Ocean and Coastal Management 169 (2019) 27–36

Contents lists available at ScienceDirect

Ocean and Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Tourism analysis at Asinara Island (Italy): Carrying capacity and web evaluations in two pocket beaches

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ARTICLE INFO

Keywords:
Sustainable tourism
Marine protected area
Pocket beaches
Park management
TripAdvisor

ABSTRACT

Tourism has many environmental impacts and particularly in marine Protected Areas, which are declared to protect biological and environmental values. The long-term objective of Protected Areas can be complex considering that preservation of a site should not be in conflict with the right of user's access and with the quality of visitors experiences. Consequently, solutions may be found to find a balance between preservation and recreational uses that can be sustained by the environmental resources of the area. In this study we propose a methodology to help park manager to develop attractive sustainable tourism. The method is based on tourist perception assessment using website reviews and specifically TripAdvisor. We analyzed 637 reviews containing overall satisfaction, environmental aspects, transport means, service and management aspects. On the other hand, the calculation of carrying capacity, based on the Cifuentes method, provided insights about the interaction of human activities with the environment, considering biophysical characteristics, social factors and management policies. Our results suggest that the tourist carrying capacity is in its lower level and that tourist experience is judged excellent. Finally, the analysis of the TripAdvisor reviews may represent a useful instrument for decision makers by identifying negative aspects and solutions.

1. Introduction

The Mediterranean coastal areas, and in particular of the Tyrrhenian-Ligurian basin, are characterized by high cultural, environmental and landscape values, and, consequently these territories are important and desirable tourist and recreational destinations. As stated by Davenport and Davenport (2006), "physical development of coastal resorts, consumption of fuel by buildings, aircraft, trains, buses, taxis and cars, overuse of water resources, pollution by vehicle emissions, sewage and litter all contribute to substantial, often irreversible, environmental degradation, as well as to dramatic social consequences". Indeed, a conserved and ecologically balanced environment is necessary to develop sustainable tourism activities that could be based on carrying capacity analysis to integrate planning and tourist destinations strategies. Carrying capacity studies principally aim to balance the conservation of the environment used for activities, with a management for sustainable growth. In other words, they can be seen as a strategic element to preserve the attractiveness of a site (Dias e Cordeiro et al., 2013).

In 1981, the World Tourism Organization (WTO) proposed a definition of tourist carrying capacity as: "The maximum number of people that may visit a tourist destination at the same time, without causing destruction of the physical, economic, socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction." (UNEP/MAP/PAP, 1997). Consequently, the concept of carrying capacity that covers all these aspects is often used to develop sustainable tourism in order to protect the destination physically, socially, culturally and ecologically (Rodella et al., 2017; Saveriades, 2000; Syed Rashidul et al., 2014; Zacarias et al., 2011). In addition, tourism carrying capacity studies are used to design and implement strategies and actions for conservation, mitigation and adaptation of tourism in a Protected Natural Area (Segrado Pavón et al., 2015), even if the definition of "limits" is a controversial subject (Butler, 1980; Driml and Common, 1995; Farrell and Marion, 2002; Mexa and Coccossis, 2004; OMT, 1992) and requires the integration of natural, social, and economic aspects to obtain a systemic understanding (Cifuentes, 1992;

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https://doi.org/10.1016/j.ocecoaman.2018.12.004
Received 18 May 2018; Received in revised form 16 September 2018; Accepted 6 December 2018

Johnson et al., 1994) of the locations. Furthermore, the long-term objectives for the conservation of Protected Areas can be complex and must assume that the preservation of a site should not be in conflict with the right of access by users (tourists, residents, environmentalists and researchers) and with the quality of visitors' experiences. Therefore, models creating short- and medium-term simulations are important tool in the decision-making process regarding land and resources management (Pizzitutti et al., 2016).

As strategy for sustainable land use, the Protected Area can benefit from sustainable tourism that aims to preserve the landscape, provide recreational services for visitors (Becken and Job, 2014; Glyptis, 1991) and promote environmental education; in which the increase of visitors can influence the system resilience or the tourist's satisfaction. The result is not expressed by an absolute number of visitors (Cifuentes et al., 1999) but by an appropriate degree or level of tourism (Segrado Pavón et al., 2015). Most of the methods for evaluating the tourist carrying capacity in natural environments use 4 different components: a) biophysical components: related to natural resources; b) socio-cultural components: take into account the impact of tourism on the local population; c) visitor psychological components: refer to the maximum number of visitors that an area is able to sustain, over a period of time, promoting acceptable recreational experiences; d) management and administration components: refer to the level of visit that can be controlled in a particular area and relate to the availability of human resources infrastructure and resources for the management of the area concerned (Maciel et al., 2008).

Despite the severe limitations associated with the carrying capacity concept, it remains “a useful concept for environmental management, especially in providing insights about the interaction of human activities with the environment” (Papageorgiou and Brotherton, 1999). The carrying capacity has been described as an appropriate concept for beach management, as it “enables the preservation of the high quality and quantity of coastal resources whilst meeting not only the current needs, but also securing long-term economic and ecological benefits for future generations” (UNEP/MAP/PAP, 1997).

Recently, as reported by Buhalis and Law (2008), Internet is one of the most influential technologies that have changed tourist's behaviour. In fact, travellers like to share their travel experiences and recommendations with others and consequently Virtual Travel Communities represent favourite areas to post travel diaries and comments. Additionally, according to Fotis et al. (2012), “the validity of electronic word-of-mouth is particularly emphasized, since social media content is very often perceived to be more trustworthy than official tourism websites or mass-media advertising”. TripAdvisor is amongst the most successful social networking/virtual community in tourism that provides reviews and comments written from TripAdvisor members and also customers satisfactions. The purpose of this study is to analyse these comments to define and understand customer's satisfactions and behaviour and eventually propose corrective actions to improve the tourism perception. The study also analyses the touristic carrying capacity in order to contribute to the sustainability of the beaches of Cala dei Ponsezi and Cala Giordano located in the National Park of Asinara (Sardinia, Italy). The park, established in 1999, records an increasing tourism demand, and in the meantime, several problems affect the management of visits and the proper use of the Park, such as the need of an efficient and valid rationalization process: the knowledge of the effective access and its regulation, the protection of nature from exploitation, as well as the planning of a process for a “socially shared fruition” (Carboni et al., 2015).

2. Study area

Asinara island is located in the north-west of Sardinia and is separated from the north-western Sardinia by a narrow channel bisected by the small island of Piana. It has a surface of 51.9 km^2, a length of 17.4 km and a width which ranges from 290 m of Cala di Sgombro to 6.4 km of the northern part; it has a coastal development of 110 km and a highest altitude of 408 m (Punta della Scomunica). The territory is entirely a state property. Asinara was a prison island from 1885 to 1997, so the island has had a quieter history than the other over-exploited coasts of Sardinia and of most of the Mediterranean. Public access and construction have been forbidden for nearly a century. This, despite the lack of environmental concern of the small resident population of prisoners and guards, has allowed the maintenance of peculiar Mediterranean flora and fauna and has prevented serious damage to the coastal benthic and marine assemblages, as opposed to that of the offshore marine environment. The island has a high natural value due to the presence of extremely rare endemic species like *Centaurea horrida Badarò* (Boccheri, 1993; Brandis et al., 2001; Diana and Corrias, 1998).

Asinara National Park was officially instituted by Italian Law no. 344 in 1997. The Park includes the surface above water and the small islands within 1 km of the coastline, except Piana island (Gazale and Congiatu, 2005). The Decree of Republic President of 3rd October 2002 and the Ministerial Decree of 13th August 2002 established the Protected Marine Area of Asinara, which has an area of 10,732 ha and a coastline length of 79.64 km (Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2010). In accordance with Law no. 394 of 1991, the territory of Asinara National Park is divided according to the degree of protection (Fig. 1): zones A – integral reserve areas in which the natural environment is entirely protected and access is denied; zones B – the actual Park areas, in which environmental and nature activities are allowed as well as interventions for the management of natural resources. However, new buildings or transformation of the territory are not allowed nor is any activity which does not pertain to the Park's institutional duties; zones C – also known as agricultural zones, in which traditional agro-sylvo-pastoral activities, fishing and harvesting of natural products can continue in accordance with the institutional aims of the Park, and moreover the production of quality craft is promoted; zones D – otherwise known as urban areas, these economic and social promotion areas are part of the same ecosystem (Carboni et al., 2015).

The promontory of Punta Sabina is located in the north-eastern part of Asinara, which presents an irregular and hilly morphology, due to a structural Paleozoic basement and resulting from a long period of emergence and weathering exposure (Ginesu et al., 1998). The island is composed of 4 main physiographic units separated by isthmuses (Ginesu et al., 1998). The northern sector is characterized by the highest relief (408 m), while the relief middle southern sector is characterized by Punta Tumbarinu (241 m) and Punta Marcutza (195 m) and is bordered southward and northward by two bays: Cala Sgombro and Cala Marcutza respectively. In the southern part of the island, granite hills may be observed at Punta Maestra di Fornelli (265 m) characterized by large denuded rocky areas fragmented by a complex fracture system. The strong contrast between the eastern and western coast represents one of the most peculiar landscape element of the island: the western coast is characterized by high and steep cliff with metamorphic lithology, like Punta della Scomunica (200 m high), while the eastern part is a low indented coast with many inlets and small beaches with coarse sand or pebbles, typical of a rias granitic morphology, with wide rocky outcrops (Ginesu et al., 1998; Oggiano, 1993).

The promontory of Punta Sabina presents two pocket beaches - Cala dei Ponzesi and Cala del Giordano (Fig. 1). A third pocket beach is present on the study area but has not been considered due to its limited dimension. The geological structure is characterized by the presence of the pre-Cambrian rocks affected to intense metamorphism processes (Ginesu et al., 1998; Oggiano, 1993). The promontory has two outcrops: one corresponds to a wide strip of land on the hydrothermal sill complex, the second one forms the substrate of the village of Cala d'Oliva, southward to Punta Sabina. The beach sediments are generally composed by silicate material providing from the Paleozioc and precambrian formation of Asinara island.

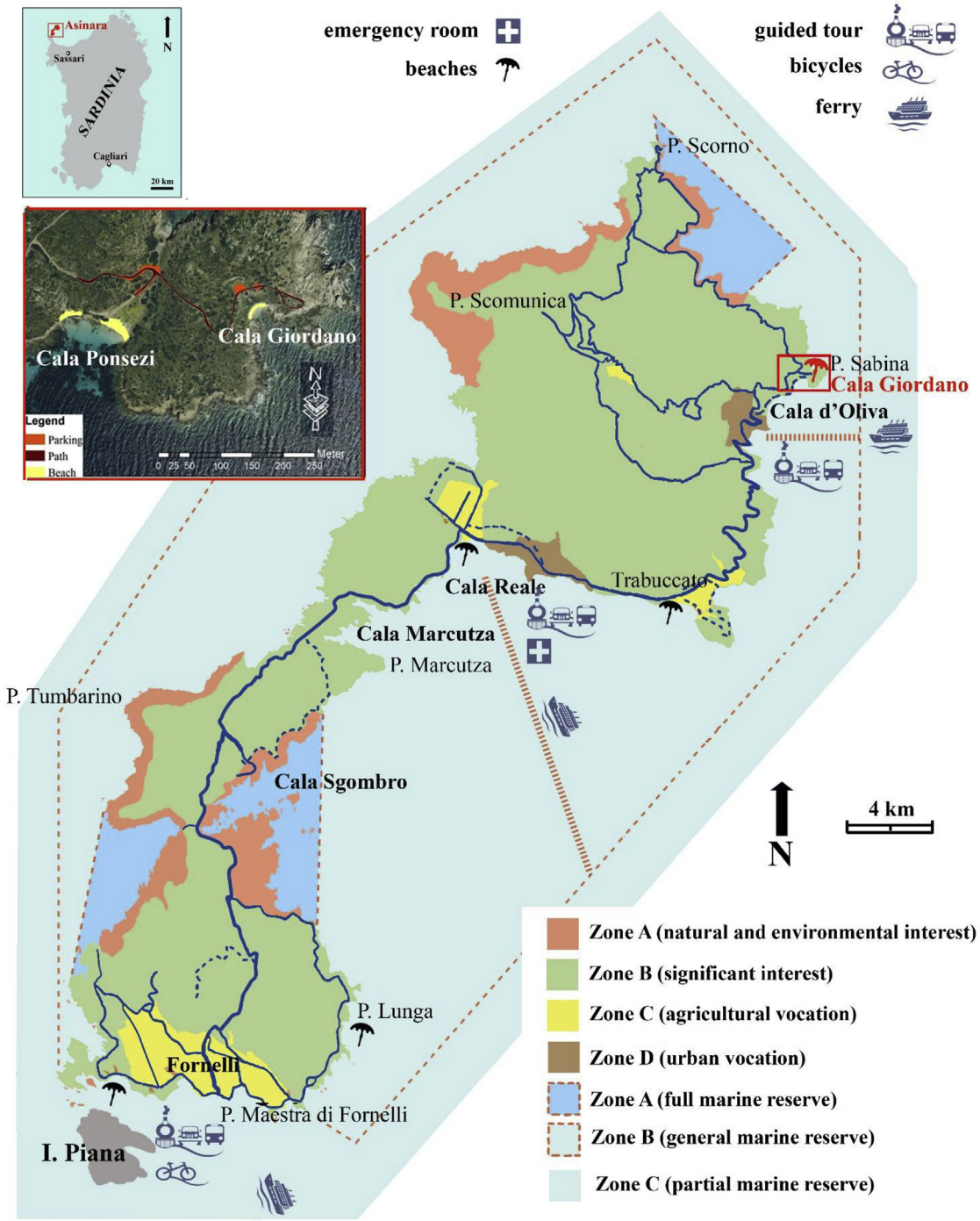

Fig. 1. Map of Asinara island. The two studied pocket beaches (Cala dei Posenzi and Cala Giordano) are located in the northern part of the island. Only Cala Giordano is reported in the map but Cala dei Ponsezi is situated just westward as observed on the photo. *Umbrellas indicate the coastal sites where tourism activities (swimming) are authorized.*

The climate in Asinara is characterized by an average annual temperature of approximately 18.0 °C, while the average annual rainfall is 480 mm (Italian Air Force Meteorological Service - Clino Asinara, http://clima.meteoam.it/Clino61-90.php). Under the Köppen Climate Classification, the Asinara has a Mediterranean climate. Winds primarily blow from north-west (35%, mistral or "*maestrale*") with velocities greater than 20 m/s, west (18.79% "*ponente*") for half of the year, and from north-east and east (12.78% "*levante*").

In 2010, the number of tourists was estimated to 81,400, then decreased to 74,467 in 2011 and progressively increased in the following years reaching 121,597 visits in 2016 (data has been provided by the Asinara National Park, Fig. 2). The maximum tourist frequentation occurs during the summer period (from May to September with a peak at August, Fig. 2). The tourist offer is quite varied and there are numerous tourist services like guided tours, tourist information, sports activities, or environmental education, etc. The National Park of Asinara also offers the visitor a historical and cultural experience. Each building and every ruin are testimony of past events from prehistoric times to the present times (Carboni et al., 2015).

The visits inside the Park are controlled by a set of fruition regulations issued by the Park Authority. The tours can be carried out by: foot, bicycle, horse-riding, by guided tour by bus, by "wheeled" train

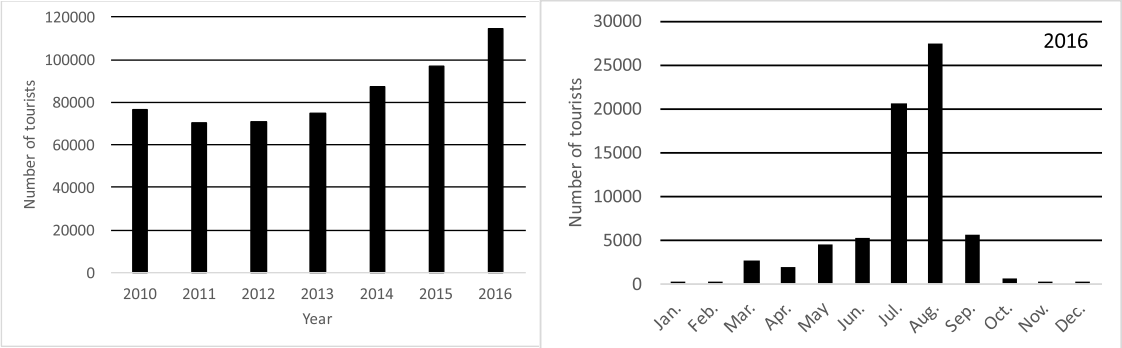

Fig. 2. a) Number of tourist from 2010 to 2016 (left) and **b)** in 2016. The data were provided by Asinara National Park (right).

and four-wheel drive car (4WD). Furthermore, there is just one "hosting establishment" located at Cala d'Oliva. During the summer period, the three visitor centers are open every day with opening times coinciding with the arrival of boats. Seven paths are proposed to the tourist for visiting the island. The path called "Sentiero del Faro" brings the tourists to the Cala dei Ponzesi and the Cala Giordano, where swimming is authorized (it must be noted that swimming and recreation activities are authorized in only 5 sites and the mentioned beaches are the most frequented according to the park authority).

3. Methodology

3.1. Tourist perception through social media

The tourist perception has been defined by using the reviews inserted on the travel review sites. As indicated by Cong et al. (2014), travel websites represent a rich information source for researchers to analyse tourist experiences (e.g., Choi et al., 2007; O'Leary and Deegan, 2005). For instance, Limberger et al. (2014) analyzed 660 reviews on TripAdvisor to verify the overall satisfaction and evaluation criteria for services provided. We select TripAdvisor because it provides reviews, comments and ratings on a destination. TripAdvisor is indeed a website based on the idea that travellers rely on other travellers' reviews to plan their trips, or at least can be satisfactorily helped in their decisions by them. TripAdvisor is considered the most used travel site and according to its official website, it has 200 million unique visitors every month and around 100 million reviews and opinions by travellers (Cong et al., 2014). It also contains the largest number of reviews and opinions on Asinara compared to other travel website (like Youvisit, Travel guide Michelin, Routard.com, Rick Steves Europe, Yelp, City search or Facebook).

Therefore, a research has been performed by using Asinara island as keyword and, a filter has been applied to select the tourist perception and comments during the "summer-seaside" period (from May to October 2009 to 2016). The comments were then analyzed in terms of visit satisfaction, management and biological and environmental aspects. The text data contents were analyzed using the following "criteria": What are the general opinion and satisfaction of their trip, what did they do and did they stop on the beach, how did they visit the island, what are the main problems.

3.2. Carrying capacity

The Cifuentes method has been applied in natural Protected Areas like in Costa Rica (Cifuentes, 1992; Cifuentes et al., 1999), in Mexico (Segrado Pavón et al., 2015) or in Turkey (Sayan and Atik, 2011) and in coastal areas (Zacarias et al., 2011; de Sousa et al., 2014; Rodella et al., 2017). This method is indicated by Ceballos-Lascuráin (1996), by the World Tourism Organisation (1998), by Eagles et al. (2002) as well as a useful method to provide information on the interactions between the human activities and the environment, and represents a quantitative analysis with a degree of verifiability (Papageorgiou and Brotherton, 1999).

The Cifuentes method (1992, 1999) requires a deep knowledge of the territory and is based on the six fundamental following steps:

(1) analysis of the tourist management policies of the Protected Area
(2) analysis of the expected objectives of the Protected Area
(3) analysis of the present situation of the site
(4) definition, increase and/or possible renewal of the management policies
(5) identification of specific factors/characteristics affecting the management of the Protected Area;
(6) calculation of the carrying capacity of the site or part of the site.

The carrying capacity is defined by three "indices", linked to each other:

- the physical carrying capacity - PCC,
- the real carrying capacity – RCC,
- the effective carrying capacity – ECC.

Each of the three indices is derived from the correction of the previous one. In particular, the PCC is greater than the RCC, while the RCC may be greater or equal to the ECC according to the following relationship:

$$PCC > RCC \& RCC >= ECC$$

3.2.1. The physical carrying capacity – PCC

PCC is the maximum number of tourists who can physically fit into a specific area over a determined period. The available area may be limited by physical factors and by limitations due to security reasons or weakness of the ecosystem.

$$PCC = A/Au \times Rf \quad (1)$$

Where: PCC = Physical carrying capacity; A = Available area for tourist use; Au = Area required per tourist; Rf = Rotation factor corresponding to the number of visits per day.

The total area (A) of the two beaches of Asinara Island was measured on the aerial photo of 2008 within ArcGis, and paths and parking have also been mapped. The results were then compared with the photo of Google Earth of March 2016 and with in-situ measurements. Considering the area of the two beaches (Cala Giordano and Cala dei Ponzesi), and according to the existing literature (Bera et al., 2015; Rodella et al., 2017; Zacarias et al., 2011), which indicated an area required per tourist (Au) ranging from 5 to 10 m^2 per tourist, three values of Au have been used: 4, 6 and 8 m^2. An area of 15 or 20 m^2 could also be adopted for these beaches located in the national park but such area cannot be considered at the moment since swimming is authorized in only 5 beaches; such an area will be too restrictive. The

rotation factor is determined by:

$$Rf = \text{Daily open period / average time of visit or occupancy of the beach} \quad (2)$$

$Rf = 8\,h/2\,h = 4.$

Rf corresponds to the daily number of visits, considering that the beaches are frequented from 09:00 to 17:00 (the first tourists reach the island at about 08:00 and leave not later than 18:00). Furthermore, considering the path to reach the beach, a second scenario has been made considering an average time of visit of 3 h and consequently a Rf of about 2.6 (8/3).

3.2.2. The real carrying capacity – RCC

RCC is the maximum permissible number of tourists, once the Correction factors (CF) derived from the particular characteristics of the site have been applied to the PCC. The RCC is determined using the following equation

$$RCC = PCC \times (Cf1 \times Cf2 \times Cf3 \times ...Cfn) \quad (3)$$

Indeed, tourism is dependent upon environmental factors, like sunshine, rainfall, soil erosion, biological disturbance, beach quality. These correction factors limit tourism activities and measure the level of tourist sustainability of the area (Cifuentes et al., 1999; Dias e Cordeiro et al., 2013; Fernández Juan and Bértola Germán, 2014; Maciel et al., 2008; Navarro Jurado et al., 2012; Queiroz et al., 2014; Segrado Pavón et al., 2015; Syed Rashidul et al., 2014; Zacarias et al., 2011). The correction factors are calculated using the following formula:

$$Cfx = 1 - Lmx/Tmx \quad (4)$$

Where: Cf_x = Correction factors of variable x; Lm_x = Limiting magnitude of variable x; Tm_x = Total magnitude of variable x.

In this study only five correction factors were used and are: rainfall, wind, perturbation to the fauna and flora, anthropic waste and animal ejections and jellyfish.

- Rainfall (Cf_1): this factor is probably the most important correction factor because it largely influences the swimming/seaside activities. A rain time series of 10 years (2006–2016) recorded by the weather station at Fornelli by the CNR-IBIMET was used to estimate the number of rainy days during the summer period (from June to September).
- Wind (Cf_2): strong wind prevents the arrival of the boats on the island, especially when its velocity exceeds 5.5 m/s. The number of windy days was calculated from the wind time series of 10 years (2006–2015) recorded by the weather station at Fornelli by the CNR-IBIMET and excluding the rainy days.
- Perturbation of the flora and fauna (Cf_3): It was necessary to introduce this correction factor because the adequate protection of the island flora and fauna is indispensable to prevent their extinction and/or degradation. Different botanical endemic species are present on the island, some species are exclusive of Asinara and Sardinia, while others are common with Corsica and the Baleares. However, since there are no specific studies demonstrating the vulnerability of endemic species present on the beaches (zone B, significant interest) of the island and protected by national and international standards (eg Evax Rotundata), it was considered to use a correction's factor of 0.95. In fact, some specimens of botanical species were observed during field surveys. They are not present on the beach but some samples have been noted on the upper part of the beach where tourists may possibly be present and cover an area of less than 5% of the total area.
- Anthropic waste (Cf_4): As for the correction factor Cf3, this factor has been estimated to be equal to 0.95. This factor represents the maximum area (5%) of presence of waste (considering a buffer of few meters around the waste) observed during field surveys.
- Presence of animal ejections and jellyfish (Cf_5): this factor has been estimated to be equal to 0.98. This factor corresponds to a maximum area (2%) of animal dejections and jellyfish that may be observed during the touristic season.

3.2.3. The effective carrying capacity – ECC –

ECC is therefore the maximum permissible number of visitors or optimum number of visitors that a site can support considering the RCC and management capacity availability (eq. (5)). The Management Capacity reflects the present condition of tourism management in the respective beaches. This final parameter is based on the available infrastructure, financial resources, services, staff, and equipment. Since these elements are variable, they may be limiting factors (Dias e Cordeiro et al., 2013; Maciel et al., 2008; Segrado Pavón et al., 2015; Syed Rashidul et al., 2014). As indicated by different authors (Rodella et al., 2017; Zacarias et al., 2011), the ECC is determined by

$$ECC = RCC \times MC \quad (5)$$

where RCC is the Real Carrying Capacity and MC is the Management Capacity of the staff, the infrastructures and the equipment for the personal care, surveillance and security of the tourists and for the flora protection. The MC index represents the ratio between the optimum management capacity discussed with the Asinara park authority and the present or real management capacity. The factors that have been considered for the management capacity are those necessary for the tourist's security and surveillance, and for the protection of the flora that can be affected by the tourists.

4. Results

4.1. Tourist perception

From the TripAdvisor website, have been analyzed 637 tourist's comments on their trip at Asinara during the summer season for the period 2009 to 2016. Because of the limitations of the TripAdvisor website content, limited demographic, origin and personal information was available on the respondents. Most of the comments are in Italian (89%), while about 5% are in English, and 4% in French. Few comments are in Spanish and in German.

Some 75% of the tourist rated their trip to Asinara as excellent and 9% as good, indicating a very high level of enjoyment and satisfaction (Fig. 3). Only 8% of the comments indicate “very bad” judgement. From the analysis of the positive comments, it appears that the natural aspects (island landscape and naturalness, fauna, flora, conservation) are the most appreciated by the tourist (about 21% of the comments), while the beach/sea is mentioned in 8% of comments and the cultural aspects in 6.5% of the tourist's reviews.

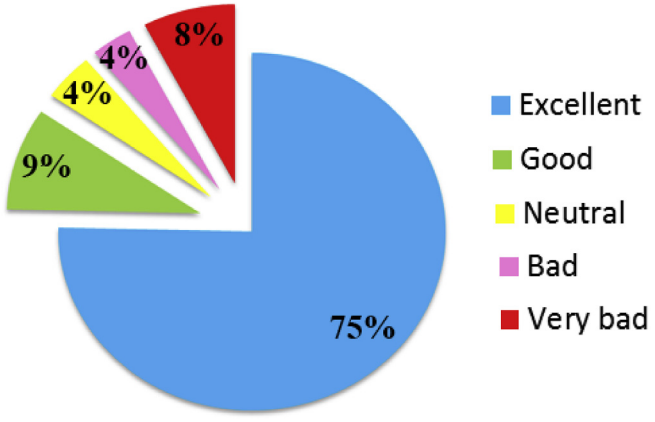

Fig. 3. Tourist satisfactions on their trip at Asinara according to their rates on tripAdvisor website.

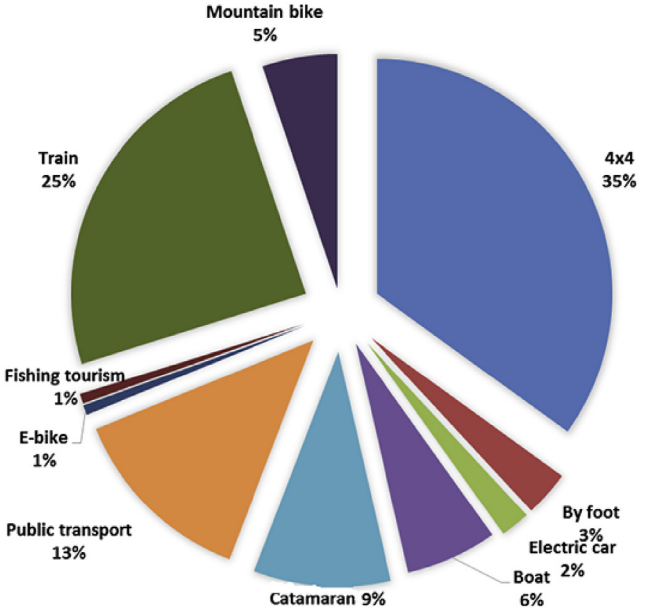

Fig. 4. Means of transport used by the tourist for visiting Asinara island. *(no colour should be used)*.

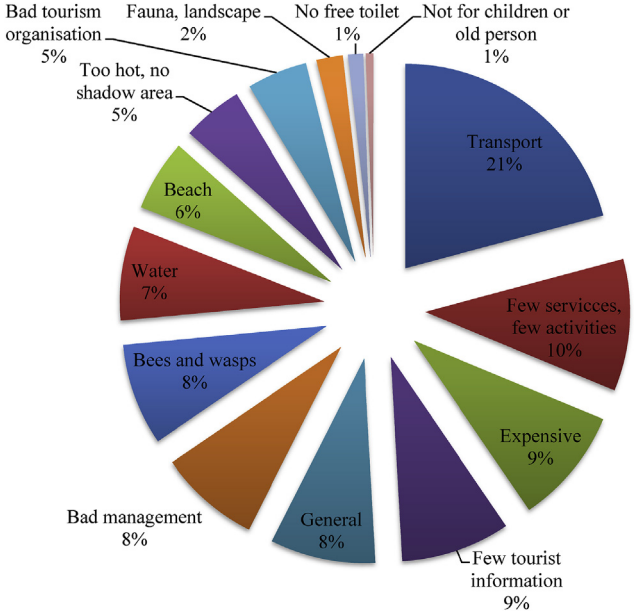

Fig. 5. Negative aspects reported by the tourists *(no colour should be used)*.

Table 1
Transport mean used and visit satisfaction in percent.

	Excellent	Good	Neutral	Bad	Very bad
four-wheel drive car	93.6	5.1	0.6	0	0.6
Train	64.9	10.8	5.4	5.4	13.5
Public transport	41.4	13.8	6.9	12.1	25.9
Catamaran	93	0	0	2	5
Boat	75	7.1	10.7	3.6	3.6
Mountian Bike	73.9	8.7	0	4.3	13.0
E-bike, E-car	58.4	25	8.3	0	8.3
By foot	64.3	35.7	0	0	0

The results show that 30% of the comments did not specify the means of transport. From the other comments it appears that the visitor principally used the four-wheel drive car (35%), the train (24%) and then the public transport (13%). The “green means transports” (by foot, e-bike, mountain bike and e-car) are generally less used (from 3 to 5%) and represent in total 11% (Fig. 4). Furthermore, the trips using a four-wheel drive car or catamaran were generally rated as excellent (94% and 93%, Table 1), while the visits using the bus or the train were generally less appreciated (41% and 65%) as excellent, and 26% and 14% as dramatic, respectively.

Furthermore, the visitors report that the four-wheel drive car is the best mean of transport to “get to” the beach. Tourist guides were mentioned in 213 comments from which 182 were positive. The beach was noted in 214 comments, from which 207 express the beauty of the beach (with 46 positive comments for Cala Giordano and Cala dei Ponsezi), while only 3 comments are very negative. Finally, only one comment regards the geological aspects of the site.

From all the comments, 215 report some negative aspects indicated in Fig. 5. Transport is the most negative cited aspect principally due to a bad organization and few available transports. Successively the tourists complain for the scarcity of services and activities and then the cost. They also report a bad management, the presence of bees and wasps and the lack of water. Only 19 negative comments regard the beach and in particular their small dimensions and the crowding (especially due the contemporary arrivals of the tourists in four-wheel drive car). Finally, 293 on 637 visitors mention the good services done by the tourist guides that were judged positively for 85%.

4.2. Carrying capacity

4.2.1. The physical carrying capacity - PCC

The two pocket beaches of Cala dei Ponsezi and Cala Giordano, of limited dimension, are considered principally dedicated to recreational activities such as sunbathing, relaxation zone, and beach access has not been considered. As indicated by Da Silva (2002) the beach areas were defined as the whole homogeneous stretch of sand, without significant topographic variations, that is limited the low tide mark (seaward limit) and the upper part of the beach colonized by vegetation. Cala dei Ponsezi has a surface area of 916 m^2, while the area of Cala Giordano is only 180 m^2 (Table 2). The PCC, calculated considering three different values of the area required by tourist (4, 6 and 8 m^2) and two rotation factors (4 and 3), ranges from 343 to 916 tourists by day at Cala dei Ponsezi (41,907–111,752 tourists from June to September) and from 67 to 180 tourists by day at Cala Giordano (8235–21,960 tourists during the four-month period).

4.2.2. The real carrying capacity - RCC

Five correction factors have been used to calculate the RCC and are reported in Table 3. For CF1, the mean number of raining days during the summer period (June to September corresponding to 122 days) is 8 days, and consequently Cf1 is equal to 0.9344. Similarly, Cf2 is equal to 0.8443 with about 19 days of windy days during the four-month period. It must be noted that a windy and rainy day has been accounted for one rainy day only.

The Real Carrying Capacity was obtained by multiplying the PCC by the total corrective factor. The different values of the RCC are indicated in Table 2. The RCC at Cala dei Posenzi ranges from a minimal of 240 tourists per day or 29,240 per season with a Rf of 3 and an area of 8 m^2 per tourist to a maximal of 639 tourists per day (77,974 per season) considering a Rf of 4 and an area of 4 m^2, while at Cala Giordano the RCC varies from 47 tourists per day (5746 per season) to 126 (11,402).

4.2.3. The effective carrying capacity - ECC

ECC represents the maximum sustainable number of tourist considering the management capacity related to the staff, the infrastructure and the equipment (Table 4). At Cala dei Ponsezi, ECC ranges from a minimum of 103 persons by day (or 12,573 for the 4 month-period) with a rotation factor of 3 and an area for tourist of 8m^2 to a maximum of 275 persons by day (33,529 for the 4 months' period, Table 2). At

Table 2
Carrying Capacity of the two beaches.

	A (m^2)	Au (m^2)	Rf	PCC by day	PCC by season	Cf total	RCC by day	RCC by season	MC	ECC by day	ECC by season
Cala dei Ponzesi	916	8	3	343	41,907	0.6977	240	29,240	0.43	103	12,573
			4	458	55,876		320	38,987		137	16,764
		6	3	458	55,876		320	38,987		137	16,764
			4	611	74,501		426	51,983		183	22,353
		4	3	687	83,814		479	58,481		206	25,147
			4	916	111,752		639	77,974		275	33,529
Cala Giordano	180	8	3	67	8235		47	5746		20	2471
			4	90	10,980		63	7661		27	3294
		6	3	90	10,980		63	7661		27	3294
			4	120	14,640		84	10,215		36	4392
		4	3	135	16,470		94	11,492		41	4942
			4	180	21,960		126	15,322		54	6589

Table 3
Corrective factors.

Cf1	Cf2	Cf3	Cf4	Cf5	Cftot
Rain	Wind	Perturbation flora fauna	Anthropic waste	Animal ejections and jellyfish	
0.9344	0.8443	0.95	0.95	0.98	0.6977

Cala Giordano the ECC ranges from a minimum of 20 persons by day (2471 persons by season) to a maximum of 54 persons by day (6589 persons by season, Table 2).

5. Discussion

There is a lack of uniformity of the TripAdvisor reviews: some reviews are very brief comments, while others are more extensive. Despite that the analysis of the TripAdvisor reviews indicates that the tourist experiences at Asinara is generally excellent (75% of the reviews against 8% of dramatic), and tourist particularly appreciate its natural and cultural aspects. Even there are limitations to information and comments collected from TripAdvisor, such result is important for the management of Asinara Park, since online reviews are important information sources of consumer experiences towards travel experiences. Additionally, the study of Collie in Fang et al. (2016) reports that 65% of leisure travellers will search online before deciding on a travel destination. Furthermore, according to the same author, 69% of the travel plans are determined by online travel review. Consequently, because the overall tourist satisfaction of their experience at Asinara is generally good (84.6% of the reviews, Fig. 6), we may assume that tourists will "be positively influenced" to visit Asinara. Furthermore, tourism at Asinara will probably continue to increase as highlighted by the positive increase in the number of arrivals. It must be remembered that the visit of Asinara is recent (opened to the public in 1999), and therefore,

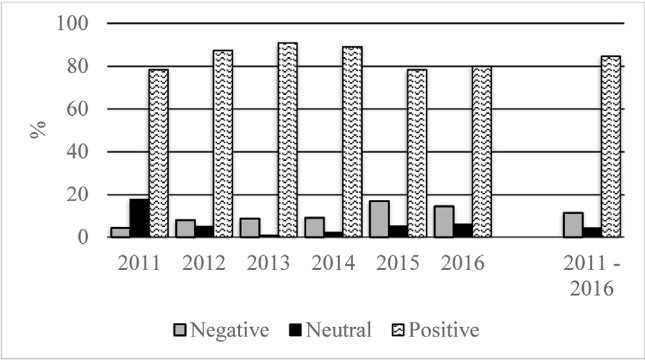

Fig. 6. Overall tourist satisfaction (in percent) during their tour at Asinara for the period 2011–2016.

tourism at Asinara should be still in the development or consolidation phase as described in the tourism area life cycle model (Butler, 1980). Consequently, it is important at this stage to define and analyse critical elements before to observe a decline of the tourism: the recent slight increase of the negative reviews (2015–2016) could be the first signals of this decline. Consequently, it could be necessary to continue to monitor the TripAdvisor reviews and eventually to promote or develop other activities and initiatives in the park that should be discussed with the stakeholders.

Tourism in Protected Area is complex because tourists cannot visit all the island and visitor conflict may occur within a spatial context (Wolf et al., 2017); the carrying capacity analysis may represent a useful tool for tourism development strategy, "avoiding" decline. According to a recent study of Simeoni et al. (2016) on the tourist perception of the Italian beaches, it appears that the tourists generally prefer a low-medium crowded beach than highly crowded one, as also

Table 4
Matrix for the calculation of the correction factor Mc.

		Optimum	Max. score	Actual situation	Score
MC – staff	Lifeguard	1 by site	1	yes	1
	Tourists guide (surveillance, remains on the site)	Present permanently	1	yes	1
MC – infrastructure	1 grouping zone[a]/beach	At least one by beach	1	yes	1
	signage[b]	At least one by beach	1	absent	0
	services (chemical toilet, shower, light)	At least one by site	1	absent	0
	walkways for access to the beach[c]	One by beach	1	absent	0
MC – Equipment	Surveillance equipment, video-camera, emergency support/	At least one by beach	1	absent	0
	Communication system (telephone and walkie talkie)	At least one by beach	1	1 for the 2 beaches	0.5
sum			8		**3.5**
MC index			1		**0.43**

[a] Shaded structure for lifeguard, first aid kit.
[b] With bathing rules and useful emergency numbers.
[c] Wooden walkways to protect the endemic flora from trampling.

Table 5
Synthesis of the Carrying Capacity calculations.

	PCC		RCC		ECC	
	Rf = 3	Rf = 4	Rf = 3	Rf = 4	Rf = 3	Rf = 4
Area for tourist						
8 m^2	50,142	66,856	34,986	46,648	15,044	20,059
6 m^2	66,856	89,141	46,648	62,198	20,059	26,745
4 m^2	100,284	133,712	69,972	93,297	30,088	40,118

PCC: Physical Carrying Capacity, RCC: Real Carrying Capacity, ECC: Effective Carrying Capacity, Rf: Rotation factor.

observed in Portugal (Praia de Faro) by Zacarias et al. (2011). Consequently, the calculation done with an area of 4 m^2 per tourist represents a crowded scenario, badly judged by the tourist and needs to be avoided. Therefore, our results indicate that the best scenario will probably be 8 m^2. Furthermore, relax and tranquillity are an important factor for chosen a locality, implying that tourist will more appreciate a 3 h' rotation factor than 2 h (for relax). Thus, the optimal ECC will probably range from 15,044 to 20,059 tourists during the summer season (123–164 by day, Table 5).

The assessment of the TCC of two authorized beaches at Asinara (Cala dei Ponsezi and Cala Giordano) indicates that the tourism is at a lower level than the real CC. In fact, considering a maximal number of tourist arrivals of 120,000, and that only the tourists travelling in four-wheel drive car will be able to reach the two beaches, we assume that the RCC (about 93,000 tourists, Table 5) will not be exceeded. The visit at Cala Giordano and Cala dei Ponsezi is not easy by foot, by train or by bus because of the distance and the available time: only a small number of tourists reach by foot the two mentioned beaches if they arrive at Fornelli. Excessive sunshine is also a limiting factor during the summer period. However, the Effective Carrying Capacity may be exceeded if the four-wheel drive cars arrive in these two beaches. Indeed, the minimal ECC is about 123 persons by day corresponding to 15 four-wheel drive cars. However, 25 four-wheel drive cars could reach simultaneously the two beaches (about 200 persons). To avoid a mass arrival of the four-wheel drive cars to Cala Ponsezi and Cala Giordano and visitor conflict, a good management of the transport should be developed requiring the participation and collaboration of the "park operators".

Some more actions could also be implemented to improve the capacity management (Table 4), like the installation of signage, the availability of first kit aid or the presence of toilet, in order to avoid the exceeding of the ECC and consequently the decline of tourism. For instance, the management capacity will increase to 0.57 if signages are installed and the minimal ECC will be 175 tourists by day instead of 123.

Furthermore, the analysis of TripAdvisor reviews shows an increase of negative comments from 2014 to 2016: in 2015 and 2016 the percent of negative comments exceeds the mean value (Fig. 6). The principal negative aspect concerns the mean of transport and especially their organization and their limited number (not enough mean of transport). The tourists also claim the few activities and services on the island, as well as the few tourist information. A similar result has been obtained by the study of Simeoni et al. (2016) that observes the general lack of activities at national scale. A better transport organization and more tourist information may be "realized" to improve the tourism satisfaction, while the increase of activities and services is almost impossible because of the regulations and rules of the island (Protected Area).

By identifying the negative and positive comments, the analysis of TripAdvisor reviews may represent a useful instrument for stakeholders and decision makers since these reviews have significant influence on tourism choice and are considered the most valuable reviews. Therefore, site managers should identify reviews that are potentially be most helpful and should fix the problems revealed in reviews (like the improvement of the transport organization as indicated previously) before they could influence the decisions of potential customers. Form the comments, it appears that the visits in four-wheel drive car are generally rating as excellent and, often a guide is present. The tourist guides are generally well appreciated by the tourist, giving useful information on the natural and cultural aspects of the island. Guides are also well-appreciated for the organization of the visit, allowing, for instance, the "stop" to the beach before the mass tourist arrival, explaining why the small dimensions of the beaches and crowding are not perceived as a problem. Such result is in agreement with the study of Randall and Rollins (2009) who recognized that tour guides can play an important and influential role in information delivery, interpretation and as conduits for natural resource management agencies. Consequently, it may be possible to develop sustainable tourism by improving the collaboration between the local authority and the tourist "managers" and using the result of the carrying capacity analysis.

6. Conclusions

The tourism industry has environmental, social, cultural, and economic impacts and as reported by Liu (2003) is necessary to manage tourism growth in a way that is appropriate to the tourists, the destination environment and the host population. The role of the park guides is also critically important and could be seen as one of the essential elements in the total touristic satisfaction and experience and in the park management. As a consequence, park managers may consider the potential impact of the tour guides especially in shaping the experience of visitors to natural parks and in influencing their behaviour related to nature conservation, protection and management.

Tourism carrying capacity assessment remains one of the most useful tool when measures are taken for management of coastal areas. Assessment of carrying capacity is imperative for the coastal zone of Asinara National Park if it reflects a sustainable level of development and consequently may represent a practical tool to maintain the balance between development and conservation. Overall measuring TCC does not have to lead to a single number (threshold), like the number of visitors. Even when this is achieved, this limit does not necessarily obey to objectively, unchangeable, everlasting criteria. It can serve as a benchmark, that should be monitored and adjusted if necessary (for instance a monitoring program for the flora may be necessary), against which it is possible to measure changes and their causes, ensuring the environmental conservation and the quality of the visit.

Furthermore, a multi-disciplinary analysis of a site allows to obtain a systematic vision. Indeed, one of the objectives is to identify the limiting factors in order to define solutions or elements to increase the target value and the number of tourists without damaging the environment or the quality of the visits. Tourist perception is an important element and TripAdvisor may represent a valuable source of information on tourist opinion and behaviour at low cost. Furthermore, the carrying capacity index may be used as an "early warning system" for trouble. An upper and a lower limit of TCC can be of more use than a fixed value. They are dependent on technology and the interaction between the physical, economic, and social factors.

The application of the carrying capacity concept for Asinara represents a first attempt to account for different aspects of the Protected Area, e.g. considering ecological, perceptual and economical aspects. The present assessment of the TCC for the beaches of Cala dei Ponzesi and Cala Giordano showed that the carrying capacity of the tourism activity is in its lower level. The results imply that managers could set different capacities in the light of different settings and demands, and this type of carrying capacity assessment can be used as an input into the regular planning process. In the Asinara National Park, there are issues related to water supply, sewage disposal, electricity and energy which are to be given additional importance on a sustainable basis while planning tourism development in these islands, as tourism activity will add additional burden with regard to available infrastructure

and resources.

A comprehensive analysis on land use and water availability, fresh water management, alternative sewage disposal methods considering the island sensitive ecology, biodiversity extent and status, seawater quality and pollution level for every island would further help for developing better tourism development strategies. The Administration should promote (i) self-generation of electricity using renewable energy sources such as solar panels, bio-gas systems, etc.; (ii) development of additional freshwater resources through rain water harvesting; and (iii) provisioning for sewage treatment plants.

Acknowledgements

The authors would like to thank the anonymous four reviewers for their valuable comments and suggestions to improve the quality of the paper.

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