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Is disability a conditioning factor to perceive cultural ecosystem services? Assessing social perception in a coastal protected dunefield

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ABSTRACT

Cultural ecosystem services (CESs) can be defined as the non-material benefits that people obtain from ecosystems. Little research has been conducted on the measurement and assessment of CESs through user perception, especially when the focus is on people with disabilities. The aim of this research is therefore to determine the CESs in a study area and to evaluate their perception by users, especially those with disabilities. The chosen study area is a dunefield with protected status that is typically used as a tourism resource. Located in the south of Gran Canaria (Canary Islands, Spain), the area surrounding the dunefield is one of the most important tourist destinations in Spain. The present research use a methodological approach to assess user perception of CESs. This was measured through 654 surveys at a total of 11 urban and natural survey points. Of these 654 surveys, separate analyses were made of the 46 which were held with people with disabilities. Firstly, the statistical relationships between the preferences of the two user types (with and without disabilities) are analyzed and discussed. Secondly, a study is undertaken as to whether the environmental management and/or/land uses of/around this protected area meet the expectations of the users, especially those with disabilities. The main results show that "landscape contemplation" was the most widely acknowledged and valued CES by both user types, especially those surveyed at the urban survey points. The "inspiration to be creative" CES obtained the lowest score at the natural survey points and the "social activities" CES at the urban survey points. Finally, it was found that the type of disability itself was not a statistically significant conditioning factor but that the specific type of disability was. The most influential social variables in the perception of CESs in Maspalomas were, in order, gender, companion, place of residence, age and type of disability. The results presented in this work can be applied to the management of the aeolian sedimentary system and to optimize user experience in the Maspalomas Dunes Special Natural Reserve.

1. Introduction

Arid coastal dunes and beaches provide a wide range of ecosystem services (ESs) which meet the needs of different societies worldwide. Besides food and construction materials, they regulate coastal erosion by acting as a wave dissipator and buffer against extreme events. Coastal strips are also the habitat of a large number of plant and animal species and a very important recreational space and tourist attraction (Defeo et al., 2009; Everard et al., 2010; Barbier et al., 2011).

Coastal areas, where 41% of the world's population live (Martínez et al., 2007), are under strong anthropic pressure in many regions of the world (Small and Nicholls, 2003; Defeo et al., 2009; Barragán and de Andrés, 2015; Neumann et al., 2015). The process of human occupation has been intensive (Rullán Salamanca, 2008; Blázquez-Salom and Yrigoy, 2016), and has had significant environmental consequences (Bird, 1996; Tuya et al., 2014; Bird and Lewis, 2015; Hernández-Calvento et al., 2014), especially in small islands (Mimura et al., 2007). For example, in the Canary Islands (Spain), the site of the present research study, this process of coastal occupation began to intensify in the 1960s as the economy gradually and progressively came to rely more and more on the service sector, especially tourism activity. Tourism in these islands is predominantly of the 'sun and beach' type, and so most tourist

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infrastructure is located in the coastal areas, usually associated with sandy areas such as beaches and dune systems (Hernández-Calvento, 2006; Hernández-Calvento et al., 2014; García-Romero et al., 2016, 2019a, b). This type of urban-tourism occupation of the coastal areas of the archipelago has been constant and continues to take place (Pérez-Chacón Espino et al., 2007b). It has caused, in addition to changes in natural values, the loss of cultural and heritage values (Pérez-Hernández et al., 2020; Sanromualdo-Collado et al., 2021).

One of the attractions of these coastal environments is the diversity and importance of the cultural ecosystem services (CESs) that the natural environment offers to society. CESs can be defined as the non-material benefits that people obtain from ecosystems (Millennium Ecosystem Assessment, 2005). These include their aesthetic value, inspiration for art, cultural identity and heritage, feelings of attachment, spiritual experiences, and tourism and recreational activities (Ghermandi et al., 2010; Pérez-Maqueo et al., 2013; Newton et al., 2018; Urbis et al., 2019a). The ways in which ecosystems have been exploited, for crop-growing, fuel extraction, etc., can also be considered CESs (Fowler and Welch, 2018; Pausas and Keeley, 2019). To date, very few studies have been undertaken within the ES framework on the measurement and assessment of CESs (Schaich et al., 2010). This gap is particularly notable in the aeolian sedimentary systems of arid as opposed to temperate regions, probably because the location of the former is commonly concentrated in countries with less research funding (García-Romero et al., 2018).

The loss of CESs is one of the main consequences of the degradation of a coastal ecosystem through its transformation by land uses (Metzger et al., 2006; Van Oudenhoven et al., 2012; Lawler et al., 2014; Carranza et al., 2019; Marrero-Rodríguez et al., 2021), climate change (Asmus et al., 2019; Mehvar et al., 2019; Weiskopf et al., 2020) or the introduction of invasive alien species (Vilà et al., 2010; Walsh et al., 2016). CESs are also affected by the globalization process (Arizpe, 1996), with examples including the disappearance of traditional practices (Plieninger et al., 2006) and the destruction of material heritage through urban and tourism developments (Pérez-Hernández et al., 2020).

The perception that each person has of a given ecosystem tends to be motivated by factors other than conventional economic parameters (Kumar & Kumar, 2007). In areas subject to the pressure of tourist and/or local visitors, knowing the motivation behind user choices can be useful for their proper management and conservation (Atauri et al., 2000; Bryan et al., 2010; Anfuso et al., 2014). CESs are perceived differently depending on the social profile of the user (age, gender, country or city of residence, etc.), as is also the case for the perception held of landscapes (Briceño et al., 2016; Peña-Alonso et al., 2019).

Landscapes are increasingly being recognized as providers of valuable CESs given their association with recreational and leisure activities that are linked to educational, inspirational and spiritual values, as well as to improved mental and physical health and well-being (Sandifer et al., 2015; Van Zanten et al., 2016; Van Berkel et al., 2018). It has been argued that an individual's perception of a landscape may be related to a process of social escapism from everyday reality, with the existence of a landscape that differs from that habitually encountered by the user representing an added value (Tuan, 1997; Kumar & Kumar, 2007; Oh et al., 2007; Martín-López et al., 2012; Briceño et al., 2016). A good knowledge of user preferences allows the application of alternative proposals for landscape management (Atauri et al., 2000; Wherrett, 2000; Fisher et al., 2009; Vilardy et al., 2011; Martín-López et al., 2012), especially in relation to tourism. Any measures that are taken should be adapted to the ongoing dynamics of the socio-ecological processes that are taking place (Garnåsjordet et al., 2012), minimizing the impact of recreational activities (Marion and Farrell, 2002) on the capacity of an ecosystem to provide CESs and maximizing the user experience. However, so far little research has been conducted on CESs and their alteration by land uses, perhaps because of their intangible character and the fact that their importance has generally been passed over in ecosystem management (Marrero-Rodríguez et al., 2021).

In the particular case of people with disabilities, O'Brien et al. (2014, 2017) demonstrated the importance to such people of the proximity of nature. Kosanic and Petzold (2020) reported that people with disabilities, due to their particular characteristics, are especially affected by changes to nature, making them more vulnerable to possible effects of climate change which could have a profound impact on their well-being (Bell et al., 2020). Summers and Vivian (2018) highlighted the important role of ecotherapy for various mental health disorders such as attention deficit, hyperactivity, mental stress, post-traumatic stress and dementia. Some researchers have indicated that living in an area near the sea or making punctual and leisurely visits to a coastal area brings a number of benefits in terms of health and psychological well-being by increasing positive emotions (Peng et al., 2016; White et al., 2013). The positive effect of visiting the beach is greater in people with disabilities, as the beach is an ideal setting for the practice of therapeutic sporting activities such as surfing (Moore et al., 2018; Matos et al., 2017; Pérez et al., 2017; Stuhl and Porter, 2015; Cavanaugh et al., 2013). In terms of tourist activity, being in a natural environment is considered an important motivation to travel for people with a mobility impairment (Shi et al., 2012). However, according to Kosanic and Petzold (2020), there remain considerable gaps in the body of knowledge related to CESs, particularly for marginalized groups, including users with disabilities, in urban areas and regions of the global south. This is especially true with respect to how the user perceives them and how this particular type of ES is managed. Kosanic and Petzold (2020) concluded that "*there needs to be a better understanding of how certain types of cultural ecosystem services affect specific perceptions of physical and mental health, going beyond generic and aggregated approaches to human wellbeing*".

In the present paper, an evaluation and analysis is carried out of both local and foreign user perceptions of CESs in the study area (Maspalomas dunefield), including a particular assessment and comparison of the perception of users with disabilities within the general sample. The aim of this research is therefore to evaluate CESs through the perception of users, especially those with disabilities. For this, we established the following sequence of specific objectives: i) to determine the user profile in the protected area, both that of the general user (as reference) and that of the user with a disability who is a minority audience (user under study); ii) to assess the CESs in the study area that have a close relationship to the intensity of human occupation; iii) to identify and analyze CES preferences according to both user profiles (general and with disabilities); iv) to analyze and discuss differences with respect to preferences between the general (without disabilities) user and the user with disabilities; v) to discuss whether current CES management conflicts with the preferences of users with disabilities.

2. Methods and materials

2.1. Study area: Maspalomas Costa Canaria

Maspalomas Costa Canaria is located in the municipality of San Bartolomé de Tirajana, Gran Canaria, Spain (Fig. 1). It has a resident population of 53,443 inhabitants and a non-resident population of 14,584 (ISTAC, 2020a). In 2018, this area accounted for 48% of all available tourist accommodation on the island (hotels, bungalows, etc.) and 52% of tourist bed units (67,419 out of a total of 129,693; ISTAC, 2020b). In terms of room nights, Gran Canaria registered a total of 29, 597,873 during 2019 (ISTAC, 2020b), with 52.6% of these in Maspalomas Costa Canaria, however there are no official public data related to disabled people and tourists. More specifically, the study area of this research is the Dunas de Maspalomas Special Natural Reserve (DMSNR), a dune system that is also a major tourist attraction in one of Spain's most important tourist resorts (Domínguez-Mujica et al., 2011). Thanks to its climate conditions, tourist demand is high throughout the year. There are two peak tourist seasons, one in winter and the other in summer, and, unlike most other 'sun and beach' destinations, the anthropic pressure of tourism is constant (Peña-Alonso et al., 2018a).

Fig. 1. Location of the study area and general view of the survey sites: Urban survey points (red points) and Natural survey plots (red square). Orthophoto source: SDI Canarias (Gobierno de Canarias, GRAFCAN, S.A.).

From an environmental perspective, the DMSNR has protected status (granted by the Canary Islands Regional Government in 1987), and in 2000 it was designated a Special Area of Conservation under the EU Habitats Directive. Four features in particular of the DMSNR can be highlighted: i) it contains a number of habitats at severe risk of disappearance, ii) it constitutes a representative sample of the Canary Islands dune ecology, iii) the singularity of its landscape, and iv) the presence of ecological, scientific and educational bio-physical processes and

elements of high value. Since 1994, the area has been further protected through the application of other regulations at European Union level. All permitted uses and activities in the DMSNR are listed in the still active 2004 Maspalomas Special Nature Reserve Master Plan (Gobierno de Canarias, 2004a). Four different zones are defined in this Plan according to level of protection and restriction of use: i) special use zone; ii) general use zone (both are outside the study area); iii) restricted use zone (Fig. 1, in green); and iv) exclusion zone (Fig. 1, in red). The most relevant of the prohibited uses for the purposes of the present study are: i) in the restricted zone - leaving the authorized paths (Fig. 1, pink lines), stays of any length of time day or night, the installation of any infrastructure not meant for DMSNR conservation activities, and any use that could compromise the conservation goals of this zone; and ii) in the exclusion zone - any type of interference with the fauna and flora found in the zone, the access and transit of users, stays of any length of time day or night, and any use that could compromise the conservation goals of this zone, with the sole exception being access for conservation, management or research purposes (Fig. 1). The DMSNR regulations establish a total of three authorized paths to cross the inner dune field, with the intention of allowing visitors to enjoy this natural environment with the least possible impact on the ecosystem. Any departure from these trails is expressly forbidden in the aforementioned regulations.

The DMSNR is a transgressive dunefield formed by a sand corridor, predominantly of biogenic origin, between El Inglés beach (sediment input zone) and Maspalomas beach (sediment output zone). The main landforms in the area are barchanoid ridges and barchan dunes (Hernández-Calvento, 2006), which endow the study area with a landscape that contrasts sharply with the rest of the island. A lagoon situated in the SW of the Reserve is another singular landform and one which has an important ecological value (Gobierno de Canarias, 2014). The best view of the area is from the sedimentary terrace (25 m above sea level) where a viewpoint was built in the southernmost point of the urbanized area of El Inglés beach. Bordering the DMSNR are other heritage elements with a high historical-cultural value, including the Maspalomas lighthouse and the Tony Gallardo Park (Botanical Garden).

2.2. Sampling and data collection

Following the Millennium Ecosystem Assessment (2005) for intertidal flats, beaches and dunes, seven CESs were identified in the study area: *landscape contemplation, social activities, inspiration to be creative, cultural heritage, spirituality and personal well-being, leisure and tourism activities* and *educational value of nature*. These same CESs have been identified by other authors for dunes and coastal areas (Everard et al., 2010; Barbier et al., 2011).

To define the value of CESs in Maspalomas, user perception was measured through surveys. The survey that was undertaken was divided into two sections. The first part comprised six questions about the reasons and motivation for visiting the Maspalomas dunes and its surrounding area. CES preferences were assessed using a Likert scale (from 0 to 5), as is common in this type of study (Roca et al., 2009). The second part of the survey included questions to define the user's social profile, including their age, gender, nationality and educational level.

A total of 654 users were randomly surveyed conducted of *in situ* at specific survey sites (Fig. 1) which were set up in the main tourist attraction sites detected in the study area (Table 1). The survey sites were in turn split into two environmental groups: *Urban*, where the user is at a tourist attraction site or point from a scalar perspective outside the dune region but can look at and enjoy the dunes and lagoon landscape in a panoramic way (Maspalomas lighthouse and Maspalomas lagoon and Maspalomas dunes Interpretation Center and viewpoint) and Tony Gallardo Park where an accessible representation of the different ecosystems that can be found in the Maspalomas dune system is shown, signifying a space adapted to people with disabilities (Table 1); and *Natural*, places (areas or plots from a scalar perspective) inside the dune system and beaches where the users can enjoy *in situ* the CESs (Table 1:

Table 1
Natural and urban tourist attraction sites.

Site	Environment	Characteristics	Infrastructure and services
Maspalomas lighthouse	Urban	It was built between 1884 and 1889 and began operating in 1890. The building consists of two main structures, the lighthouse keeper's house and the lighthouse tower (60 m tall). Declared a Site of Cultural Interest with the category of Historical Monument in 2005. Since 2019, it has been the site of a Gran Canaria Ethnographic Museum.	Free entrance. Ethnographic Museum. Tourist information point. Local craft store. Toilets. Lift. Roof terrace with wonderful views. Restaurants close by.
Maspalomas lagoon	Urban	Located at the mouth of the Maspalomas ravine, this permanent coastal lagoon forms the "Oasis of Maspalomas" together with the neighbouring palm grove. Its surface area varies seasonally but averages 3.5 ha. It is notable for its biotic interest, functioning as a sheltering point for different species of migratory birds. Along with the Maspalomas dunefield, it has been a protected area since 1987. It forms part of the Maspalomas Special Nature Reserve.	Bird viewpoint with some nature information. Close by are restaurants, tourist excursion points of sale, a spa and benches.
Tony Gallardo Park	Urban	Botanical Garden. In this 2,000 m^2 area built in 1993 and recently renovated, different habitats of the Nature Reserve are recreated. The garden includes information boards about the flora and fauna that can be found there. It forms part of the Maspalomas Special Nature Reserve.	Botanical Garden. Free entrance. Different resting spots. Information point about the natural values of the Maspalomas Special Nature Reserve. Adapted information to people with disabilities.
Maspalomas dunefield (foredune)	Natural	In this active mobile dunefield (3.6 km^2), the dominant sedimentary landforms correspond to barchan dunes and barchanoid ridges. The area includes two beaches: Playa del Inglés and Maspalomas. It has	Four very poorly marked nature trails between the dunes.

(*continued on next page*)

Table 1 (*continued*)

Site	Environment	Characteristics	Infrastructure and services
		been a protected space since 1987. Currently, it is a Special Nature Reserve.	
Inglés beach	Natural	The beaches of El Inglés and Maspalomas are areas of input and output, respectively, of the sands that form the dunes. Both are urban beaches and form part of the DMSNR.	Sun lounger rental service. Lifeguard service. Beach bar. Bathroom assistance service for people with disabilities in only one point of Inglés beach.
Maspalomas dunes Interpretation Center and viewpoint	Urban	Located on the edge of the DMSNR, the most important information about the Reserve is on display here. The viewpoint is located next to the Centre and offers a panoramic view of the dunefield. This site is one of the most visited places in the Reserve, especially at sunset.	Free entrance. Free public toilets.

Maspalomas dunefield especially on the foredune and the Inglés beach). In the *Natural* group, the survey sites comprised six plots (200m * 200m) located on El Inglés beach (Fig. 1). These plots or areas of beach were strategically chosen to reflect different degrees of crowding depending on the availability of beach facilities (sun loungers, umbrellas, kiosks, etc.). In addition, the distance to the urban area of Playa del Inglés increased from plots 1 to 6, a condition that could determine the access of certain users by foot (Appendix 1) and, therefore, their profile and social perception (Peña-Alonso et al., 2018b). The different distances also allowed CES assessment from a spatial perspective. The surveys were carried out in the two peak tourism seasons: summer (August 2019) and winter (December 2019, January and February 2020), and users who were in the area during a given date and time were asked by two researchers, being this time period time the same in all the points and plots indicated in the Fig. 1 (surveys were conducted and were carried out simultaneously). Each survey was conducted on paper and each person surveyed had to read and complete the document. The survey was designed in three languages: Spanish, English and German. Finally, the information collected was statistically analyzed using the IBM SPSS Statistics 26 package. Spearman correlations were determined and Kruskal-Wallis tests applied to determine and understand any patterns between social profile, user location when surveyed, and each CES in the nature-tourism area (Fig. 2; Appendix 1; Appendix 2). The Mann-Whitney *U* test was applied to specifically determine how disability influences CES perception (Table 4).

In order to contrast user perception of CESs with current management of the Reserve, a review of the measures established in the regulatory regulations was carried out. It was found, through field data collection and GIS assessments, that prohibited uses are being violated by users and that current management strategies are affecting CES conservation. More specifically, in order to quantify this reality, a set of variables were considered for each prohibited use (Table 2 and Appendix 3): percentage of extension, persistence (impact time duration), reversibility (ability of the environment itself to return to its initial state) and recoverability (ability to recover the environment through human intervention). This made it possible to count the number of human impacts and determine an impact value by assigning a weight to each variable. The result of this weighting was a normalized value (from 0 to 1, where 0 means no impact value and 1 a very high impact value). In a positive sense, this can be considered a conservation value, in that when a CES registers no impact (0.0) its conservation value is high (1.0), whereas if it registers a very high impact (1.0) its conservation value is the minimum (0.0). It is this conservation value that has made it possible to make a comparison with the social importance of each CES.

3. Results and discussion

3.1. User profiles

Survey points located in the *Natural* environment had a higher number of responses (370; 23 with disabilities) than the *Urban* survey points (284; 23 with disabilities). As occurs in other places with similar

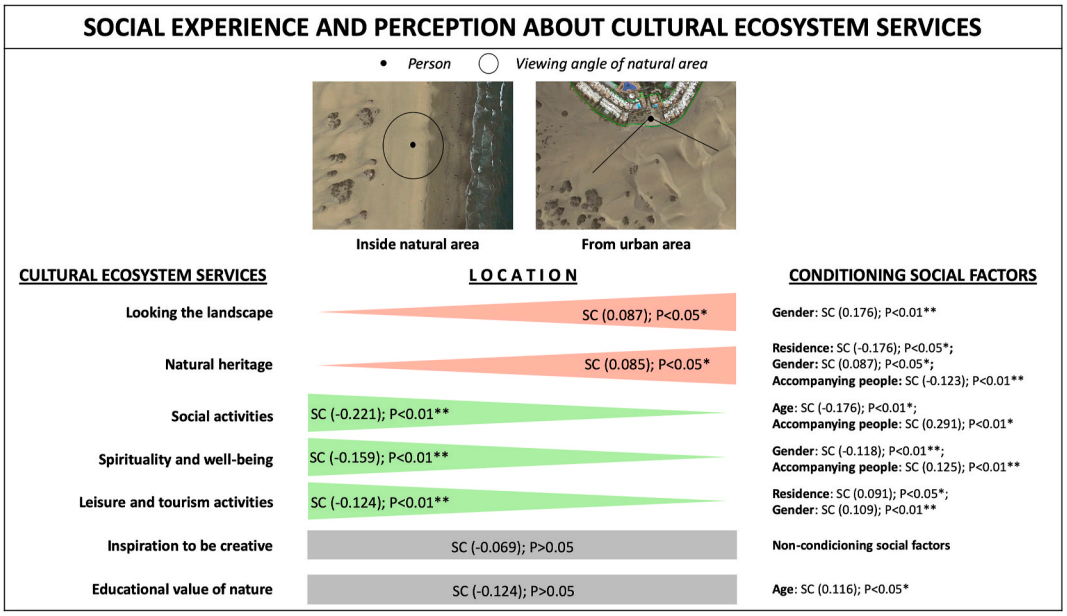

Fig. 2. Social experience and perception of CESs.

Table 2
Value of CES impact weighting.

Weighting					
Variable	None	Low	Moderate	High	Very high
	0	1	2	3	4
Percentage of extension	0	0.01–0.25	0.26–0.50	0.51–0.75	0.75–100
Persistence	Provisional	–	–	–	Permanent
Reversible	Reversible	–	–	–	Irreversible
Recoverability	Recoverable	–	–	–	Not recoverable

characteristics (Pereira da Silva, 2002; Pereira Da Silva et al., 2007; 2020), along Inglés beach (where the *Natural* survey points were located) user participation tended to decrease as the distance to the urban area increased (Table 3 and Appendix 1).

The users surveyed (n = 654) come generally from Europe (86.4%). The presence of users from other continents was recorded to a lesser degree, with just 0.6% from South America and 0.2% from North America. A total of 25 different countries were represented in the survey: Spain (30.9%), Germany (23.7%), United Kingdom (9.2%), Holland (5.0%) and various other countries with less than 5% representation each (amounting to 19.2% in total). A total of 48.0% of the surveyed users were male, 46.3% female, and 5.7% opted not to specify their gender. Average age was 50.41 (ranging from 18 to 87).

3.1.1. User profile with disabilities

According to Kosanic and Petzold (2020) "*Only few publications address the relevance of cultural ecosystem services specifically for disabled populations (including people with visible and non-visible disabilities)*", in addition "*Few publications refer to tourists, and only two specifically address disabled people*". For this reason, it is difficult to calculate the representative sample size with respect to other similar publications, although it should be noted that the sample of people with disabilities (n = 46) can be considered statistically representative, given that other similar studies have been based on much lower numbers (O'Brien et al., 2014) due to the difficulty in specifically finding this type of user. In terms of social factors, disability is treated as a heterogeneous concept (Ray and Ryder, 2003; Buhalis et al., 2005; Small et al., 2012; Wu and Song, 2017; McKercher and Darcy, 2018), and for this reason the surveyed users with disabilities (n = 46) were classified into five groups based on disability type: physical, intellectual, sensory, multiple, and other types of disability like post-traumatic stress disorder or diabetes (Table 3). Reduced mobility was the most common disability among the surveyed users (56.5%), while users with sensorial (10.2%), multiple (6.5%) and intellectual disabilities (2.2%) were also surveyed. The remaining 15.2% included other types of disability. Compared to the group of users without disabilities, a lower percentage were of Spanish origin (17.4%), with Germany (26.1%) and the UK (17.4%) the countries of origin with the highest contributions. Of those surveyed with disabilities, 73.9% were over 30 years old, 56.5% had undertaken post-compulsory or higher education studies and 63.0% were accompanied by their partners.

3.2. Social importance of CESs

User preferences with respect to the CESs varied depending on whether the user was interviewed at a *Natural* or an *Urban* survey point (Appendix 1). The results indicate that the majority of the CESs analyzed are not related with differences between the *Natural* and *Urban* survey point environments (Kruskal-Wallis Test; $p < 0.05$), with the exception of *inspiration to be creative* and *educational value of nature* (Kruskal-Wallis test; $p > 0.05$ in both CESs), perhaps because both environments allow an adequate enjoyment of these CESs (Fig. 3). *Landscape contemplation* was the most valued CES by users in all the survey points (mean = 4.46; standard deviation (SD) = 0.11 in *Natural* environments; mean = 4.52 and SD = 0.20 in *Urban* environments). The second most valued CES at the *Natural* survey points was *leisure and tourism activities* (mean = 4.46; SD = 0.20), while *cultural heritage* ranked second at the *Urban* survey points (mean = 4.31; SD = 0.11). The least valued CES in the *Natural* group was *educational value of nature* (mean = 3.54; SD = 0.27) followed by *inspiration to be creative* (mean = 3.24; SD = 0.20). In the *Urban* group, *social activities* (mean = 2.98; SD = 0.27) and *inspiration to be creative* were the lowest valued services (mean = 3.01; SD 0.13).

3.2.1. Landscape contemplation

Visual coherence and the visual scale of open and semi-open dune landscapes are key aspects that define the aesthetic appeal of coastal landscapes for users (Urbis et al., 2019b). As a result of these characteristics of the singular landscape of the study area, *landscape contemplation* was the most valued CES at 90.9% of the survey points. A statistically significant correlation was obtained between *Urban* survey points and the preference for this CES (Spearman correlation (SC): $p < 0.05$). The highest values were obtained for Maspalomas lighthouse (with its recently opened rooftop where it is possible to enjoy a panoramic view of the Maspalomas beach and dunes) and Tony Gallardo Park (mean = 4.67 in both cases), both in the *Urban* survey points. Tony Gallardo Park offers, within the tourist urbanization, an artificial setting with a recreation of the different ecosystems present in the DMSNR. Unlike the Reserve itself, the Park offers a comfortable, short and safe route with multiple resting spots. Of the *Natural* survey points, Plot 5 (4.56) and Plot 6 (4.60) obtained the highest values. The lowest values were registered in the Anexo II Shopping Center (4.20), precisely where urbanization prevents any view of the Reserve. This could be because as alteration to the landscape increases, it becomes less valued by visitors (Huang, 2013).

3.2.2. Social activities

In *Urban* survey points, *social activities* was the lowest valued CES by users (mean = 2.98), and in the *Natural* survey points it was the second lowest (mean: 3.54). In fact, there was a highly significant and positive correlation between the beach as a *Natural* survey point and the valuation of this CES (SC: $p < 0.01$). In all the selected urban places social activities are regulated, reducing their potential diversity. The Tony Gallardo Park scored lowest (2.82), perhaps because this botanical garden has been designed as a place for a stroll and a relaxing time. The plots equipped with beach kiosk and sun loungers for hire scored highest (Plot 2 = 3.81; Plot 3 = 3.72). Plot 6, with no type of infrastructure, had the lowest score of the different *Natural* survey points (3.13).

3.2.3. Inspiration to be creative

Research addressing the impact of specific natural features on creativity is non-existent (Van Rompay and Jol, 2016). Recent studies suggest that people may be more attracted to natural landscapes when green stimuli are present (Berman et al., 2014; Szolosi et al., 2014). In any case, *inspiration to be creative* was the lowest scoring CES in the *Natural* survey points (mean: 3.24; SD = 0.20) and the second lowest valued in the *Urban* group (mean: 3.01; SD = 0.13). It can also be interpreted that higher scores for this CES were related to a lower degree of human occupation in the sense that the lowest scores were in the *Urban* group, with Maspalomas lighthouse scoring 2.85 and Anexo II Shopping Centre 2.92, while the Tony Gallardo Park obtained the

Table 3
User profile without/with disability.

SOCIAL PROFILE		TOTAL	People without disability	People with disability
		n = 654	n = 608	n = 46
Place of residence		(%)	(%)	(%)
Spain	Gran Canaria	17.0	17.3	13.0
	Rest of Spain	13.9	14.6	4.3
Foreign tourism	German	23.7	23.5	26.1
	United Kingdom	9.2	8.6	17.4
	Holland	5.0	4.4	13.0
	Sweden	3.1	2.8	6.5
	Switzerland	1.8	2.0	0.0
	Other countries	13.9	18.8	8.8
No answer		26.3	8.0	10.9
Age				
Young people (18–30)		15.4	15.5	15.2
Adults (31–64)		42.0	42.3	39.1
Older adults (+65)		20.0	18.9	34.8
No answer		22.6	23.3	10.9
Gender				
Male		48.0	47.4	56.5
Female		46.3	46.9	39.1
No answer		5.7	5.7	4.4
Educational level				
Without school leaving certificate		1.2	1.3	0.0
Compulsory education (with school leaving certificate)		19.4	19.6	17.4
Post-compulsory studies (Baccalaureate or vocational training)		19.0	18.4	26.1
Higher education (university studies or equivalent)		38.1	38.7	30.4
Companion				
Alone		9.3	9.0	13.0
Partner		49.7	48.7	63.0
Family		21.7	22.4	13.0
Group of friends		12.8	13.9	6.5
Other		2.1	2.2	2.2
No answer		22.3	22.0	26.1
Disability				
Users with disability		6.3	N/A	N/A
Users with physical disability		4.0	N/A	56.5
Users with intellectual disability		0.2	N/A	2.2
Users with sensory disability		0.8	N/A	10.9
Users with multiple disabilities		0.5	N/A	6.5
Users with other type of disability		1.1	N/A	15.2
Users who do not specify		N/A	N/A	8.7
Survey point				
Plot 1		11.6	11.5	13.0
Plot 2		15.1	15.3	13.0
Plot 3		9.8	10.2	4.3
Plot 4		3.7	3.3	8.7
Plot 5		14.7	15.0	10.9
Plot 6		1.7	1.8	0
Maspalomas lighthouse		5.2	5.1	6.5
Maspalomas lagoon		8.0	7.7	10.9
Tony Gallardo Park		13.8	13.5	17.4
Maspalomas viewpoint		8.4	8.6	6.5
Anexo II Shopping Centre		8.1	8.1	8.7

N/A = Not applicable.

highest value of the group (3.17). In the *Natural* group, the survey points furthest from the urban area obtained the highest values (Plots 5 and 6, for example). However, in the closest plot to the urban area (Plot 1), the main access point to the beach, this CES was much appreciated by users (3.45).

Table 4
Differences between CES perception by survey point and disability condition according to Mann-Whitney *U* test.

Services		Natural survey point	Urban survey point
Landscape contemplation	Mann-Whitney U	2963.5	2879.0
	Asymptotic sign. (bilateral)	**0.020***	0.717
Social activities	Mann-Whitney U	3724.5	2619.0
	Asymptotic sign. (bilateral)	0.583	0.289
Inspiration to be creative	Mann-Whitney U	3460.5	2829.0
	Asymptotic sign. (bilateral)	0.278	0.637
Cultural heritage interest	Mann-Whitney U	3923.0	2663.5
	Asymptotic sign. (bilateral)	0.885	0.343
Spiritually and well-being	Mann-Whitney U	3298.0	2432.5
	Asymptotic sign. (bilateral)	0.132	0.119
Leisure and tourism activities	Mann-Whitney U	3379.5	2113.0
	Asymptotic sign. (bilateral)	0.164	**0.013***
Educational value of nature	Mann-Whitney U	3134.5	2577.0
	Asymptotic sign. (bilateral)	0.052	0.246
	N	370	284
	People with disabilities	23	23

U Mann-Whitney test for significative differences between CES perception by survey point and disability condition. Values marked in bold: * = significant at 0.05; ** = significant at 0.01.

3.2.4. *Cultural heritage*

Transgressive dunefields show a greater variety and complexity of aeolian landforms (Criado 1987; Hernández-Calvento 2006; Alonso Bilbao et al., 2011). This singular cultural heritage was highly valued by users at both the *Natural* (mean = 4.17; SD = 0.18) and *Urban* survey points (mean = 4.31; SD = 0.11). *Cultural heritage* was found to be related to the degree of urbanization (SC: $p < 0.05$). The three *Natural* survey points with the highest scores were Plot 5 (4.33), Plot 6 (4.27) and Plot 1 (4.28), despite the fact none of these places had any corresponding information available (such as posters, information panels, etc.). Some of the *Urban* survey points with information about the DMSNR, such as Tony Gallardo Park (4.45), Maspalomas lighthouse (4.36) or the lagoon (4.33), are visited by users with a manifest interest in natural heritage aspects.

3.2.5. *Spirituality and personal well-being*

The CES of *spirituality and personal well-being* was highly valued by users in the *Natural* survey points (mean = 4.38; SD = 0.18) and also recorded moderately high scores at the *Urban* survey points (mean = 3.97; SD = 0.11). Peng et al. (2016) suggest that coastal zones positively affect individual well-being. In this sense, ecotherapy is one of the ESs that nature provides, helping people connect with nature and deal with physical and mental illnesses (Buzzell and Chalquist, 2009; Summers and Vivian, 2018). The beach plot farthest from the urban area, a quiet place to rest and sunbathe with no type of infrastructure, scored highest (Plot 6 = 4.67). In the *Urban* group, the highest scores were obtained for Anexo II Shopping Centre (4.14) and Maspalomas lighthouse (4.09). These two urban places function as a gateway that connects the urban area with the natural area, enabling users to access both the beaches and the interior of the dune system (Santana-Santana et al., 2020).

3.2.6. *Leisure and tourism activities*

For users, *leisure and tourism activities* was one of the three highest scoring CESs at both the *Natural* survey points (mean = 4.46; SD = 0.20) and the *Urban* (mean = 4.26; SD = 0.26) (SC: $p < 0.01$). Maspalomas is a suitable setting for leisure and tourism activities, and indeed has been

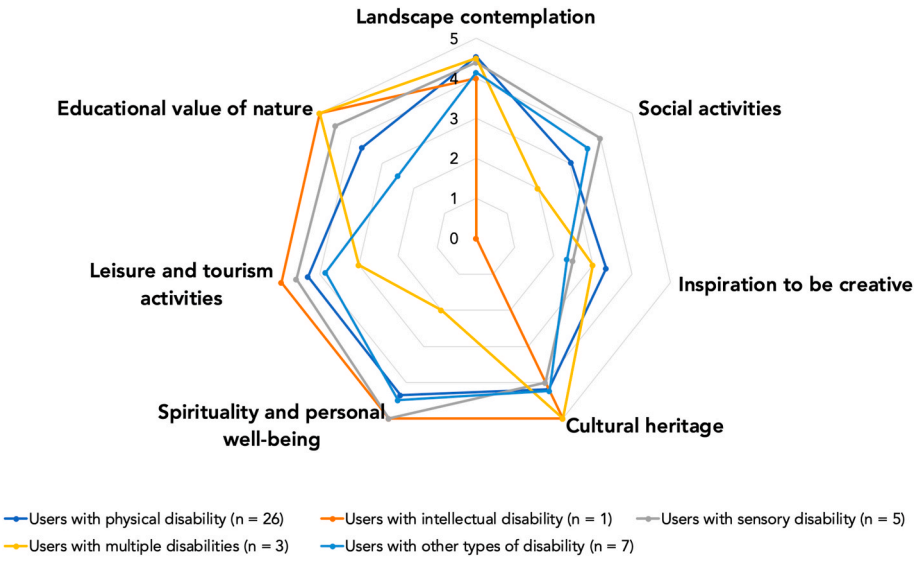

Fig. 3. CESs chosen by users with disability. Classification related to disability type.

designed as such from an urban planning perspective (Domínguez-Mujica et al., 2011; Peña-Alonso et al., 2018a; b; Sanabria Díaz et al., 2020). In this sense, the highest scoring *Natural* survey point was Plot 5 (4.76), offering tranquility and a rest from urban noise and overcrowding but at the same time a wide and varied offer of services, followed by Plot 1 (4.44) and Plot 2 (4.46) near to the urban area. The selected *Urban* survey points are close to restaurant areas, tourist information points, places to book excursions, etc., which may explain the three survey points with the highest score: Anexo II Shopping Center (4.56), Maspalomas lagoon (4.40), and Maspalomas lighthouse (4.28). The Maspalomas viewpoint lacks tourist services and had the lowest score (3.88).

3.2.7. Educational value of nature

Educational value of nature was one of the three lowest scoring CESs at both the *Natural* survey points (mean = 3.87; SD = 017) and the *Urban* (mean = 3.66; SD = 0.38). The highest score in the *Urban* group was for Tony Gallardo Park (4.29). This botanical garden has been designed as an exhibition space for the main natural characteristics of the Reserve. In contrast, Anexo II Shopping Center, a place with a high degree of human impact, obtained the lowest score (3.38). At the *Natural* survey points, Plot 3 scored lowest (3.58). This plot contains no information about the natural processes that occur around it although is a place for the transit of visitors along the beach, and can be valuable and produce an income for local businesses (Hutcheson et al., 2018).

3.3. CES preferences according to user profile

3.3.1. User without disabilities

The sociocultural profile of users conditions their preferences towards ESs (Tuan, 1997; Kumar & Kumar, 2007; Oh et al., 2007; Martín-López et al., 2012; Briceño et al., 2016). Furthermore, these preferences may vary due to a complex set of personal factors such as age, formal education level, gender, individual needs, cultural traditions and household sources of income (Hartter, 2010; Martín-López et al., 2012). In Maspalomas, significant correlations (SC: $p < 0.01$) were found for six (residence, age, sex, educational level, accompanying people, or disability) of the seven social variables considered (Fig. 3; Appendix 2). The most influential social variables in the perception of CESs in Maspalomas were, in order, gender, companion, place of residence, age and type of disability (Fig. 2; Appendix 2). *Cultural heritage* was the CES that varied most according to user profile. According to Van Rompay and Jol (2016), an ecosystem inspiring someone to be creative has a direct relationship with each individual, however the users did not identify Maspalomas as a place of inspiration, with this CES showing no correlation with any characteristic of the user profile.

Gender registered the greatest number of statistically significant differences. Men (n = 314) and women (n = 303) had different preferences regarding four CESs: the two CES with the highest significant differences, namely *landscape contemplation* and *spirituality and personal well-being* ($p < 0.01$), and the two CES with the lowest, namely *leisure and tourism activities* and *cultural heritage* ($p < 0.05$). All four services were valued higher by women than by men. Regarding the order of preferences, for both men and women *leisure and tourism activities* (mean = 4.39; SD = 0.14) was the second highest valued service after *landscape contemplation* (mean = 4.48; SD = 0.17). However, third place differed between the two profiles, with men preferring *cultural heritage* (4.16) and women choosing *spirituality and personal well-being* (4.28).

Five social profiles were established depending on who the users were accompanied by: unaccompanied users (n = 61), users accompanied by their partner (n = 325), by friends (n = 84), by relatives (n = 142), and users who came with another type of company (n = 14). Based on this characteristic, three services were identified, but with no clear consensus between the social profiles considered and with highly significant statistical differences (KW: $p < 0.01$). One of the identified CESs was *social activities* (mean = 3.48; SD = 0.45), which was highly valued by families (4.15), but the least valued of all seven CESs by users who were accompanied by their partners (2.98). Statistical significance was attached to users accompanied by their families ($p < 0.01$) with respect to *cultural heritage* (mean = 3.78; SD = 0.22) and *spirituality and personal well-being* (mean = 3.77; SD = 0.25). Based on this classification, couples are the population segment that most value the *cultural heritage* CES of Maspalomas (mean = 4.34), while *spirituality and personal well-being* was the most valued service by unaccompanied users (mean = 4.41). The services that require a certain degree of social interaction, such as *leisure and tourism activities* (4.30) and *social activities* (4.15) were, together with *landscape contemplation* (4.28), the three CESs most valued by users accompanied by their family.

Briceño et al. (2016) and Peña-Alonso et al. (2019) reported the detection of differences between ES preferences depending on the place of residence, differentiating between local people and foreign visitors. Maspalomas is a tourist destination with European and Spanish importance and statistically significant differences (SC: $p < 0.05$) were recorded with respect to two CESs depending on the place of origin of the user: *leisure and tourism activities* and *cultural heritage*. Non-local users showed a preference towards *leisure and tourism activities* (national users

= 4.33; international users = 4.22), whereas local users gave this a lower value (3.76). Maspalomas is a place endowed with a large number of infrastructures and services such as hotels, bars, restaurants, etc., directed almost exclusively at tourists. In contrast, *cultural heritage* (mean = 4.32; SD = 0.15) registered a greater interest among national and local users (mean = 4.44 and 4.38, respectively) than among international users (mean = 4.15). Locals showed a greater preference for those services less aimed at tourists, which can be enjoyed autonomously and which are more linked to passive CESs such as *spirituality and personal well-being* (mean = 4.12).

With respect to age, Martín-López et al. (2012) and Briceño et al. (2016) mention that, in general, younger people prioritize regulatory and cultural services over other types of ESs, showing significant differences with respect to other age groups in those services linked to the enhancement of tourism activity. Of the CESs analyzed in Maspalomas, age had a significant influence on two services. *Social activities* (mean = 3.34; SD = 0.35) was the CES with the greatest discrepancy between the age groups considered (SC: $p < 0.01$). Although one of the three least valued services, its preference was determined by age, with young people valuing it highest (mean = 3.74). Something similar, but in the opposite direction, was observed with the *educational value of nature* CES (mean = 3.78; SD = 0.23). This was another poorly valued CES, with differences according to age (SC: $p < 0.05$) and preference increasing with age (older adults: mean 3.89).

3.3.2. User with disabilities

Like the rest of the sample, for people with disabilities *landscape contemplation* was the highest valued service (mean = 4.38). Perception of a landscape is not limited only to the view, but encompasses other senses as well (Recommendation CM/Rec (2008) 3, from the Committee of Ministers to the member states on the guidelines for the application of the European Landscape Convention, section 1.2). This means that when designing the legal framework and planning and executing activities for the protection, management and planning of the landscape, public authorities must take into account the rights of all people, regardless of their sensory abilities. Similarly, *inspiration to be creative* was the least valued CES by users both with and without disability (mean = 3.26 and 3.32, respectively). However, the rest of the ranking differed between these two groups. For example, *spirituality and well-being* was the second highest rated CES by users with disabilities (mean = 4.44), while for users without disabilities *leisure activities and tourism* (mean = 4.40) occupied second place. Only one CES showed a statistically significant variation (SC: $p < 0.05$) depending on the type of disability: *inspiration to be creative* (mean = 2.53; SD = 1.60).

3.3.3. Differences between CES perception by user type

The disability condition was a characteristic with interesting results despite the absence of statistical significance in relation to each CES (Fig. 3; Appendix 2). However, despite the benefits that contact with nature has for this type of user (O'Brien et al. (2014, 2017); Kosanic and Petzold (2020); Summers and Vivian (2018)), a disability status did not determine any significant difference with respect to the appreciation of the CESs present in the DMSNR (Fig. 3; Appendix 2). For the determination of whether the social perception of a CES is influenced by the survey point and by the fact of having a disability, the Mann-Whitney *U* test only registered two significant differences (Table 4). The first refers to *landscape contemplation*, with people without disabilities appreciating this CES more in *Natural* survey points than people without disabilities (4.40 vs. 3.96, respectively), while in *Urban* survey points people without disabilities give a higher value to *leisure and tourism activities* (3.62 vs. 2.65, respectively).

In this sense and regarding disability, there are no major differences with respect to the CESs perceived by users who have a disability condition and users without disabilities. Social variables such as gender, company, place of residence or age were found to be more important conditioning factors. Significant differences were, however, detected according to type of disability. People with multiple and intellectual disabilities attached significantly different social importance to *spirituality and personal well-being* and *educational value of nature, as well as to social activities* and *inspiration to be creative*.

3.4. Current CES management and conflicts with user with disabilities preferences

3.4.1. Permitted uses

Based on the services defined in the previous section, a review of the management measures and land uses that occur in the protected area was carried out. Traditional management regarding CESs has been based on maintaining scenic beauty to create an ideal setting for recreational activity (Peña-Alonso et al., 2019). It should be noted that, according to the previously referenced Master Plan, of the 10 fundamental pillars on which the protection of space is based, only one is related to CESs (beauty of the landscape). In fact, according to the Master Plan, the purpose of the protection of the space is "the maintenance of the essential ecological processes linked to the dune ecosystem and the lake area of Maspalomas lagoon, the integrity of its associated flora and fauna as well as the scenic beauty of the unique landscape that they make up". Therefore, the paradox arises that the management of the space is based on the conservation of the ecosystem and its recreational exploitation, resulting in impacts from the recreational activity itself on the ESs.

Associated with this, activities related to leisure and tourism and social activities are promoted, such as the installation of kiosks, hammocks and umbrellas in the immediate surroundings of the beach. At the limits of the Reserve, management based on leisure and tourism is very evident in the construction of tourist infrastructures.

The management actions related to the CESs of *landscape contemplation* and *educational value of nature* are restricted to the area surrounding the lagoon, where there is a bird observatory with signage detaining the local fauna and flora, as well as the evolution of the environment before and after urbanization. Other management elements related to *educational value of nature* are the Visitor Center (Table 1) and the Tony Gallardo Park, although the latter is a botanical garden not related to the vegetation of the dune environment of Maspalomas and its objective is more recreational than educational.

It is evident, therefore, that management actions have to date aimed to highlight the aesthetic values and maximize them as a tourist resource and that this has in fact resulted in further degradation of the ecosystem itself (Hernández-Calvento, 2006). The CESs least taken into account in the management actions carried out to date according to the Master Plan are *inspiration to be creative* and *spirituality and personal well-being*. Knowledge of the cultural heritage associated with the traditional uses of the ecosystem (agriculture, grazing, etc.) has not been considered in its management. Added to this is the scarcity of material heritage within the dune system. That is, environmental management has historically separated ecological and social processes, even though it has been shown in numerous studies that this type of system behaves as a socio-ecological system (Peña-Alonso et al., 2018b).

3.4.2. Prohibited uses

The prohibited uses are generally associated with recreational activities. Examples that demonstrate the non-compliance of users include the proliferation of so-called *goros* (artificially built structures from nearby stones to provide shelter and act as windbreakers) in the foredune, the gathering together of cut vegetation and sediments, accumulation of stones for "decorative" forms and users wandering off from the official trails inside the Reserve among other (Fig. 4). Shown in Appendix 3 and Table 5 are the CESs most affected by prohibited uses. It is necessary to indicate that despite the fact that the sample sizes are very different, it is possible to identify some preliminary results among the responses obtained between users with and without disabilities. These include *educational value of nature* affected by 12 prohibited uses (0.62 value of impact; 0.38 value of conservation), *cultural heritage* (also

Fig. 4. Human impacts in the Dunas de Maspalomas Special Nature Reserve explained in 3.4.2. Prohibited uses section and Appendix 3. 1 = camel excursions; 2 = trash; 3 = accumulation of stones in "decorative" forms; 4 = information posters in poor condition; 5 = vegetation broken by users; 6 = use of heavy machinery; 7 = uncontrolled traffic of users through prohibited areas; 8 = windbreaker created by users; 9 = dispersion of exotic species such as *Neurada procumbes*.

Table 5
Human impacts vs. social preferences.

				SOCIAL PERCEPTION					
	Human impacts			People without disabilities (n = 608)			People with disabilities (n = 46)		
	No. of human impacts	Impact value	Conservation value (CV)	Social importance	Social importance normalization (SIN)	Difference between SIN and CV (SIN – CV)	Social importance	Social importance normalization (SIN)	Difference between SIN and CV (SIN – CV)
CES1	11	0.58	0.42	4.49	0.89	0.47	4.38	0.87	0.45
CES2	0	0.00	1.00	3.36	0.67	−0.33	3.27	0.65	−0.35
CES3	5	0.25	0.75	3.19	0.63	−0.12	3.32	0.66	−0.09
CES4	12	0.62	0.38	4.22	0.84	0.46	4.21	0.84	0.46
CES5	6	0.31	0.69	4.15	0.83	0.14	4.44	0.88	0.20
CES6	5	0.22	0.78	4.4	0.88	0.10	4.29	0.85	0.08
CES7	12	0.58	0.42	3.38	0.67	0.25	3.78	0.75	0.33

Notes: CES 1 = Landscape contemplation; CES 2 = Social activities; CES 3 = Inspiration to be creative; CES 4 = Cultural heritage; CES 5 = Spirituality and personal well-being; CES 6 = Leisure and tourism activities; CES 7 = Educational value of nature.

affected by 12 prohibited uses), *landscape contemplation* (affected by 11), *spirituality and personal well-being* (affected by 6), *leisure and tourism activities* and *inspiration to be creative* (both affected by 5), while *social activities* is not affected by any prohibited use.

Regarding the difference between social importance normalization (SIN) and conservation value (CV), positive results indicate that the perception of the importance of the CES is greater than the current level of conservation. In the case of people with disabilities, the high impact values obtained for *landscape contemplation* and *inspiration to be creative* do not translate into low social importance; on the contrary, people with disabilities give these CESs values of 0.88 and 0.84, respectively. Interestingly, *social activities* and *inspiration to be creative*, despite negative SIN-CV values (−0.35 and −0.09, respectively) and high CVs (1.00 and 0.75, respectively), do not constitute highly valued CESs by this type of user. This may be due to two main reasons related to and produced by the current management of the system: i) there are no offers that promote, in an inclusive way, these types of CES in the DMSNR; and/or ii) the facilities intended to promote leisure and creative activities are not accessible from an architectural point of view (Santana-Santana et al., 2020).

Despite the interest that these results may arouse, it is necessary to delve into the interests of users with disabilities, since within the general sample it is an unrepresentative group. However, not for this reason, it ceases to be a group with needs that must be satisfied through the development of inclusive management measures.

4. General discussion

The condition of disability itself was not a statistically significant conditioning factor but that the specific type of disability was. The most influential social variables in the perception of CESs in Maspalomas were, in order, gender, companion, place of residence, age and type of disability. The main results show that “landscape contemplation” was the most widely acknowledged and valued CES by both user types, especially those surveyed at the urban survey points. The “inspiration to be creative” CES obtained the lowest score at the natural survey points and the “social activities” CES at the urban survey points. The plots furthest from the urban area and equipped with beach kiosk and sun

loungers for hire scored highest. However, these places are not adapted for people with reduced mobility, is no adapted beach walkway connecting these places with the urban promenade. In other hand, there is limited information available about DMSNR natural and cultural values (such as posters, information panels, etc.). This aspect should be improved in order to provide quality knowledge about the Natural Reserve importance.

The surveys carried out revealed which CESs are present in Maspalomas and how they are valued by the users of the dunefield based on their personal characteristics and the survey point (natural or urban). Tourist destinations based only on a sun and beach model (as is Maspalomas) need a new focus as well as innovative products to help improve their market position (Fraiz Brea et al., 2008; Cànoves et al., 2016). The study carried out has made it possible to identify a large number of human impacts that influence the status of the identified CESs. More specifically, *educational value of nature* and *cultural heritage* are the CES with the highest number of impacts (12 each), followed by *landscape contemplation* (11 impacts). In the case of Maspalomas, the orientation of management entirely towards leisure and tourism has led to degradation of the system. However, promoting the CESs of, for example, *educational value of nature* or *cultural heritage* can help users understand that this is a protected ecosystem that provides other ESs in addition to being a setting for leisure and tourism.

The method employed could be a fundamental tool for institutional communication, helping to generate comments based on the daily experience of space managers. In addition, initiatives on citizen participation could be developed to deepen socio-ecological relationships with dune environments. The study of ESs can play an important role in ecosystem management and conservation (Atauri et al., 2000; Bryan et al., 2010; Anfuso et al., 2014). Moreover, ESs are an essential tool to understand the relationship between society and the benefits that nature offers, especially in environments where human pressure is high. Provisioning services in particular have been the most studied as they have a tangible value, and are identifiable and easier to measure (DeFries et al., 2004; Carpenter et al., 2009). However, previous research studies in which CESs have been measured and assessed are very scarce in the ES framework (Schaich et al., 2010). This gap is particularly notable in the aeolian sedimentary systems of arid regions compared to temperate regions, due to the typical location of the former in countries with less research funding (García-Romero et al., 2018).

As in other coastal areas, the dune landscape considered in the present study plays an important role in providing a scenario for recreation and tourism (Nicholls and Tol, 2006; Alves et al., 2009; Robert, 2018; Urbis et al., 2019a, b). Research studies in the fields of environmental psychology and consumer behaviour have shown that spacious, open settings can inspire feelings of freedom and enhance self-expression (Meyers-Levy and Zhu, 2007; Okken et al., 2013; Urbis et al., 2019b), perhaps accounting for the widespread appeal of the contemplation of spacious scenery.

The assessment of ESs from community perspectives can offer a direct route to understanding the complex relationships between ecosystems and human well-being (Berbés-Blázquez, 2012). The type of analysis undertaken serves to identify management requirements as a basis for enhancing the sustainable link between society and the natural space. Proper management of the *educational value of nature*, a CES poorly valued in the present study, can be a way to reduce the knowledge gap between users, managers and scientists (Van Wyk et al., 2008; Casado-Arzuaga et al., 2013) and improve the perception of other services beyond the CES of *leisure and tourism activities* on which management has been based in recent decades. As indicated by Martín-López et al. (2012), a correctly developed and implemented management strategy can modify the perception of users and, therefore, how they interact with the ecosystem and affect its degradation or conservation.

After this study, based on the places most frequented by users, it would be necessary pay more attention social perception at the authorized paths and at most natural areas of the landscape. This way it can be found more unperceived cultural ecosystem services could be detected from the survey points and plots, significant differences between general population and people with disabilities and give answer about management conflicts with users with disabilities. Finally, there are other ES in Maspalomas that have not been analyzed in this first approach, such as: protection against erosion, biodiversity and regulation) and it is of great interest to continue analysing them in future research.

The research carried out in the present work allows us to know the cultural ecosystem services best perceived by users and with them implement their accessibility. Among the possible management measures to provide environmental justice to people with disabilities that could be carried out are: improvements in accessibility to the observation areas of the dune field, creation of walkways to access the spaces where the restrictions established by the protection allow, highlighting those elements of the cultural heritage such as sites or relevant buildings with panels adapted to different disabilities, among others. In this sense, the low presence of people with disabilities may indicate that the area is not prepared for these users; however, implementing the measures proposed above can serve to attract people with disabilities and, therefore, improve and create a more varied tourist offer.

Finally, it is necessary to raise the need for good management of cultural ecosystem services because it could generate benefits for regulating services. Taking into account that Maspalomas Costa Canaria is one of the main sun and beach tourist destinations in Spain and Europe, it is worrying that users have not been able to identify the *educational value* of CES nature in the study area. To improve the provision of this ecosystem service, the competent authorities can, for example, refurbish educational spaces such as the Maspalomas lighthouse or the Interpretation Center or implement quality signage in the most characteristic places of interest. If *educational value* is sufficiently developed and properly managed, the chances that users perceive the biodiversity value or the role of the dune system in the protection of *coastal* erosion will be much greater. On the other hand, if accessibility conditions are improved and this place is promoted as a safe destination adapted to the needs of people with disabilities, they will probably be encouraged to visit the area more frequently to, among other things, environmental visits and social activities.

5. Conclusion

Following the Millennium Ecosystem Assessment (2005), seven CESs were identified in a protected dunefield: *landscape contemplation, social activities, inspiration to be creative, cultural heritage, spirituality and personal well-being, leisure and tourism activities* and *educational value of nature*. A methodology was proposed for a rough analysis of the social perception of the importance of these CESs in the study area (the protected status Maspalomas dunefield), including for the first time a separate analysis of the perception held of CESs by people with disabilities. In the study area, *landscape contemplation* was the most valued CES, chosen by users at 9 of the 11 survey points considered in the research. However, the development of management strategies and actions focused on tourism activity has had a negative influence on the current status of the CESs. The research has made it possible to identify a large number of human impacts that influence this current status, with *landscape contemplation* recording the third highest number of human impacts (11).

The study allowed us to delve into the relationship between the nature of the environment and the social importance of each of the CESs. Maspalomas users who have participated in this study come mainly from Spain (30.9%), Germany (23.7%) and United Kingdom (9.2%). Regarding the user profile. 4 out of 10 people surveyed are between 31 and 64 years old. 48% of the sample are male. Almost half of the 654 people who participated in the study come with their partner. And only 46 of 654 of people surveyed have a disability. Despite these social differences, for all the people *Landscape contemplation* was the most valued CES in all the survey points, *social activities* was the lowest valued service in urban places and *inspiration to be creative* was for natural environments.

Analyzing how these services are being managed has also made it possible to know which ones are less well managed and, therefore, should be improved. On a general scale, in Maspalomas, CES user preferences vary depending on whether the user is located inside or outside the natural environment. In addition, the sociocultural profile of the user conditions CES preferences, especially in relation to gender and who the user is accompanied by (family member, partner, alone, etc.). Considering that Maspalomas Costa Canaria is one of the main sun and beach tourist destinations in Spain and indeed Europe, it is worrying that users were unable to identify in the study area the *educational value of nature* CES.

Importantly, and in contrast to users without disabilities, the Maspalomas study area was not considered a suitable area for social activities by users with disabilities. Finally, the disability extent was not a statistically significant conditioning factor with respect to the appreciation of the CESs present in the Duna de Maspalomas Special Nature Reserve. However, type of disability was found to be influential, with *inspiration to be creative* the only CES analyzed that varied with statistical significance depending on the type of disability.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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Appendix

Appendix 1
CES results by survey point

	People without disability	People with disability	CES 1	CES 2	CES 3	CES 4	CES 5	CES 6	CES 7	Mean
Kruskal-Wallis test (P value)	–	–	0.031	0.000	0.134*	0.039	0.000	0.003	0.223*	–
Spearman correlation coefficient	–	–	0.087*	−0.221**	−0.069	0.085*	−0.159**	−0.124**	−0.066	–
Sig. (2-tailed)	–	–	0.031	0.000	0.134	0.039	0.000	0.003	0.224	–
N	608	46	610	459	476	588	530	578	345	–
NATURAL SURVEY POINTS (N = 370)										
Plot 1	70	6	4.34	3.57	3.45	4.28	4.30	4.44	4.06	4.06
Plot 2	92	6	4.37	3.81	3.24	3.83	4.24	4.46	3.84	3.97
Plot 3	62	2	4.49	3.72	3.16	4.19	4.41	4.26	3.58	3.97
Plot 4	20	4	4.42	3.70	2.89	4.13	4.48	4.26	3.83	3.96
Plot 5	91	5	4.56	3.31	3.36	4.33	4.17	4.76	4.05	4.08
Plot 6	11	0	4.60	3.13	3.36	4.27	4.67	4.60	3.88	4.07
Mean	–	–	4.46	3.54	3.24	4.17	4.38	4.46	3.87	–
Standard deviation (SD)	–	–	0.11	0.27	0.20	0.18	0.18	0.20	0.17	–
URBAN SURVEY POINTS (N = 284)										
Maspalomas lighthouse	31	3	4.67	3.42	2.85	4.36	4.09	4.28	3.74	3.91
Maspalomas lagoon	47	5	4.63	2.84	3.05	4.33	3.86	4.40	3.45	3.79
Tony Gallardo Park	82	8	4.67	2.82	3.17	4.45	3.98	4.20	4.29	3.94
Maspalomas viewpoint	52	3	4.43	2.77	3.05	4.15	3.78	3.88	3.46	3.64
Anexo II Shopping Centre	49	4	4.20	3.04	2.92	4.25	4.14	4.56	3.38	3.78
Mean	–	–	4.52	2.98	3.01	4.31	3.97	4.26	3.66	–
Standard deviation (SD)	–	–	0.20	0.27	0.13	0.11	0.15	0.26	0.38	–

Notes: ES 1 = *Landscape contemplation*; ES 2 = *Social activities*; ES 3 = *Inspiration to be creative*; ES 4 = *Cultural heritage*; ES 5 = *Spirituality and personal well-being*; ES 6 = *Leisure and tourism activities*; ES 7 = *Educational value of nature*.
*P value > 0.05 = significant differences in Kruskal-Wallis test.
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Appendix 2
CES results by social profile

		CES 1	CES 2	CES 3	CES 4	CES 5	CES 6	CES 7	Mean
PLACE OF RESIDENCE									
Local	*(n = 111)*	4.59	3.45	3.12	4.38	4.12	3.76	3.76	3.88
National	*(n = 91)*	4.54	3.22	3.03	4.44	4.09	4.33	2.02	3.67
International	*(n = 370)*	4.44	3.26	3.18	4.15	4.15	4.22	3.84	3.89
Mean		4.52	3.31	3.11	4.32	4.12	4.10	3.21	–
Standard deviation (SD)		0.08	0.12	0.08	0.15	0.03	0.30	1.03	–
Spearman correlation coefficient		−0.081	−0.092	0.007	−0.107*	−0.021	0.091*	−0.019	–
Sig. (2-tailed)		0.061	0.065	0.888	0.015	0.659	0.041	0.737	–
N		537	400	421	515	462	510	326	–
AGE									
Young people	*(n = 101)*	4.51	3.74	3.24	4.10	4.24	4.40	3.52	3.96
Adults	*(n = 275)*	4.56	3.16	3.20	4.30	4.18	4.38	3.93	3.96
Older adults	*(n = 131)*	4.34	3.13	3.19	4.21	4.11	4.35	3.89	3.89
Mean		4.47	3.34	3.21	4.21	4.17	4.38	3.78	–
Standard deviation (SD)		0.12	0.35	0.03	0.10	0.07	0.02	0.23	–
Spearman correlation coefficient		−0.023	−0.176**	−0.024	0.073	−0.004	0.020	0,116*	–
Sig. (2-tailed)		0.617	0.001	0.646	0.122	0.939	0.680	0.049	–
N		470	342	356	446	398	447	291	–
GENDER									
Male	*(n = 314)*	4.36	3.24	3.08	4.16	4.04	4.29	3.77	3.85
Female	*(n = 303)*	4.61	3.43	3.30	4.27	4.28	4.49	3.89	4.04
Mean		4.48	3,34	3.19	4.21	4.16	4.39	3.83	–
Standard deviation (SD)		0.17	0,13	0.15	0,08	0.17	0.14	0.09	–
Spearman correlation coefficient		0.176**	0.093	0.082	0.087*	0.118**	0.109*	0.071	–
Sig. (2-tailed)		0.000	0.054	0.080	0.041	0.008	0.010	0.197	–
N		581	434	451	558	504	550	335	–
EDUCATIONAL LEVEL									
Without studies or incomplete	*(n = 8)*	4.38	3.67	3.88	4.13	4.00	4.14	5.00	4.17
Secondary education	*(n = 127)*	4.55	3.38	3.26	4.38	4.20	4.54	3.97	4.04
Post-compulsory education	*(n = 124)*	4.48	3.55	3.23	4.15	4.38	4.47	3.92	4.03
University studies	*(n = 249)*	4.49	3.37	3.07	4.20	4.06	4.35	3.68	3.89
Mean		4.47	3.49	3.36	4.21	4.16	4.37	4.14	–
Standard deviation (SD)		0.07	0.14	0.35	0.12	0.17	0.17	0.59	–
Spearman correlation coefficient		0.012	−0.019	−0.073	−0.067	−0.062	−0.078	−0.106	–
Sig. (2-tailed)		0.799	0.713	0.146	0.150	0.199	0.096	0.084	–
N		486	373	395	468	434	457	269	–
COMPANION									
Alone	*(n = 61)*	4.42	3.18	3.40	4.06	4.41	4.48	3.59	3.93
Partner	*(n = 325)*	4.48	2.98	3.22	4.34	4.22	4.41	3.96	3.95
Friends	*(n = 84)*	4.63	3.46	3.25	4.26	4.17	4.34	3.99	4.01
Family	*(n = 142)*	4.28	4.15	2.97	3.78	3.77	4.30	3.20	3.78
Other	*(n = 14)*	4.49	3.64	3.10	4.22	4.33	4.45	4.00	4.03
Mean		4.46	3.48	3.19	4.13	4.18	4.40	3.74	–
Standard deviation (SD)		0.13	0.45	0.16	0.22	0.25	0.08	0.35	–
Spearman correlation coefficient		0.000	0.291**	−0.061	−0.123**	−0.125**	−0.058	−0.067	–
Sig. (2-tailed)		0.996	0.000	0.192	0.004	0.005	0.174	0.221	–
N		583	434	455	561	506	554	338	–
DISABILITY (YES OR NO)									
Without disability	*(n = 608)*	4.49	3.36	3.19	4.22	4.15	4.40	3.83	3.95
With disability	*(n = 46)*	4.38	3.27	3.32	4.21	4.44	4.29	3.78	3.95
Mean		4.44	3.31	3.26	4.21	4.29	4.34	3.81	–
Standard deviation (SD)		0.08	0.07	0.09	0.01	0.20	0.08	0.04	–
Spearman correlation coefficient		0.049	0.014	−0.016	0.010	−0.078	0.014	0.006	–
Sig. (2-tailed)		0.227	0.772	0.733	0.811	0.073	0.734	0.906	–
N		610	459	476	588	530	578	345	–
DISABILITY TYPE									
Users with physical disability	*(n = 26)*	4.55	3.06	3.35	4.19	4.35	4.32	3.64	3.92
Users with intellectual disability	*(n = 1)*	4.00	0.00	0.00	5.00	5.00	5.00	5.00	3.43
Users with sensory disability	*(n = 5)*	4.40	4.00	2.50	4.00	5.00	4.60	4.50	4.14
Users with multiple disabilities	*(n = 3)*	4.50	2.00	3.00	5.00	2.00	3.00	5.00	3.50
Users with other type of disability	*(n = 7)*	4.14	3.60	2.33	4.23	4.50	3.86	2.50	3.59
Mean		4.32	2.53	2.24	4.48	4.17	4.15	4.13	–
Standard deviation (SD)		0.24	1.60	1.31	0.48	1.25	0.77	1.07	–
Spearman correlation coefficient		−0.105	−0.019	−0.405*	−0.063	−0.054	−0.224	0.174	–
Sig. (2-tailed)		0.513	0.919	0.033	0.705	0.745	0.176	0.476	–
N		41	31	28	39	39	38	19	–

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Notes: CES 1 = *Landscape contemplation*; CES 2 = *Social activities*; CES 3 = *Inspiration to be creative*; CES 4 = *Cultural heritage*; CES 5 = *Spirituality and personal well-being*; CES 6 = *Leisure and tourism activities*; CES 7 = *Educational value of nature.*

Appendix 3
Prohibited uses in the Maspalomas Dunes Special Nature Reserve (DMSNR)

Prohibited uses violated by the actual management	Cause of violation	Source	DMSNR Zone	Extension Percentage	Persistence	Reversibility	Recoverability	CES						
								CES 1	CES 2	CES 3	CES 4	CES 5	CES 6	CES 7
The construction of artificial wind protection facilities, especially using materials from coastal palaeoreefs or native vegetation	Identification of windbreakers made with vegetation created by users	Field data	Zone 3 and Zone 4	50–75	Pr	R	R	X		X	X	X		X
The transit of people through the Restricted Use Zone, except for access to the coast along the trails enabled for this purpose in the fixed dunes area	Identification of numerous unofficial tracks and windbreakers made with vegetation created by users	Field data and GIS assessment	Zone 3	100	Pr	R	R	X			X	X	X	X
The traffic of people along the left margin of the Maspalomas ravine, in the section included in the Restricted Use Zone, as well as along the posterior region of the coastal lagoon (*Charca de Maspalomas*) and its surroundings, except for the trails enabled for educational purposes	Identification of numerous unofficial tracks and windbreakers made with vegetation created by users	Field data and GIS assessment	Zone 4	60	Pr	R	R	X		X	X	X	X	X
The alteration, by any means, of the characteristics of the natural sedimentary dynamics of the DMSNR	Breakage of branches of native plants and creation of tracks that alter the sedimentary dynamics	Field data	Zone 3	100	Pr	I	R	X			X			
Cutting, collecting or causing any damage whatsoever to the native plants or parts thereof, except for specifically authorized management and conservation purposes	Breakage of branches of native plants including *Tamarix Canariensis* and *Launaea asborescens*	Field data	Zone 3 and Zone 4	60	Pr	I	R	X		X	X			X
The introduction of exotic species or the reintroduction of native species unless specifically included in technical projects approved by the management	Dispersion of exotic species such as *Neurada procumbes*, with zoochory-type dispersal due to the transit of people outside the official trails	Gobierno de Canarias, 2004b; Hernández-Cordero et al., 2015	Zone 3 and Zone 4	30	Pr	I	R	X		X	X			X
The capture of any animals/ birds or collection of their eggs, and any type of damage or disturbance to their habitat, except for specific research reasons approved by the management	Construction of 242 windbreakers created by users in the Restricted Use Zone where there are animal native species such as *Gallotia stehlini*, and also 56 windbreakers in the Exclusion Zone where the nesting of migratory birds occurs. Identification of waste inside the windbreakers in the DMSNR which alters the natural habitat of the animal species that inhabit the area	Field data	Zone 4	10	Pr	I	R				X			X

(*continued on next page*)

Appendix 3 (*continued*)

Prohibited uses violated by the actual management	Cause of violation	Source	DMSNR Zone	Extension Percentage	Persistence	Reversibility	Recoverability	CES						
								CES 1	CES 2	CES 3	CES 4	CES 5	CES 6	CES 7
The generation of tracks or pathways in the Restricted Use Zone	Identification of numerous unofficial tracks created by users	Field data and GIS assessment	Zone 3 and Zone 4	80	Pr	R	R	X			X		X	X
The installation of any external advertising, billboards, signs or posters, except those related to DMSNR signage	Unauthorized tourist services (e.g. camel excursion and its infraestructures), information brochures and information on pickpockets	Field exploration	Zone 3 and Zone 4	20	Pr	R	R						X	X
Any activity or project contrary to the purpose of protection, or that represents an activity outside the objectives of conservation of natural resources or the landscape of the DMSNR	Construction of 298 windbreakers created by users with broken vegetation to sunbathe or spend time there	Field data	Zone 3 and Zone 4	80	Pr	I	R	X			X	X		X
All types of actions carried out within the DMSNR that contravene the provisions of this Master Plan	Construction of 298 windbreakers created by users with broken vegetation to sunbathe or spend time there	Field data	Zone 3 and Zone 4	80	Pr	I	R	X			X	X		X
Spills or waste outside authorized places	Identification of numerous uncontrolled discharge points	Field data	All zones	30	Pr	R	R	X		X	X		X	X
Emission of noises that disturb the tranquillity of animal species	Restaurants, tourist excursion points of sale, a spa and benches close to the Exclusion Zone or use of heavy machinery	Field data	Zone 4	10	Pr	R	R	X			X	X		X

Persistence: Pr = provisional; Pe = permanent; Reversibility: I = Irreversible; R = Reversible; Recoverability: R = Recoverable; NR = Not recoverable.
Notes: CES 1 = Landscape contemplation; CES 2 = Social activities; CES 3 = Inspiration to be creative; CES 4 = Cultural heritage; CES 5 = Spirituality and personal well-being; CES 6 = Leisure and tourism activities; CES 7 = Educational value of nature.

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