>The aim of Infrastructure Carrying Capacity assessment is to quantify and control the additional pressure that tourism puts on the utilization of existing infrastructures. Especially in cruising destinations, thresholds should be defined in relation to infrastructure capacities (water, discharges, energy, etc) in order to mitigate negative externalities (water limitations, waste treatment capacity, etc.).</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>

Table 5: Proposed Metrics for TCCA in recreational boating destinations

Carrying Capacity		Proposed Indicators	Description of Basic Estimation Methods and notes on Indicators
Physical Carrying Capacity	Carrying Capacity	Indicators from 3.16.1 Div.A2. Number of yachts per year (by month) Div.A3. % annual yachts arriving in peak month/ season Div.C1. Number of berths and moorings for recreational boating	Estimation of Physical Carrying Capacity, Real Carrying Capacity, Effective Carrying Capacity could be based on the formulas described in Section 2 Carrying capacity assessment should be conducted in places of interest for which overcrowding phenomena arise or are expected to arise. In order to estimate the three types of Physical Carrying Capacity, data on site capacity, tourist flows and other potential limiting factors should be extracted. The proposed indicators may be used as a basis for acquiring the essential data for estimating PCC. In addition, more indicators could be employed by each destination according to its particular characteristics and challenges.
		Indicators from 3.16.1 C.B1.3 Relative contribution of tourism to the destination's economy per year (% GDP) Div.A5. Total and average port fees and charges received per boat (€) Additional Indicators Total purchases of local goods (e.g., foodstuffs, beverages, souvenirs) per boat	Estimation of Economic Carrying Capacity could be conducted with the use of surveys or with the use of longitudinal economic data for all the sectors of the local economy. In destinations where tourism activities lie at the core of the economy, negative externalities to other economic sectors are very possible to be observed. Special attention in recreational boating destinations should be given in potential interlinked economic activities and commercial services. The proposed indicators are expected to capture the relative performance of local economic sectors in a dynamic context. By doing so, the possible negative externalities of tourism on other sectors performance could be revealed. Then it is on the local community to define the threshold for tourism development.
		Indicators from 3.16.1 C.A2.1 % of tourists and same-day visitors that are satisfied with their overall experience in the destination C.C1.2 % of residents who are satisfied with tourism in the destination (per month/season) C.C4.1 % of residents that are satisfied with the impacts of tourism on the destination's identity	Estimation of Social Carrying Capacity and Perceptual Carrying Capacity could be conducted with the use of dedicated surveys. In order for Social Carrying Capacity to be reviewed in a logical timeframe it is advisable that surveys are conducted periodically in an annual basis. This procedure may prove to be helpful towards the definition of SCC thresholds. The proposed indicators may be used in order to form the structure of the surveys and extract the essential metrics for the longitudinal analysis of Social Carrying Capacity
		Indicators from 3.16.1 Div.B5. Number of reported pollution or contamination events per annum (by month) in watercourses receiving effluents (in tourist	Environmental Carrying Capacity should rely on real data and observations. Nevertheless, perception of users and residents/stakeholders towards environmental state of the destinations may also be used in a

Infrastructure Carrying Capacity	<p>harbours/marinas)</p> <p>Div.B6. Number of discharge violations (Ballast water)</p> <p>Div.B7. Level of contamination of seawater per 100 ml (heavy metals)</p>	<p>complementary context.</p> <p>In recreational boating destinations, special attention should be paid to metrics related to the operation of the ships and water quality records.</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>
	<p>Indicators from 3.16.1</p> <p>Div.B1.Volume of fresh water on-loaded at port (m³)</p> <p>Div.B2.Volume of waste accepted for disposal (solid, liquid) at port (m³)</p>	<p>Infrastructure Carrying Capacity should take into account all infrastructures associated with tourism activities either directly or indirectly.</p> <p>The aim of Infrastructure Carrying Capacity assessment is to quantify and control the additional pressure that tourism puts on the utilization of existing infrastructures. In recreational boating destinations, thresholds should be defined in relation to infrastructure capacities (water, discharges, energy, etc) in order to mitigate negative externalities (water limitations, waste treatment capacity, etc.).</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>

Table 6: Proposed Metrics for TCCA in nature/ecotourism destinations

Carrying Capacity	Proposed Indicators	Description of Basic Estimation Methods and notes on Indicators
Physical Carrying Capacity	Indicators from 3.16.1 Dv.A3. Total number of visitors to parks and to key sites Dv.A4. Number of tourists per square meter of the site (mean number/peak month average/peak day) Dv.B5.N° of visitors acceptable, according to the capacity of the equipment and facilities of the site (depends on capacity studies establishing limits) Additional Indicators % of area subject to control	Estimation of Physical Carrying Capacity, Real Carrying Capacity, Effective Carrying Capacity could be based on the formulas described in Section 2 Carrying capacity assessment should be conducted in places of interest for which overcrowding phenomena arise or are expected to arise. In order to estimate the three types of Physical Carrying Capacity, data on site capacity, tourist flows and other potential limiting factors should be extracted. The proposed indicators may be used as a basis for acquiring the essential data for estimating PCC. In addition, more indicators could be employed by each destination according to its particular characteristics and challenges.
	Indicators from 3.16.1 C.B1.3 Relative contribution of tourism to the destination's economy per year (% GDP) C.B4.1 % of locally produced food, drinks, goods and services sourced by the destination's tourism enterprises Additional Indicators Employment of local residents in site management and tourism operations (numbers, income levels)	Estimation of Economic Carrying Capacity could be conducted with the use of surveys or with the use of longitudinal economic data for all the sectors of the local economy. In destinations where tourism activities lie at the core of the economy, negative externalities to other economic sectors are very possible to be observed. In nature/ecotourism destinations, economic relations between tourism activities and local communities should be regularly recorded. The proposed indicators are expected to capture the relative performance of local economic sectors in a dynamic context. By doing so, the possible negative externalities of tourism on other sectors performance could be revealed. Then it is on the local community to define the threshold for tourism development.
	Indicators from 3.16.1 C.A2.1 % of tourists and same-day visitors that are satisfied with their overall experience in the destination C.C1.2 % of residents who are satisfied with tourism in the destination (per month/season) C.C4.1 % of residents that are satisfied with the impacts of tourism on the destination's identity Additional Indicators Level of satisfaction of residents regarding tourism development in the area - particularly regarding that targeting natural systems Existence of a participatory process for community and protected area collaboration in planning and management	Estimation of Social Carrying Capacity and Perceptual Carrying Capacity could be conducted with the use of dedicated surveys. In order for Social Carrying Capacity to be reviewed in a logical timeframe it is advisable that surveys are conducted periodically in an annual basis. This procedure may prove to be helpful towards the definition of SCC thresholds. Especially in nature/ecotourism destinations where active participation and agreement of local communities is fundamental, SCC should be assessed and reviewed in a systematic context The proposed indicators may be used in order to form the structure of the surveys and extract the essential metrics for the longitudinal analysis of Social Carrying Capacity
Environmental	Indicators from 3.16.1	Environmental Carrying Capacity should rely on real data and observations.

Carrying Capacity	<p>C.D3.1 Waste production per tourist night compared to general population waste production per person (kg)</p> <p>Dv.B1. Number of sites/ecosystems/assets considered to be damaged or threatened (% of all defined systems/assets in protected area)</p> <p>Dv.B2. % of protected area in eroded or degraded state</p> <p>Additional Indicators</p> <p>Amount of litter in natural areas (seasonality of waste can relate to tourist numbers)</p> <p>Noise pollution due to motors: visitors perceiving annoying motor noises (cars, launches, motorcycles, planes, generators, etc.) in natural areas</p>	<p>Nevertheless, perception of users and residents/stakeholders towards environmental state of the destinations may also be used in a complementary context.</p> <p>In nature/ecotourism destinations, special attention should be paid to recording changes in the ecosystems. Thus, metrics should target on measuring, recording and monitoring ecological values and protection level of the ecosystems.</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>
Infrastructure Carrying Capacity	<p>Indicators from 3.16.1</p> <p>C.D5.1 Water consumption per tourist night compared to general population water consumption per resident night</p> <p>C.D6.1 Energy consumption per tourist night compared to general population energy consumption per resident night</p> <p>Dv.C5. N° of access routes in good condition for tourism use</p> <p>Additional Indicators</p> <p>% occupancy of camping sites and accommodation</p>	<p>Infrastructure Carrying Capacity should take into account all infrastructures associated with tourism activities either directly or indirectly.</p> <p>The aim of Infrastructure Carrying Capacity assessment is to quantify and control the additional pressure that tourism puts on the utilization of existing infrastructures.</p> <p>The proposed indicators should be reviewed constantly. The thresholds could be shaped through a participatory approach and with the use of the relevant literature.</p>

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