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MASTER'S THESIS

BEACHES PRESSURES ANALYSIS AS A TOOL FOR TOURISM PLANNING: THE CASE OF MALLORCA

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Master's Degree in Economy of Tourism: Monitoring and Evaluation
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ABSTRACT

Mallorca is one of the top Europe´s sun and beach destination attracting millions of tourists every year. This was found to bring challenges to the island due it´s limited resources over tourism have been discussed as problem in the island over recent year, before pandemic. Because of this, also due to lack of attempts to study the effects it brings to beaches of Mallorca this research was conducted. Main objective being to construct a model using GIS to measure the anthropic pressures beaches in the island are under. In total 171 beaches were included in the research. The model was constructed using 7 factors: pressure generated by proximity to urban nucleus, tourist accommodation pressures based on proximity, accessibility of the beach, beach level of artificial surrounding, capacity of the beach based on size, potential activities to be developed on the beach based on its geomorphology, potential of the beach activities based on swimming conditions. All the factors were obtained from various data bases, normalized, weighted and included in the model of Anthropic Pressures Indicator. With API we found pressures among beaches to be very unevenly distributed, and more than half of beaches being under more than moderate pressure in the tourism season. Further development of this model is proposed by including sensitivity of a beach and response of a management indicators. With this study we concentrated on anthropic pressure, inclusion of mentioned two additional indicators could significantly improve the accuracy of results and be extremely useful for further coastline management strategies, to make them best suited for every beach.

1. INTRODUCTION

Up until 2020 tourism was one of the fastest growing and largest sectors in the world, it´s expansion was undeniable in all world regions. Spain being the second county in the world by international tourist arrivals and international tourist receipts (UNWTO, 2020) and Mallorca – one of the most tourism specialized regions in Spain, it is highly dependent on tourism and has been excluded and one of the Mediterranean's leading sun and beach destinations (Capó et al., 2007; Enríquez & Bujosa Bestard, 2020). Mallorca's rapid growth of tourism demand and consequently dependence on tourism industry has been noticed and discussed for decades. Originally it has started in 1960s highly due to a new, at the time, recreational use that was found on island´s natural coastal resources which, in consequence, encouraged chaotic development of tourism facilities (Capó et al., 2007; Garcia & Servera, 2016). Ever since, Mallorca has grown in popularity as sun and beach (or in other sources 3S: sun, sea and sand) destination, Mallorca´s coastline has become main attraction specifically, beaches – main export (Roig-Munar et al., 2013). Following the high rise in popularity Mallorca now is one of the mass tourism destination in a world and is even facing challenges of over tourism. In year 2019 Mallorca had registered 11,866,513 tourist arrivals (IBESTAT, 2021c) while the number of inhabitants where 896,038 (IBESTAT, 2021b). Over tourism issue was indicated as such only few years before Covid-19 started and there for, it is relatively new phenomenon and is in the first stages of an any empirical attempts to measure it. Nonetheless it already had a great recognition threw it's impacts, mostly negative ones. In Mallorca the main over tourism impact were excluded as: anti-tourism protests, environmental issues and real estate speculations (Peeters et al., 2018). Naturally, at this point in time this is not the primary issue of Mallorca, however the situation tourism sector is at right now can be taken as an opportunity to reflect, transform and place tourism on a more responsible and sustainable trajectory (Higgins-Desbiolles, 2020).

Purpose of this paper is look at impact on Mallorca´s main tourism attraction – beaches are under the circumstances of mass tourism as it was before the pandemic. The research includes a theoretical part and an empirical part. In the first part the literature review will be presented: i.) The pressures sun and beach destinations are facing; ii.) Previous studies and methods take analysing tourism pressures; iii.) Lastly, it will look at actions taken and methods suggested for management of the beaches.

In the second part spatial analysis methods will be conducted on anthropic pressure beaches of Mallorca are under. The aim being, to create model that would serve as a tool for tourism planners to use when proposing sustainable development in the island. To achieve the model, further objectives of a research were put forward: i.) Collection and integration of geodata from various geographical information systems databases, in order to obtain the best suited for further analysis; ii.) Attainment of factors determining division of pressures on different beaches in the main island of Mallorca; iii.) Normalization of factors by rescaling formula and assignment of weights using Analytic Hierarchy Model (further AHP); iv.) Obtaining of beaches anthropic pressures model using a multicriteria analysis.

2. LITERATURE REVIEW

2.1. The pressures sun and beach tourism destinations are facing

In a sun and beach tourism destination like Mallorca, as one of the top priorities should be the need to conserve the environment based both on ecological concerns and protection of main asset of the tourism sector- natural areas (Capó et al., 2007). High increase in tourist mobility through the years resulted in mass tourism, that has been pointed out as concentrated in coastal areas of Mediterranean. Tourist flows like that change land cover and land use, effects biodiversity, changes people´s understanding of the environment among other things. Due to seasonal uneven distribution and visitor's attitudes being different from residents toward consumption and waste, as those are two things highly associated with vacations itself, tourism highly contributes to the pressures sun and beach destination deals with (Nunes et al., 2020). Tourism in many cases overuses natural local resources in high seasons such as: drinking water availability, energy consumption, it raises waste management issues and it can cause a negative impact on fragile or ill prepared areas (Nunes et al., 2020; Sanyé-Mengual et al., 2014) Further, mass tourism specifically to beaches can be found as being direct reason of marine litter generation in Mediterranean. A study has been conducted analysing marine litter accumulation in beaches of eight Mediterranean island by Grelaud and Ziveri (2020) they found that the most litter is generated in most popular tourist beaches, with local beaches not far behind. In the high season accumulation index in beaches was found to vary from moderate to extremely high.

Further to validate, the purpose of beach protection and management it is important to mention the pressures Mallorca is facing already by the climate change. It has been determined that Mediterranean climate regions will be the most affected by global warming, this not only would make tourism less environmentally sustainable, but economically as well. Main three negative impacts to the coastal areas can be excluded: first, the sea level rise, second, loss of seagrass *Posidonia oceanica* meadows and third, the increase in jellyfish population, last two both are direct consequence of seawater temperature rising (Enríquez & Bujosa Bestard, 2020; Nunes et al., 2020).

These issues are largely dependent on lack of assessment of carrying capacity and not well-equipped local governments, who under pressure can even cause more negative externalities. Even in time causing to lose popularity among tourists due to deterioration of nature and have more costs for the islands, then it brought economic benefits if more serious attention is not paid (European Commission, 2016).

For all these issues, various ways were proposed to strengthen the carrying capacity of destination, for example, improvements of waste management systems, supply chains of the food services, to move hotels and regions towards circular economy models, landscape management and land use, preservation of ecosystem and biodiversity (Nunes et al., 2020). The issues caused by unsustainable tourism practices in coastal tourism destinations has been a cause of attention from European commission (2016) launching their own studies in order to give response to the challenges faced by the various destination, Mallorca being one of them, and to highlight the issues. A rise in literature on coastal areas and beaches can be noticed in the last years, which will be presented in the next part.

2.2. Previous studies and methods taken analysing tourism pressures

Previous study has been conducted in order to evaluate the impact of tourism on beaches degradation in island of Mallorca by Garcia and Servera (2016), it had identified insufficient urban planning as one of the first issues that predisposed Mallorca's coastline for beach degradation. According to them overcrowded beaches and massive constructions on the coastal zone, more beaches being transformed to urban beaches made coastline retreat. The second issue is a high decline of seagrass – *Posidonia oceanica* threw out the Mediterranean Sea, this seagrass is considered to be the main control factor for preservation of natural balance in the beaches. It creates the habitat for nearshore marine species, seagrass meadows supply nutrients, carbon and sand (Jiménez et al., 2017), further they absorb the wave energy and their remains accumulate on the beach creating a subaerial for beach. Last two benefits of seagrass are especially important as they directly protect beaches from erosion. Nonetheless, the dead seagrasses accumulation on the beach has been pointed out as a direct clash with tourism development, due to remains of a seagrass being perceived "dirty" and unattractive to tourists it has led to it being repeatedly cleaned up, therefore leaving beaches unprotected. More recent studies had argued the effectiveness of seagrass beach-cast accumulation against erosion, by pointing out other natural factors to be determining the effectiveness of the banquettes (Gómez-Pujol et al., 2013; Jiménez et al., 2017). Nevertheless, in 80% of beaches analysed by Garcia and Servera (2003) they found beaches to be overcrowded, therefore undoubtably pressuring natural coastal areas. The authors pointed out attempts to stop erosion process, but according to the results it had only backlashed and made the situation worst at that point in time leaving beach degradation unsustainable (Garcia & Servera, 2016).

The tourism induced pressured on coastal areas is a relevant issue around the world as we can see from further studies: Roig-Munar et al. (2013), Mooser et al. (2021), and Ghafourian et al. (2021). All of these studies as their main driving factor exclude tourism's negative externalities on the beaches choosing different type of methodologies and objectives to contribute to the fiels of coastal research.

In Formentera and Ibiza 100 beaches were classified and analysed (Roig-Munar et al., 2013) taking into account their conservation state, use and services and management variables in total 20 variables were selected. Principal Component Analysis (PCA) and Cluster analysis has been conducted prioritizing environment variables above service. In Ibiza and in Formentera they found most of the beaches with low natural values, however the explications for that differ. In case of Ibiza it is explained by rapid unrestricted urban growth, which is not the case in Formentera, nonetheless Formentera´s beaches are heavily used by tourist and is lacking managing. Both islands were found to have a risk of losing the numbers of their natural beaches without correct management strategies. Study conducted by Mooser et al. (2021) had aimed at analysing 29 sites along coat of Andalusia in order to propose a method for determining scenic sensitivity considering the climate change and naturally induced processes as well as human implemented pressures by tourism and coastal development. Coastal Scenic Evaluation Systems (CSES) and Fuzzy Logic Approach (FLA) has been used in process of the analysis. Constructed two folded sensitivity indexes had let to determination of not just most vulnerable coastal areas, but also led to identifying most vulnerable zones to natural processes and to human pressures separately. It does give more tools for managers to prepare the soundest strategies for every coastal area in order to prevent degradation and in perfect outcome increase resilience and enhance scenic beauty. Next, coastal planning study by Ghafourian et al. (2021) was conducted in coast of Shirud, Iran using GIS tools, to achieve the best allocation of tourist activities based on characteristics of landscape, measures coastal sensitivity and zoning. The main aim of the paper being, to improve the sustainable growth and achieve Integrated Coastal Zone Management (further ICZM) goals so to reduce human intervention on the sensitive coastlines. Their study proposes the regional evaluation and zoning and then a repeated evaluation on smaller zones in a quest to improve the sensitivity results and adapt management strategies more accurately to the smaller scale.

Further, two references were found that took on spatial analysis and relatively new methods of using social media and social big data to measure and determine the pressures natural areas undergo. First article by Papafitsoros et. al. (2020) had used help of social media to collect picture of tourist while turtle viewing in an island of Greece, they were able to not only follow up on the individual animal, the researchers were able to evaluate the pressures marina animals faced, their moving patterns under the high viewing intensity this type of methodology resulted significant in creating a viewing guidelines and or zoning, this could be taken as a great example of utilizing new technology use to researchers benefit in further analysis even analysing the pressures of different beaches. Second, article used social big data to analyse size and spatial distribution of visitors created pressures in Korean protected areas (Chun et al., 2020) This type of approach in addition to regular calculation of tourism pressures based on visitor's numbers, where able to determine specific locations in parks where the pressure was highest. These two methodologies for spatial analysis are especially interested, as it could change the way data on human preference are collected, integrated with qualitative analysis can help to better understand the beach users, therefore, to improve the management strategies taken.

2.3. Beach management research and strategies

As a main challenge of Balearic Islands, we can consider an efficient environmental management, considering the fragility of natural resources, in a long run the decision has to be made in how to allocate them for use of a future generations (Capó et al., 2007). It is one thing to imagine the management of natural resources when the talk is about water supply, or land but what can be done and considered when talking about beach management which is generally perceived as a public good.

Valiente et al. (2016) analysed Spain´s tourism evolution and its main position in tourism market and sun and beach destination in the eyes of travellers. The authors proposed a cultural tourism reinforcement in the coastal destinations in order to take some pressure of the beaches of Spain, to put littoral tourism on a more sustainable and more evenly distributed tourism trajectory. It would not just redirect some of the economic and environmental pressures from the beaches, moreover, Valiente et al. (2016) added that cultural tourism would have a power to highlight the preservation of cultural heritage and keep the identity of the destination alive.

To test tourist's willingness to pay in order to combat climate change negative impacts on beaches in Mallorca choice experiment was conducted by Enríquez and Bujosa Bestard (2020). It showed the difference of attitude, between the tourist, older and higher educated visitors have shown a stronger support for new policies compare to other tourists. While this work does not discuss a direct tourism pressures on beach areas and negative impacts from that, it coincides with people's attitudes to preserving ecosystem and willingness to pay for it. Other study, that could be seen and complementary to the Enríquez and Bujosa Bestard (2020), tested beaches user's willingness to pay for beach preservation depending on the scenery was conducted in Italy by Rodella et al. (2020). With qualitative and quantitative analysis methods, they analysed 40 beaches, classifying the form I – the natural beaches with highly valuated scenery and physical conditions and to V – poorly valuated beaches due to high anthropic pressures and low physical evaluation. The study found that people do give more importance to and are more likely to pay for beaches with high value of scenery and low level of urbanization, this is an important observation, when poorly managed coastal urbanization is an issue in many tourist's destinations including Mallorca. Further, in agreement to the Enríquez and Bujosa Bestard study they found that user´s with a higher education tend to be more willing to pay and contribute to the preservation of the beaches.

Attempts has been made to deseasonalise tourism with campaign like "Better in Winter", only publication of it was found in 2018. The bases for this project were to combat the over tourism and its negative impacts in high seasons (Peeters et al., 2018), which in theory should relieve the pressures beaches are facing due to mass tourism. However, even if campaign were successful, it gives no guarantees that pressure in high season would decrease. Other research “Innovation and internationalization as development strategies for coastal tourism destinations: The role of organizational networks” (Brandão et al., 2019) had suggested diversification and innovation is needed to reinvent coastal destination, among other beneficial factors, this might be necessary in order to move Mallorca towards more sustainable path of beach protection.

Economic and Social Council of the Balearic Islands (2007) has prepared a system of indicators for the ICZM explicitly defining all social environmental, economic and even politic, quite similarly to the European Commission (2016) report. In general, ICZM aims to get research and data on coastal studies to be shared and different policies applications to be affecting coastal areas to be coordinated. However, EC (2016) to approach coastal management uses Drivers, Pressures, State, Impact, Response approach (further DPSIR) concentrating on finding innovative solutions to protect beaches from negative externalities on a larger scope of issues around different destinations. While CES (2007) is vastly concentrated on the coastline issues in the Balearic Island issues it is facing. Nontheless, both studies offer solutions on how to tackle specific challenges and can be found complimentary one to another depending on the management issues.

All in all, many articles were found exposing negative externalities that beaches are dealing with due to over tourism, human activities or natural factors and changes. Various attempts have been made to measure the level of impact, also to classify the coastline areas in accordance to the issues faced in Spain as well as in other parts of the world. Even solutions have been proposed for general Europe´s coastline tourism destination, other parts of Spain and even in Balearic Island on how to tackle occurring issues in order to preserve the beaches and maintain tourism growth. That being said, not enough attention has been paid to specifically beaches in Mallorca, where tourism is are ruling sector, therefore causing more seasonal pressures. When looking at methods taken place when analysing beaches, we found spatial analysis to be important tool for it, nonetheless we were unable to find spatial analysis used for construction of indicators. This paper will attempt to improve that by creation of new tool for measuring the anthropic pressures of mass tourism on Mallorca´s coastal areas. This is a major issue, as it requires different management strategies for specific cases therefore creation of model of measurement is important, not to only detect issues, but also monitor the change induced by different management strategies.

3. METHODOLOGY

3.1. Study site and data

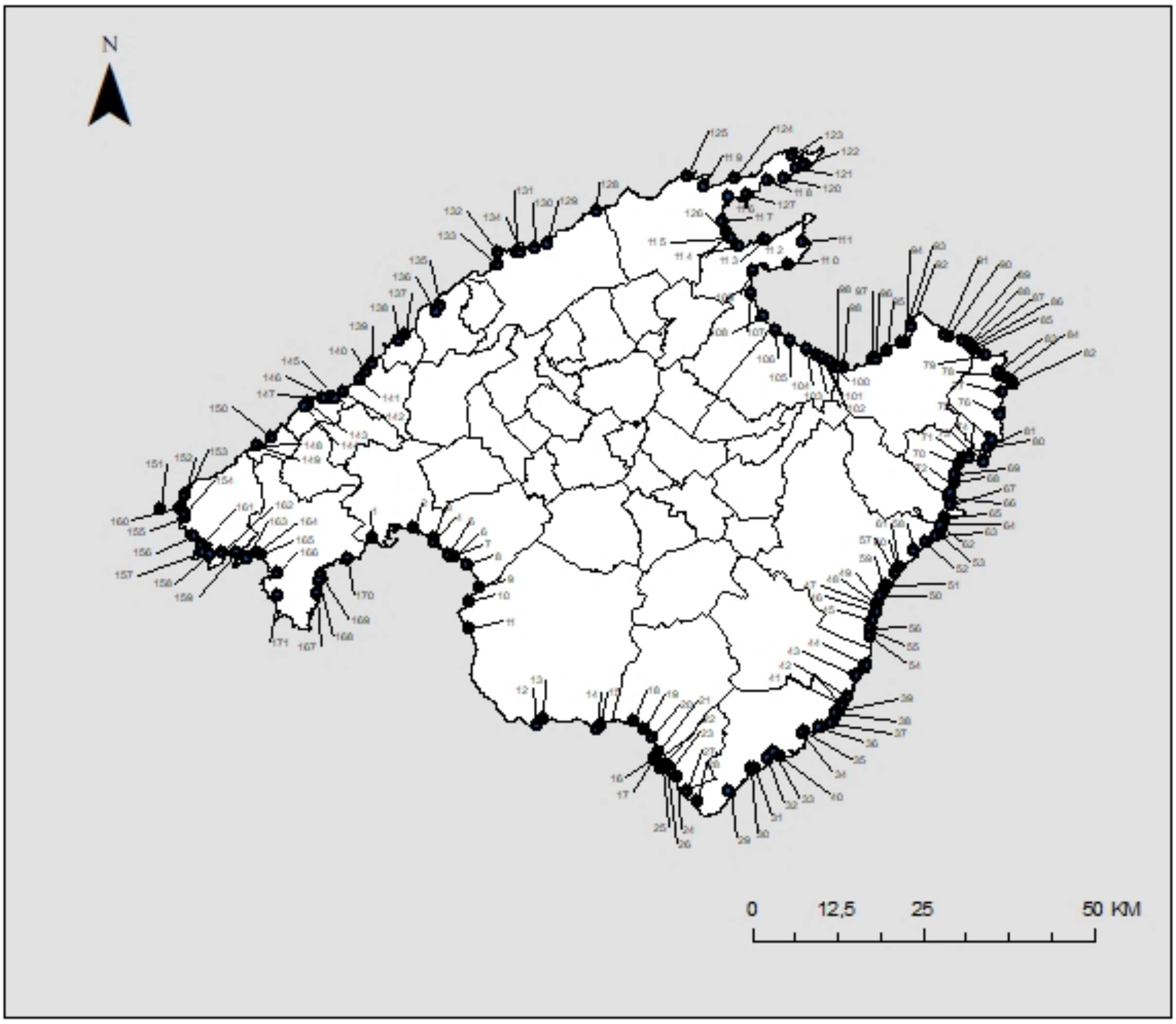
Mallorca is a Spanish Island located in the west of Mediterranean, it belongs to Balearic Islands and is the largest of the conglomerate takes 3.635 squared kilometres of surface that is approximately 73 %

of the Balearic Island conglomerate (IBESTAT, 2021d). It is also most populated of the Balearic Islands, with 896,038 residents. Largest municipalities of Mallorca include Palma, Calviá, Manacor and Marratxí (IBESTAT, 2021b). Due to its Mediterranean whether and scenery Mallorca has become beloved tourist destination in summer season more than doubling the actual number of residences in the island.

The topography of Mallorca includes northwest mountain ranges – Serra de Tramuntana slightly separating the Island from main urban nucleus and a much smaller mountain range on the east, between these two ranges the height of the island is mostly homogeneous (Jiménez et al., 2017). Mallorca's coastal area is 841,80 kilometres long (IBESTAT, 2021a) and in total Mallorca has 262 beaches and coves including the ones in the mini-islands belonging to the Mallorca (GOIB, 2021c). From MITECO classified beaches are 180, most of the beaches are white sand ones, with calm waters. Length of the beaches can vary from 15 meters to 4,6 kilometres and width from 3 meters to 220 meters (MITECO, 2020). For the purpose of this analysis, we excluded the Island of Cabrera and will be analysing 171 beaches around the coastline of Mallorca (fig. 1).

The data characterizing beaches was obtained from geographical data bases in The Ministry for the Ecological Transition and the Demographic Challenges (MITECO, 2020) and Government of Balearic Islands (GOIB, 2021c). Further, for factors analysis one of the data used was Corine Land Cover data from European Environment Agency (EEA, 2018), as this source provided the information of land uses distribution in the island. Number of tourist accommodations with places of stay were collected from three data sets one from Airbnb data base (Inside Airbnb, 2021) and two from GOIB (2021b, 2021a) one on tourists owned houses in Mallorca and other on tourist accommodations, for instance, hotels, hostels and etc. Data on resident's numbers and distributions threw out island was used from Institute of National Geography (ING, 2020). While working with accessibility a network data from TomTom (2017) was used to analysis road connections to the beaches. All collected data was used while attaining factors for multicriteria analysis and further in the multicriteria analysis itself, the detailed information on that will be presented in a next section.

Figure 1. Beaches in the coastline of Mallorca

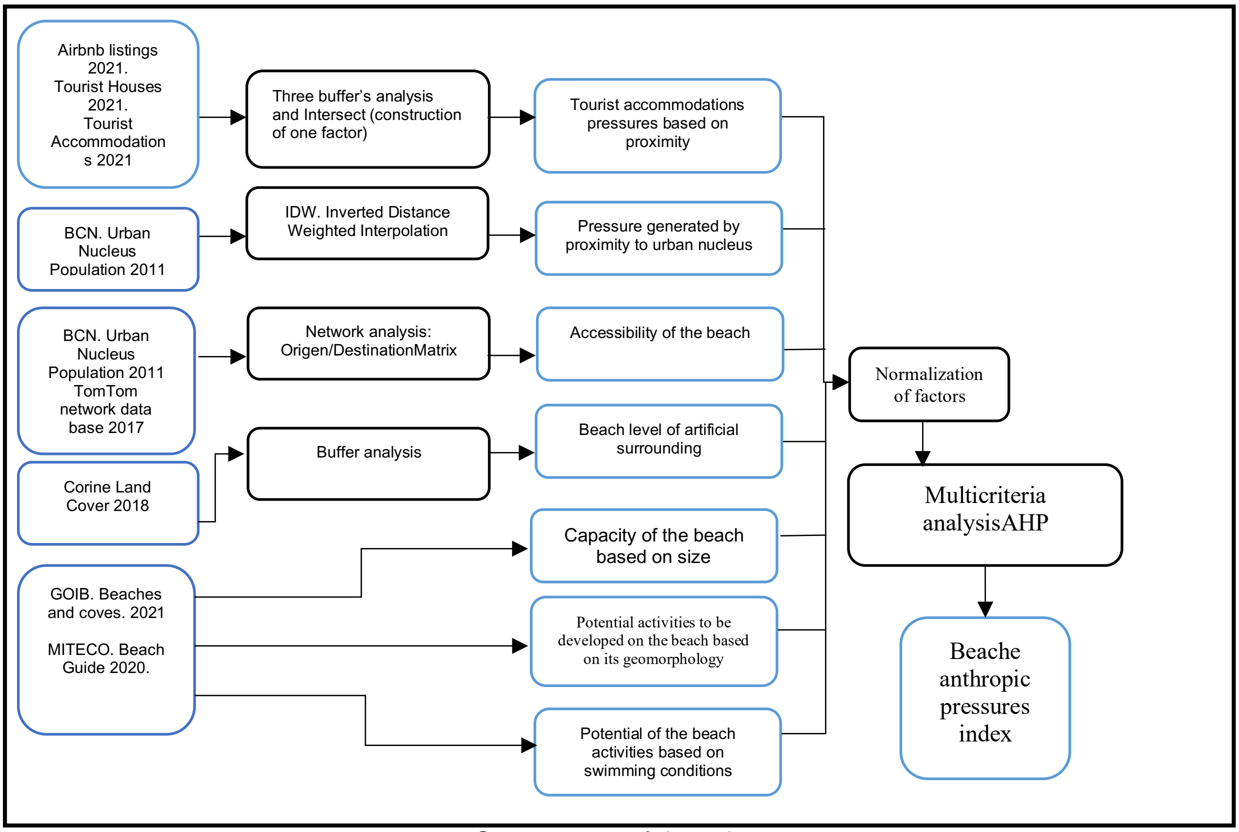


Source: Own elaboration based on GOIB (2021c) and MITECO (2020)

3.2. Study design

This research aims to create a model calculating the level of anthropic pressure beaches of Mallorca are under. The proximity is being put forward as a definitive component of the factors while measuring impact on individual beaches. As disclosed before study will analyse the scope 171 beaches in Mallorca, it is important to point out that there are 4 pair of beaches with the same name and beach id number. Those are the beaches provided by GOIB (2021), that even they are very close in proximity and have the same identification are separate by some landmark. Decision has been made to keep the initial dataset numeration, therefore in a study you can find, for example Muro 1 and Muro 2, the number being added for analysis. All of the factor analysis are done using ArcGis software version 10.4 (ESRI, 2021) and various analysis tools depending on the factors further information will be presented in the next sub-chapter, also you can observe the methodology flow chart in the that in the figure 2.

Figure 2. A conceptual flow chart for data used and methodology applied.



Source: own elaboration

3.2.1. Attainment of factors

In this section factors chosen for construction of the model will be presented, as well as GIS tools used to attain them. Factors chosen as influential to the anthropic pressure of the beaches were based on literature reviewed and potential of attraction taking into account physical aspects. In total there are seven factors, all can be separated in anthropic and physical.

ANTHROPIC FACTORS:

a.) Pressure generated by proximity to urban nucleus

Population nucleus distribution in the island were taken into account and how it can affect the beaches in the proximity. The pressure produced by the resident population is obtained from the generation of a map of population potentials in a 100x100 meter grid. This map is generated through an interpolation process from the specific population data of the urban centers of Mallorca. Using the Inverse Distance Weighting (further IDW) interpolation method, an anthropic pressure value is obtained (1). Subsequently, the beaches are superimposed on the grids and an average value of the potential population is obtained. IDW method is suggesting that points closer to each other has a higher value, also it can evaluate the size of the population is a nucleus, therefore urban nucleus with higher population count and closer to the beach would have a higher value of pressure on the beach. On another hand, smaller nucleus in the same proximity would have a lower pressure on the beach. The analysis was conducted with around 235 nucleuses in the island of Mallorca with population warrying from 2 to 301106 inhabitants.

$$z_p = \frac{\sum_i^n z_i \frac{1}{d_i^k}}{\sum_i^n \frac{1}{d_i^k}} \tag{1}$$

IDW formula: where z_p is the estimated value, z_i is the value at the known point i, d is distance between points i and p, n – is the number of known points and k is the specified power, in this case size of the population in the nucleus.

b.) Tourist accommodation pressures based on proximity

To determine tourist pressures on the beach a lower proximity was chosen, then for population because of different nature of tourist behaviour and it´s high concentration around coastline. Method used for this factor was buffer analysis. Three buffers were created around the surrounding beaches sizes: 500m, 1km and 5km. The sum of the beds in accommodation of each buffer were calculated including three datasets: on hotel and hostel stays, tourist houses and Airbnb accommodations. Once obtained the count of all beds in the buffer were summed (2) in order to get the final result and due to buffers overlapping (intersect) giving a higher value to the buffer´s 500m and 1000m, because of them being in the closer proximity to the beach. Gotten value showed us the pressures on the beaches in Mallorca by tourist allocation based on proximity.

$$TB_i = \sum_i^n P_{in} \tag{2}$$

*Formula for calculating tourist concentration around the beach**:** TB – tourist beds pressure, P_{in} – beds in the buffers, i –number of beds depending on the buffer, n – the buffers in the analysis: 500m, 1000m and 5000m.*

c.) Accessibility of the beach

Origin destination matrix using time distance from urban nucleus to beaches has been generated. Then a statistic summary has been applied to obtain the beach accessibility index (BAI). In previous factor analysis used 241 urban nucleuses were introduced as origin variables and all the beaches as destinations ones. The network analysis has connected each beach of the island with each nucleus point finding the most optimal root to be taken counting measuring time and distance separately. Once completed statistical analysis was obtained with sum of all time and distance that would take to reach each beach, from each nucleus. After some consideration, for the indicator construction only the time value was chosen to be included, as it has potential to more accurately represent the optimal travel experience, while distance could be misleading due to different types of roads considered. Therefore, presenting the highest values are the least accessible beaches, as it would take more time to reach them, and the lowest values are the most accessible one. In this analysis we make an assumption that beaches with lower values are more likely to be visited due to their easy access.

d.) Beach level of artificial surrounding

Level of artificial surrounding of a beach was chosen in order to evaluate level of intensive human activity surrounding the beach in a close proximity. To do so buffer analysis was used, creating a buffer of 500m radius around the beach and measuring 3 types of land use: 1.) artificial surface, 2.) forest and semi-natural areas and 3.) agricultural use surface. Once attained each of the 3 areas sizes were converted to the percentage values, but as excluded above in this evaluation we will be using only the part of artificial surface as it is more representative to the human activity.

PHYSICAL FACTORS:

e.) Capacity of the beach based on size

Beach size is m^2 was obtained as a secondary data, it was added in a model as a factor to improve the pressure distribution. From data, we know that beaches in our analysis vary in size from 142 m^2 to 21.3 hectares. Therefore, assigning same level of pressure to two different size beaches in the same area of anthropic pressure can be found misleading. In this study, we consider smaller size beaches to be more vulnerable to the pressures from beach users.

f.) Potential activities to be developed on the beach based on its geomorphology

The types of composition, is a secondary data, that takes into account if beach is sand beach, rocky, gravel or mixed composition beach. This was seen as necessary to include in the model, as from previous studies it is known, that type of beach composition do indicate the potential of attraction, therefore directing the higher weight towards the sandy beaches (Mooser et al., 2021) For the purpose of distributing values towards more preferred – sand beaches the value of 1 was assigned to it, and other types of beaches were valued 0. In this study 138 beaches were identified as sand beaches. The type of sand was not considered as we did not had information on all beaches sand type.

g.) Potential of the beach activities based on swimming conditions

The same as with types of beach composition, this indicator is obtained as secondary data and it supposed to divide the pressure based on the potential of attraction. It measures the waving at the beach from calm water, to higher waving, assuming that calmer water beach is more preferred, therefore more popular got value of 1, and beaches with moderate or high waving was assigned value of 0. Overall, 70 beaches were assigned calm water conditions, the rest indicated as having moderate or strong waving.

3.2.2. Model construction

3.2.2.1. Normalization of indicators

First step before constructing the model all the factors will be normalized using rescaling formula (3). Where *NI* is the normalized indicator, x_i – the value before normalization and *i* – a number of observations, in this case we know it is from 1 to 171, that is the beaches in the analysis. Using maximum and minimum values of x_i and calculating the difference all the values will be converted to the interval from 0 to 1, therefore, ready to be used in the further index construction.

$$NI_i = \frac{X_i - \min(X_i)}{\max(X_i) - \min(X_i)} \tag{3}$$

3.2.2.2. AHP for weight determination and construction of model

For assignment of weights in Multicriteria Analysis of pressure beaches of Mallorca are under Analytic Hierarchy Process was used. This model was chosen due to it simple and effective nature, it AHP model was prepared with Excel version MS Excel 2013 template (Goepel, 2013) This model can be found in various case of multicriteria analysis earlier on been used in corporate decision making, more recently was adapted in academic various studies including in work with geographical information systems (Lee et al., 2021; Ramadan & Effat, 2021; Wang et al., 2021). The AHP model uses pair-wise comparison of factors evaluating them from 1 to 9, 1 – being equal importance, 9 – extreme importance of one factor over another, calculating their weights on the model. Obtained matrix between factors can be seen in the table 2. The threshold of inconstancy chosen at 5% level (α = 0.05).

Table 1. Matrix of factors

		Proximity of an urban nucleus to the beach	Tourist accommodations pressures based on proximity	Accessibility of the beach	Beach level of artificial surrounding	Capacity of the beach based on size	Potential of the beach activities based on the composition	Potential of the beach activities based on swimming conditions	Weight
		1	2	3	4	5	6	7	
Proximity of an urban nucleus to the beach	1	1	1/3	1/2	1	3	1/4	3	10.2%
Tourist accommodations pressures based on proximity	2	3	1	1	4	3	1	5	23.6%
Accessibility of the beach	3	2	1	1	4	4	1	5	23.0%
Beach level of artificial surrounding	4	1	1/4	1/4	1	1	1/4	3	7.4%
Capacity of the beach based on size	5	1/3	1/3	1/4	1	1	1/4	2	6.2%
Potential of the beach activities based on the composition	6	4	1	1	4	4	1	5	25.9%
Potential of the beach activities based on swimming conditions	7	1/3	1/5	1/5	1/3	1/2	1/5	1	3.8%

Source: own elaboration from AHP Excel template

Finally, after finding all the indicators necessary for the model construction, rescaling them and determining the weights assigned to them the following formula is to be use in order to determine the level of anthropic pressures beaches of Mallorca are under (4). The accessibility and size indicators were added their inverted values.

$$API = w_1UNI + w_2TBI + w_3(1 - AI) + w_4ASI + w_5(1 - SI) + w_6CI + w_7WI \quad (4)$$

Anthropic beach pressure indicator formula where w presents specific weights assigned to each indicator: UNI – Urban Nucleus Indicator, TBI – Tourists Beds Indicator, AI – Accessibility Indicator, ASI – Artificial Surrounding Indicator, SI – Size Indicator, CI – Composition Indicator and WI – Water Conditions Indicator.

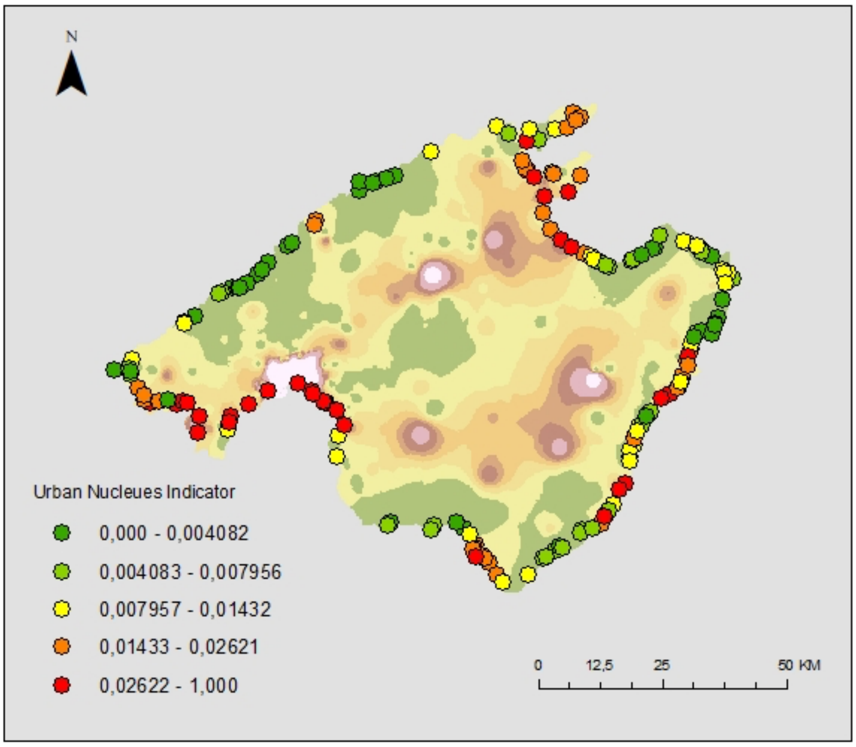
4. RESULTS

4.1. Anthropic factor analysis

a.) Proximity of a beach from urban nucleus

From IDW analysis we obtained information on urban nucleus on beaches, that are in 20 km radius and to represent it we included a map (fig. 4). Nucleus size is represented by the size of its population and in this map is noticeable, how from largest urban areas pressure dissolves with the distance. The values presented in the legend of the map are values of IDW mean already normalized to urban nucleus indicator (UNI) on each beach and they are classified using quantile classification. We can notice that highest value has a wide range from 0,02622 to 1. That does not indicate a high number of beaches with significant pressures from population within the limits we have chosen. This is largely due to some of the largest population concentration being farther from the coastline. From data obtained we found that 4 beaches of Palma municipality are the ones with the most population pressure, also beaches in municipalities close to Palma, in the Southern part of an island like Calviá, have a higher value. Other municipalities like: Santa Margalida Alcudía, Santayí, Manacor, all include a few beaches with higher pressures from urban nucleus. The least, by population proximity affected beaches concentrate in the Western part of an island, which is normal due to unsuitable landscape for urbanization. From descriptive statistics 0,023348 was found as a mean value of this pressure indicator.

Figure 3. Mallorca urban nucleus pressure on beaches



i

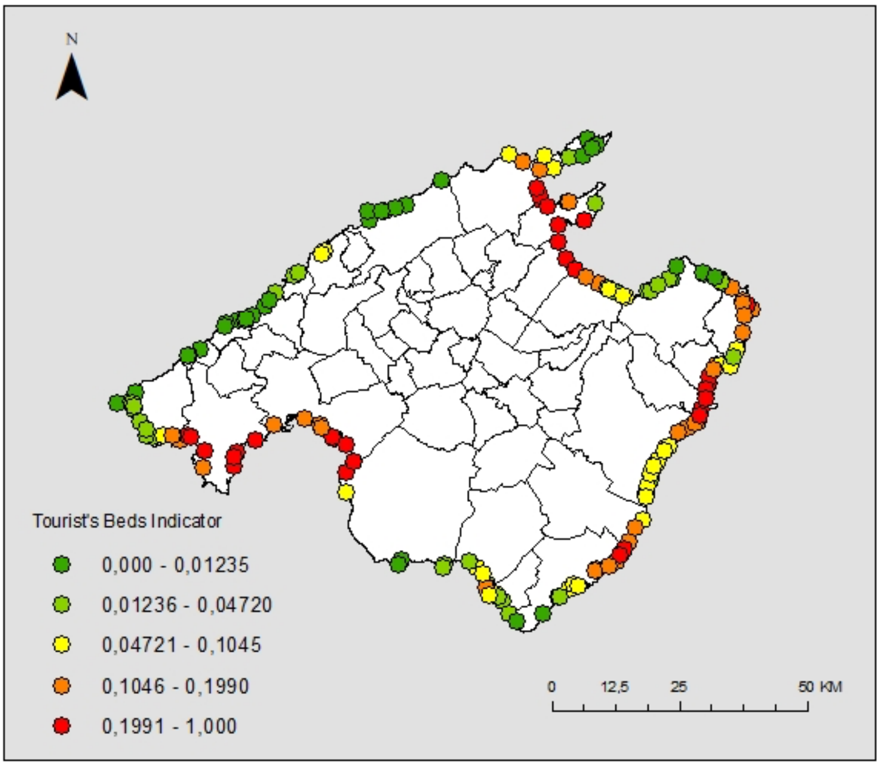
Source: own elaboration based on ING (2020)

b.) Tourist accommodation pressures based on proximity

Using previously disclosed data sources and methods the tourist beds indicator (TBI) was obtained (fig. 4). First of all, from data collected, before having it processed in an indicator we noticed high concentration of tourist accommodations in the coastline, as previously expected and discussed. Accommodations carrying was found to be very unevenly distributed along the shore of Mallorca, in the buffer of 500 meters, we found 47 beaches with no tourist accommodations and the left beaches varying from 4 tourist beds to 31 648 beds near the Playa de Palma and it is the 2 second largest beach in the island. For comparison, the largest beach – Alcudia has 18 484 beds in the same proximity. Next, at buffer of 1km the number of beaches with no values decreases to 34, other values varying from 8 to 39395, Playa de Palma still having the highest value. However, at the buffer of 5km the beaches with largest tourist beds are: Muro (1 and 2) 105 625 beds and Cala Estancia (1 and 2) with 72 219 tourist beds. Also, at 5km level all of the beaches have a a number of tourist beds around the lowest value being 6.

Once introduced all the values in the index and normalized it we are presented with a more accurate tourist bends pressure on beaches representation (fig. 4), from the index table found. Some of the most tourist beds pressure was found beaches in municipalities of Muro, Play de Mallorca, Calviá and Alcudia.

Figure 4. Mallorca tourist's beds pressures on beaches indicator



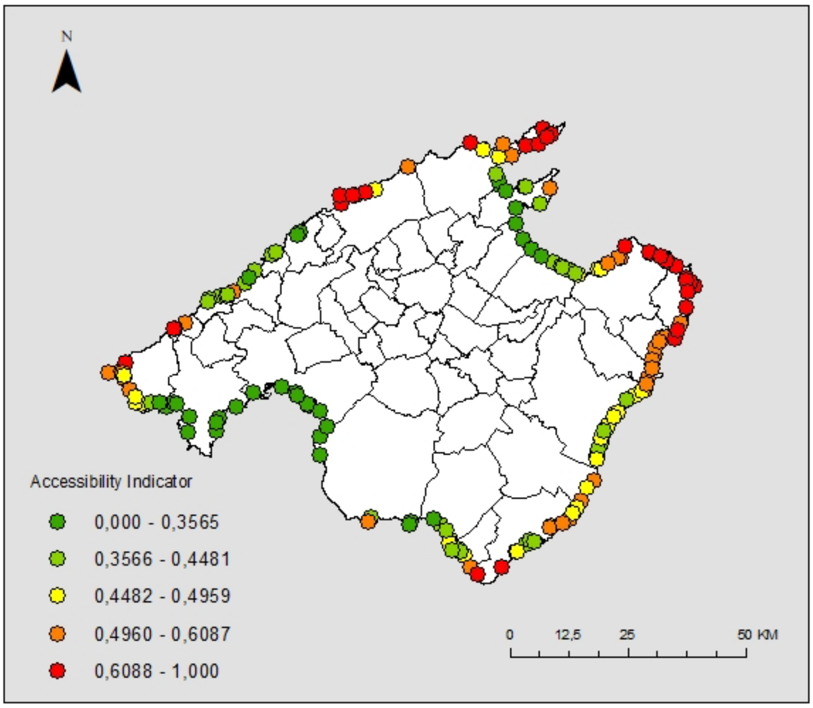
Source: own elaboration based on Inside Airbnb (2021) and GOIB (2021b, 2021a)

c.) Accessibility of the beach

From accessibility of the beach analysis, we found that the most and the least accessible beaches of Mallorca. From figure 6, representing accessibility indicators of beaches we can clearly notice the largest range of easily accessible beaches going from far east of Llucmajor municipality threw Palma and all Calvia. Other smaller groups of easily accessible beaches in Mallorca are in Muro and Alcudia, also beaches in Soller and other individual beaches. From data obtained we found that all over most accessible beaches are all eight beaches from Palma municipality, with other beaches being more variated between municipalities. From in the firstly obtained accessibility measured with time we learned that the most accessible beach in Mallorca – C'an Pere Antoni is 2,5 times faster to access over all, then the least accessible one - S'Arenalet d'Aubarca in Arta. Some of the municipalities with the most leas accessible beaches include Arta, Pollenca, Cadapera, Escorca and Alcudia.

Naturally, in this representation the network infrastructure and topographic influence to it is a major factor. If we are to presume, that beach users that choses beaches to visit based on a convenience of access this tool can be very useful while analysing the influence on individual beaches and managing accordingly. However, other factors, as people choice based on individual preferences is not presented here and should be taken in consideration if this study is to be continued. At this point in research, we are drawing analysis on anthropic pressure and connectivity of roads to the beaches can be seen as representative of that, and therefore fit for the further analysis as apart of a final model.

Figure 5. Mallorca beach accessibility indicator



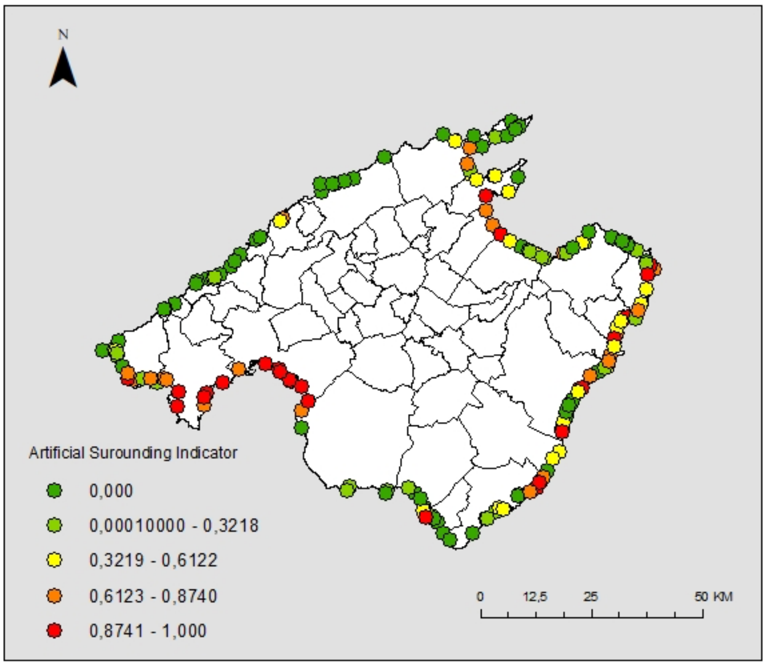
Source: own elaboration based on TomTom (2017)

d.) Beach level of artificial surrounding

We used percentage of land use around the beaches in 500 m radius in order to evaluate level of human activity surrounding it. From areas analysed we found that 63 beaches have no artificial surface in the close proximity. After checking the data previously obtained, we found that out of those beaches 39 are 100 % natural, meaning that the rest of this group are surrounded by natural land with agricultural area, as no beaches were found with 100% agricultural surrounding. From the map provided (fig. 7) we notice most of the beaches with 0 level of artificial surrounding are in the western part of the island, behind Sa Tramontana mountain range. In contrast to that the northern and eastern parts of an island looks very heterogenous with different levels of artificiality carrying beaches from high levels to none. The highest number and most homogeneous looking part of beaches with artificial surroundings we notice around Palma and Calvia municipalities. We found 28 beaches with 87 % and up artificiality level, from those 8 beaches we totally surrounded by artificial surfaces.

It is important to mention, that level of artificial surface use can also vary depending on the purpose and use of it, the variation inside the factor was not included as a part of this study. However, it could be considered and analysed further, as Mallorca urban surrounding keep on growing, not just for tourism purposes, but also for the resident's number rising, more beaches can become 100 % surrounded by artificial surfaces. We already noticed very unevenly distributed levels of artificial surrounding, this we can conclude as direct effect of islands' topography. The important issue should be to uphold the balance between urban and natural beaches while not detreating them.

Figure 7. Mallorca beach artificial surrounding indicator



Source: own elaboration based on IGN (2020)

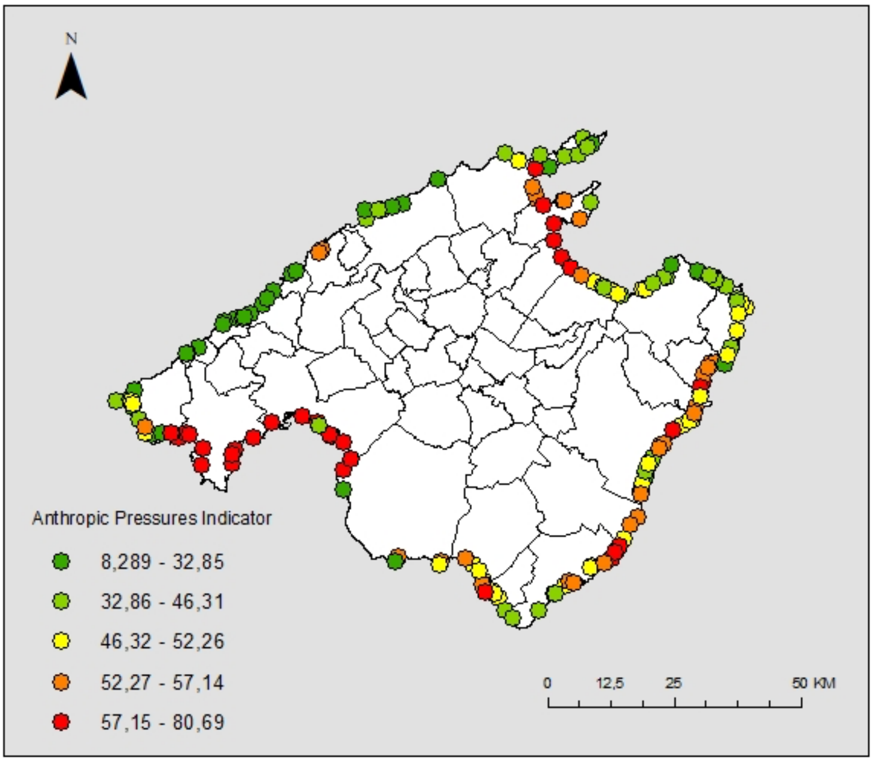
4.2. Beach anthropic pressures model

Using previously disccused methods anthropic pressure model was conducted, results you can find in appendix (tab. 2), and a map presenting the pressures spatialy (fig.8). From main desctiptive statistics we know that API that we obtained takes values from from minimum value of 8,289 to maximum of 80,69. None of the beaches got extremely high values of anthropic pressure, and half of them were found not to have a value highger than 50,099, while overall mean is 46,297. Further, too look at API distibution we have found that more than a half of observed beaches have values of pressure distributed between of 50 and 60, however for the the rest of beaches pressure values numbers barely reach over 10. This is especially important information when looking at the highest pressure values, as not a lot of beaches obtain them.

Next, from the map (fig. 8), we find spatial distribution of pressure point. We can observe most of higly pressured beaches be concentratied along the coast of Palma and Calvia and in the closer parts of the neighbouring municipalities. Other high pressure beaches we notice in Muro and Pollenca coastline. All the eastern part of the island we can exclude as the most variated with lowest and highest values beaches in a close proximity. While all the western part of an island once again appear to be under the least of pressure almost all of the beaches taking the lowest values, with exeption of beaches in Soller, largely due to their conectivity taking higher pressure values. Overall, in this model anthropic indicators took an much higher weight of the API equationn, so it not suprising that a lot of similarities can be found in the final model map from the previously discussed ones. Nonetheless, we do notice important differences while taking a more detailed look. Some of the beaches, that in previous anthropic indicators were only valuated like under a high pressure, but after itergration of have a reduced API, this might be due to beach composition or swimming condition indicators.As well as some smaller size beaches might increased theirs pressure representation. This is a good sign as it guve a more realistic idea on beaches in pressures, esepcially when comparin the one in the close proximity.

When analysing a table of index values (appendix: table 2), we find that beaches Cala estancia (1 and 2) and Moro (1 and 2), then followed by Play de Palma and Arenal and further various beaches of Calvia. All beaches we find having one of the highest values. The beach with the lowest value of pressure is Cala en gossalba, in Pollenca other beaches with lowest values include beaches from Arta, Escorca and Estellencs municipalitie’s. We can not say we find the most or the least pressured beaches only in one part of an island. That is somewhat indicative of variated distribution in the coastline.

Figure 8. Mallorca beach anthropic pressures



Source*:* own elaboration from ArcGis Map

Overall, we do notice field of interest that should be paid attention to when managing the well-being of Mallorca´s coastline. At this point in time, we still observe half beaches in Mallorca with lesser then moderate anthropic pressure. However, what calls for attention first, is distribution of beach pressures frequency. The largest group of beaches in the island have more then moderate pressures. Left unmanaged they have a pottential to grow in pressure level, if that were to happen wast majority of Mallorcas beaches would be under a high pressure. Actions of prevention to stop that from happening need to be seriousl considered, in order to prevent beach deteriation. Next, from beach athropic pressure distribution in the island (fig 8.) we can take few pointers. First, the zone from Palma to Calvia and in Muro and parts of Pollenca are the one calling fot the most management actions to prevent negative externalities from further human activity. As those areas already have groops of high pressured beaches around them it is important, governments of those municipalities ensure sustainable beach use, so that the quality of beaches would not be lost. Secondy, we preveously disclosed, that all the eastern part of Mallorca seems to be the most variated in the levels of pressure, this might not present serious chalanges at the moment, but some following factors. The distributio if different pressured beaches all along the coast, can be indicative to the expansion of the anthropic pressures around that part of coastline and if human activity is not managed ahead it can be found as a subject of unsustainable tourism growth.

5. CONCLUSIONS

In this study we were able to construct an Anthropic Pressure Indicator (API) and apply it for 171 beaches in Mallorca. The API was constructed from seven other normalized and weighted indicators: Urban Nucleus (UNI), Tourist´s Beds (TBI), Accessibility (AI), Artificial Surrounding (ASI), Size of the Beach (SI), Beach Composition (CI) and Swimming Conditions (WI). What we found approved our previously raise hypothesis – the pressures among beaches in are unevenly distributed.

What we were able to find approved our previously raises hypothesis – the pressures among beaches in are unevenly distributed. We found main two areas where accumulations of all high pressures beaches is seen: First, the largest one include beaches in Palma and Calvia municicpalities and few closer beaches from neighbouring areas. Second, in the territory of Muro and Alcudia. This areas come at risk of in high tourism seasons having the most overcrowded beaches. That could mean negative ecternalities on the beach and even tourism experience quality. Secondly, we clearely notice that beaches in the western coast behind Sa Tramuntana mountain range apear to be the least by athropic pressures. One exception of Soller municipality beaches, their values are higer, this can be explain by the nea being city of Soller and good accesibility to it. Third, the eastern coast we found it to be the most variated among beaches pressures from lowest to highes ones. This area need to be paid more attention to as it could mean the growth of anthropic pressures around it, the actions of prevention for the negavitve human created externalities on beaches should be considered. Over all, we found more then a half of all the beaches being in pressure range of 50 to 60, which is more then a moderate pressure. Actions needs to be put in places to prevent those pressures from growing, if that is not done we might find in a some time Mallorca with most of it´s beaches under a high pressure.

When thinnking of beach pressures it is imortant to understand, that is will not just mean enironmental problem, as beach deteriation might mean also lost of tourism. Tourist mains attraction are beaches in Mallorca, if the beach quality is lost, or more beaches convert to urnab ones, the island would loose it´s point of attraction. Proper prevention and management tools have to be put in place to ensure sustainable environmental, social and economical tourism development. The API suppose to help in that cuest, as with this model we can keep on monitoring the coastline changes and find the most optimal management startegies for each. Same stategie is not the most efficent way to use, due to different levels of anthropic and very variated beach characteristics.

The model conducted in this study is limited by only anthropic pressures and their division in accordance to the proximity and can be highly improved by the further research. For the further development of beach pressures and analysis based on PSR (Pressures, State, Response) framework could be developed, as in this research we have only concentrated on one side of pressures. First, pressure analysis could be improved by the natural pressures island of Mallorca is under due to climate change. Next, the in a state analysis a sensitivity index of each beach could be conducted analysing the physical internal and external factors in order to get indicator on each beach sensitivity level to the pressures exposed. This part is very important as due to different compositions, places and other factors the capacity to uphold pressures may differ among the coastline Third, response can be the most difficult to measure, but it would be very beneficial to compute an indicator measuring management tools taken to prevent beach degradation and increase resistance while keeping sustainable practices in mind. Further, then that I would add a qualitative study on Mallorca's beach users' preferences for beaches. Right now, there is a lack of this information, especially from resident's perspective, it is necessary to better understand the decision-making process to better predict the pressures inflicted on beaches, Further, it might even help to predict where higher pressors can be expected and give a chance to prepare response ahead of time.

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APPENDIX

Table 2. Anthropic Pressures Indicator composition for each beach

	Num	ID	Name	Factors							API
				UNI	TBI	AI	ASI	SI	CI	WI	
Palma de Mallorca	1	2421	Cala Major	0.133	0.169	0.059	0.826	0.055	1	1	**68.644**
	2	2422	C'an Pere Antoni	1.000	0.123	0.000	1.000	0.156	1	0	**74.613**
	3	2423	Ciudad Jardín	0.145	0.122	0.013	0.933	0.102	1	0	**65.404**
	4	2424	Cala Gamba	0.132	0.120	0.039	1.000	0.019	0	1	**43.662**
	5	2425	Caló de son Caios	0.053	0.248	0.017	0.943	0.001	1	1	**71.867**
	6	2426	Cala Estancia 1	0.053	0.623	0.026	0.964	0.086	1	1	**80.130**
	7	2426	Cala Estancia 2	0.053	0.623	0.019	0.964	0.021	1	1	**80.694**
	8	2427	Playa de Palma	0.045	0.736	0.044	0.905	0.850	1	1	**77.063**
Llucmajor	9	2437	El Arenal	0.079	0.439	0.064	0.924	0.119	1	1	**74.672**
	10	2438	Cala Blava	0.009	0.229	0.103	0.665	0.007	1	1	**66.894**
	11	2439	Cala Vella	0.014	0.069	0.192	0.000	0.000	0	0	**26.664**
	12	2440	Cala Beltrán	0.005	0.007	0.501	0.003	0.001	0	1	**21.810**
	13	2441	Cala Pi	0.004	0.010	0.359	0.248	0.019	1	1	**52.654**
	14	2554	Caló En Timo	0.004	0.015	0.314	0.000	0.006	1	0	**48.227**
	15	2555	Racó de S'Arena	0.004	0.017	0.316	0.164	0.035	1	1	**53.095**
Campos	16	2343	Ses Estanques 1	0.026	0.136	0.458	0.458	0.061	1	1	**54.842**
	17	2343	Ses Estanques 2	0.026	0.136	0.452	0.458	0.003	1	1	**55.356**
	18	2442	S'Arenal de Sa Rápita	0.003	0.042	0.328	0.173	0.219	1	1	**52.282**
	19	2443	Ses Covetes	0.000	0.052	0.368	0.000	0.012	1	1	**51.600**
	20	2444	Es Trenc	0.010	0.054	0.427	0.000	0.410	1	1	**47.868**
	21	2556	Es Perengons Petits	0.022	0.046	0.458	0.000	0.038	1	1	**49.430**
Ses Salines	22	2344	Cala Galiota	0.029	0.068	0.411	1.000	0.005	1	1	**58.723**
	23	2345	Playeta d'Es Delfí	0.023	0.037	0.428	0.000	0.027	1	1	**49.988**
	24	2346	Es Carbó	0.019	0.036	0.451	0.000	0.269	1	1	**47.874**
	25	2445	Es Port	0.029	0.067	0.405	0.785	0.020	1	1	**57.145**
	26	2446	Es Dolþ	0.026	0.052	0.392	0.165	0.089	1	1	**52.041**
Santanya	27	2347	Cala en Tugores	0.015	0.022	0.524	0.000	0.025	1	0	**43.561**
	28	2348	Es Caragol	0.013	0.000	0.753	0.000	0.204	1	0	**36.639**
	29	2349	Cala Marmols	0.010	0.003	0.638	0.000	0.013	1	0	**40.518**
	30	2350	Cala s'Almonia	0.006	0.033	0.462	0.000	0.001	0	0	**19.500**
	31	2351	Caló d'Es Moro	0.005	0.034	0.458	0.014	0.001	1	0	**45.524**
	32	2448	Cala Llombards	0.005	0.048	0.423	0.288	0.036	1	1	**52.259**
	33	2449	Cala Santanyi	0.004	0.053	0.432	0.448	0.030	1	1	**53.386**
	34	2450	S'Amarador	0.005	0.133	0.527	0.000	0.047	1	1	**49.674**
	35	2451	Sa Font de N'Alis	0.007	0.150	0.493	0.003	0.020	1	1	**51.055**
	36	2452	Caló de Sa Torre	0.008	0.172	0.525	0.655	0.002	1	1	**55.793**
	37	2453	Cala Egos	0.017	0.199	0.497	0.902	0.009	1	1	**58.957**
	38	2454	Cala D'Or	0.033	0.255	0.476	1.000	0.004	1	1	**61.677**
	39	2455	Cala Gran	0.038	0.251	0.464	1.000	0.019	1	1	**61.817**
	40	2576	Caló Santanyí	0.006	0.054	0.435	0.411	0.001	1	1	**53.272**
Felanitx	41	2456	Cala Ferrera	0.004	0.239	0.492	0.784	0.021	1	1	**58.933**
	42	2457	Cala Mitjana	0.009	0.155	0.512	0.000	0.003	1	1	**50.863**
	43	2458	Cala Marþal	0.035	0.130	0.474	0.472	0.052	1	1	**54.586**
	44	300701	S'Arenal de Portocolom	0.029	0.075	0.514	0.550	0.011	1	1	**53.157**
Manacor	45	2352	Caló Antena	0.010	0.101	0.438	0.576	0.012	1	0	**51.707**
	46	2353	Caló Bota	0.010	0.047	0.440	0.000	0.007	0	0	**20.359**

	47	2354	Cala Virgili	0.015	0.052	0.452	0.000	0.003	1	0	**46.083**
	48	2355	Cala Pilota	0.015	0.061	0.452	0.000	0.005	1	0	**46.284**
	49	2356	Cala Magraner	0.016	0.075	0.452	0.000	0.015	1	0	**46.560**
	50	2357	Cala Sequer	0.010	0.075	0.448	0.000	0.004	1	0	**46.630**
	51	2358	Cala Falco	0.008	0.067	0.459	0.000	0.001	1	0	**46.202**
	52	2359	Cala Petita	0.043	0.124	0.488	0.000	0.002	1	0	**47.232**
	53	2360	Cala Morlanda	0.018	0.165	0.514	0.397	0.001	1	0	**50.294**
	54	2459	Cala Murada	0.010	0.083	0.448	0.909	0.022	1	0	**53.447**
	55	2460	Cala Tropicana	0.010	0.089	0.476	0.705	0.033	1	1	**55.173**
	56	2461	Cala Domingos	0.010	0.087	0.457	0.686	0.036	1	1	**55.382**
	57	2462	Cala Estany	0.004	0.090	0.491	0.603	0.070	1	1	**53.789**
	58	2463	Porto Cristo	0.059	0.106	0.440	0.874	0.027	1	1	**58.183**
	59	2511	Cala Varques	0.009	0.072	0.460	0.000	0.016	1	0	**46.187**
	60	2512	Cala Mandia	0.006	0.107	0.488	0.905	0.043	1	0	**52.890**
	61	2513	Cala Anguila	0.006	0.103	0.491	0.922	0.026	1	0	**52.972**
	62	2514	Cala Moreia	0.012	0.230	0.519	0.700	0.073	1	0	**53.438**
	63	200701	Cala Rafalino	0.019	0.153	0.496	0.093	0.003	1	1	**51.968**
Sant Llorenc des Cardassar	64	2464	Cala Moreia	0.007	0.264	0.513	0.819	0.021	1	1	**59.320**
	65	2465	Sa Coma	0.017	0.319	0.529	0.664	0.185	1	0	**54.384**
	66	2466	Cala Millor	0.016	0.350	0.550	0.733	0.237	1	0	**54.792**
	67	2515	Cala Nau	0.016	0.249	0.567	0.424	0.039	1	0	**51.012**
Son Servera	68	2467	Cala Bona	0.018	0.267	0.522	0.797	0.082	1	1	**58.758**
	69	2468	Port Roig	0.012	0.211	0.538	0.554	0.015	1	1	**55.630**
	70	2469	Port Vell	0.003	0.143	0.516	0.373	0.006	1	1	**53.168**
	71	2470	Es Ribell	0.006	0.132	0.524	0.519	0.087	1	1	**53.334**
	72	2517	Cala Millor	0.039	0.320	0.530	0.944	0.046	1	0	**57.570**
	73	2518	Es Torrent d'Es Morts	0.004	0.051	0.703	0.277	0.000	0	0	**16.430**
	74	200702	Es Rajoli	0.004	0.100	0.571	0.999	0.001	1	1	**55.550**
Capdepera	75	2471	Canyamel	0.002	0.070	0.609	0.443	0.119	1	0	**45.296**
	76	2472	Sa Font de Sa Cala	0.002	0.142	0.658	0.557	0.027	1	1	**51.103**
	77	2473	Son Moll	0.011	0.190	0.646	0.897	0.034	1	0	**51.270**
	78	2474	Cala Agulla	0.014	0.154	0.671	0.125	0.140	1	0	**43.490**
	79	2475	Cala Mesquida	0.002	0.106	0.718	0.244	0.110	1	0	**42.197**
	80	2519	Cala Rotja	0.002	0.037	0.643	0.733	0.001	1	0	**46.614**
	81	2520	Cala Auberdans	0.002	0.038	0.617	0.564	0.003	1	0	**45.974**
	82	2521	Cala Gat	0.004	0.196	0.701	0.635	0.004	1	0	**48.305**
	83	2522	Cala Moltó	0.013	0.124	0.718	0.000	0.002	1	1	**45.420**
	84	200703	Cala Lliteras	0.009	0.214	0.688	0.907	0.002	1	0	**51.106**
Arta	85	2476	Cala Torta	0.005	0.014	0.815	0.000	0.114	1	0	**36.017**
	86	2477	Cala Mitjana	0.007	0.013	0.872	0.000	0.052	1	0	**35.090**
	87	2523	Cala Estreta	0.008	0.012	0.885	0.000	0.005	0	0	**9.285**
	88	2524	Cala DÞntol	0.008	0.012	0.883	0.000	0.002	0	0	**9.331**
	89	2525	Cala es Matzoc	0.010	0.011	0.946	0.000	0.036	1	0	**33.483**
	90	2526	Sa Font Salada	0.012	0.011	0.982	0.000	0.020	1	0	**32.749**
	91	2527	S'Arenalet d'Aubarca	0.012	0.011	1.000	0.000	0.022	1	0	**32.332**
	92	2528	Es Caló	0.006	0.003	0.972	0.000	0.006	1	0	**32.852**
	93	2529	Cala Mata	0.001	0.015	0.579	0.558	0.002	1	0	**46.261**
	94	2530	Caló d'En Sureda	0.002	0.010	0.586	0.028	0.001	1	0	**42.081**
	95	2531	Caló D'Es Cans	0.002	0.014	0.546	0.000	0.001	1	0	**42.882**
	96	2532	Cala Estret	0.004	0.022	0.487	0.322	0.007	1	0	**46.804**

	97	2533	Caló d'Es Parral	0.005	0.024	0.491	0.628	0.008	1	0	**49.036**
	98	2534	Sa Cánova	0.004	0.053	0.455	0.136	0.334	1	0	**44.817**
	99	2534	Sa Cánova	0.004	0.053	0.443	0.136	0.056	1	0	**46.845**
Santa Margalida	100	2478	Son Serra de Marina	0.007	0.033	0.398	0.612	0.066	1	0	**50.909**
	101	2535	Es Dolþ	0.007	0.042	0.394	0.449	0.052	1	0	**50.100**
	102	2536	Son Real	0.009	0.048	0.419	0.021	0.085	1	0	**46.306**
	103	2537	Cala Serralot	0.012	0.047	0.415	0.000	0.007	1	0	**46.743**
	104	2538	S'Arenal d'En Casat	0.023	0.109	0.417	0.000	0.193	1	0	**47.100**
	105	2539	Son Bauló	0.060	0.181	0.331	0.464	0.076	1	0	**55.324**
	106	2540	Ca'n Picafort	0.068	0.299	0.284	0.899	0.244	1	0	**61.442**
Muro	107	2479	Muro 1	0.026	1.000	0.295	0.745	0.256	1	1	**79.874**
	108	2479	Muro 2	0.026	1.000	0.279	0.745	0.256	1	1	**80.239**
Alcudia	109	2480	Alcudia	0.050	0.612	0.320	0.950	1.000	1	1	**67.231**
	110	2481	Alcanada	0.032	0.201	0.402	0.594	0.038	1	0	**55.062**
	111	2482	Coll Baix	0.023	0.032	0.579	0.000	0.057	1	0	**42.412**
	112	2483	Sant Joan	0.014	0.193	0.388	0.298	0.006	1	0	**53.047**
	113	2484	Sant Pere	0.016	0.194	0.388	0.447	0.010	1	0	**54.169**
	114	2485	Sa Marina d'Alcudia	0.039	0.310	0.312	0.503	0.230	1	0	**57.902**
	115	2486	Cap des Bou	0.029	0.317	0.341	0.333	0.103	1	0	**56.863**
Pollenca	116	2487	Platja d'Albercuix	0.028	0.187	0.457	0.801	0.086	1	1	**58.481**
	117	2488	Port de Pollenþa	0.021	0.281	0.376	0.747	0.366	1	0	**56.501**
	118	2489	Cala Formentor	0.014	0.014	0.682	0.302	0.025	1	1	**45.775**
	119	2490	Cala Sant Vicens	0.004	0.160	0.462	0.344	0.016	1	0	**50.742**
	120	2541	Cala En Feliu	0.017	0.000	0.806	0.000	0.003	1	0	**36.720**
	121	2542	Cala Murta	0.018	0.000	0.848	0.000	0.006	1	0	**35.749**
	122	2543	Cala en gossalba	0.018	0.000	0.921	0.000	0.001	0	0	**8.289**
	123	2544	Cala Figuera	0.017	0.000	0.830	0.000	0.008	1	0	**36.149**
	124	2545	Cala Boquer	0.012	0.085	0.545	0.000	0.007	1	0	**44.641**
	125	2546	Cala Castell	0.013	0.068	0.782	0.000	0.009	1	0	**38.798**
	126	200704	Ca'n Cuarassa	0.022	0.297	0.354	0.040	0.149	1	0	**53.548**
	127	200705	Es Caló	0.005	0.083	0.516	0.000	0.003	0	0	**19.430**
Escorca	128	2491	Racó de Mortix	0.012	0.000	0.600	0.000	0.013	0	0	**15.549**
	129	2492	Cala Codolar	0.003	0.001	0.472	0.000	0.046	0	0	**18.192**
	130	2493	Cala Capellans	0.003	0.001	0.740	0.000	0.003	0	0	**12.319**
	131	2495	Sa Calobra	0.001	0.001	0.722	0.000	0.003	1	0	**38.500**
	132	2496	Cala Fotuda	0.002	0.001	0.787	0.000	0.002	0	0	**11.217**
	133	2497	Cala Tuent	0.001	0.001	0.859	0.000	0.038	1	0	**35.130**
	134	2547	Torrent de Pareis	0.001	0.001	0.740	0.000	0.002	1	0	**38.106**
Soller	135	2498	Puerto de Sóller	0.021	0.078	0.357	0.723	0.022	1	0	**54.178**
	136	2499	En Repic	0.024	0.079	0.350	0.488	0.053	1	0	**52.438**
Deya	137	2500	Llucalcari	0.000	0.025	0.420	0.000	0.005	0	0	**20.213**
	138	2501	Cala DeiÓ	0.000	0.013	0.423	0.000	0.004	0	0	**19.839**
Valldemossa	139	2502	Caló de S'Estaca	0.003	0.016	0.440	0.000	0.003	0	0	**19.574**
	140	2503	Sa Font Figuera	0.002	0.012	0.355	0.000	0.008	0	0	**21.401**
	141	2504	Port de Valldemossa	0.000	0.010	0.367	0.000	0.005	0	0	**21.039**
	142	2548	Sa Cova	0.002	0.009	0.499	0.000	0.002	0	0	**18.055**
Banyalbufar	143	2505	Punta Galera	0.004	0.005	0.399	0.000	0.002	0	0	**20.271**
	144	2506	Cala Banyalbufar	0.004	0.007	0.386	0.000	0.002	0	0	**20.614**
	145	2549	Port D'Es Canonge	0.001	0.007	0.357	0.290	0.003	0	0	**23.389**

	146	2550	Son Bunyola	0.001	0.007	0.375	0.234	0.008	0	0	**22.528**
	147	2551	Es Corral Fals	0.003	0.005	0.386	0.000	0.017	0	0	**20.466**
Estellencs	148	2507	Cala Ca's Xirimié	0.008	0.003	0.637	0.000	0.006	0	0	**14.758**
	149	2508	Cala de son Pruaga	0.008	0.003	0.642	0.000	0.011	0	0	**14.619**
	150	2552	Cala Estellencs	0.004	0.005	0.533	0.000	0.003	0	0	**17.183**
Andratx	151	2405	Cala En Cucó	0.000	0.005	0.560	0.000	0.001	1	0	**42.333**
	152	2406	Cala Basset	0.010	0.007	0.636	0.000	0.014	0	1	**18.655**
	153	2407	Es Descarregador	0.004	0.019	0.520	0.385	0.004	1	1	**50.275**
	154	2408	Sant Elm	0.004	0.026	0.479	0.320	0.017	1	1	**50.802**
	155	2409	Cala Conills	0.006	0.025	0.503	0.181	0.001	0	1	**23.521**
	156	2410	Cala Egos	0.021	0.025	0.585	0.000	0.008	1	1	**46.180**
	157	2411	Cala Marmassén	0.026	0.040	0.468	0.903	0.002	1	0	**52.229**
	158	2412	Cala Llamp	0.026	0.042	0.475	0.828	0.001	0	0	**25.752**
	159	2413	Camp de Mar	0.003	0.158	0.325	0.710	0.048	1	1	**60.148**
	160	2414	S'Algar	0.005	0.017	0.540	0.260	0.005	0	1	**23.034**
	161	2415	Cala Fonoll	0.026	0.046	0.465	0.649	0.003	1	1	**54.352**
	162	2553	Cala Blanca	0.021	0.104	0.426	0.096	0.012	0	1	**26.630**
Calvia	163	2416	Cala Fornells	0.029	0.164	0.294	0.262	0.000	1	1	**58.256**
	164	2417	Peguera 1	0.039	0.529	0.254	0.857	0.087	1	1	**71.722**
	165	2417	Peguera 2	0.039	0.529	0.206	0.857	0.220	1	1	**71.983**
	166	2418	Cala de Santa Ponça	0.038	0.349	0.195	1.000	0.220	1	1	**69.046**
	167	2419	Cala Vinyes	0.010	0.232	0.243	0.729	0.021	1	1	**64.161**
	168	2420	Magalluf	0.043	0.421	0.217	0.910	0.260	1	1	**69.380**
	169	2509	Palma Nova	0.062	0.387	0.184	1.000	0.114	1	1	**71.108**
	170	2510	Oratori de Portals	0.029	0.249	0.145	1.000	0.024	1	1	**69.006**
	171	300702	Cala Penyas Rotges	0.040	0.139	0.293	0.996	0.015	1	0	**59.331**