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Tourists' Preferences for Stargazing Land Resources

Carlos Fernández-Hernández [1], Jorge E. Araña [2], Javier de León [3] and Carmelo J. León [3,*]

[1] Department of Applied Economics and Quantitative Methods, Campus de Guajara, University of La Laguna, 38200 San Cristóbal de La Laguna, Spain; cferher@ull.edu.es
[2] Department of Applied Economic Analysis, University of Las Palmas de Gran Canaria, 35017 Las Palmas de Gran Canaria, Spain; jorge.arana@ulpgc.es
[3] Institute for Tourism and Economic Sustainable Development, University of Las Palmas de Gran Canaria, 35017 Las Palmas de Gran Canaria, Spain; javier.leon@ulpgc.es
* Correspondence: carmelo.leon@ulpgc.es

Abstract: Stargazing tourism is an expanding market niche that requires the development of territorial resources for its implementation and attraction. This paper's objective is to investigate the preferences and willingness to pay of tourists for the development of strategic land resources for stargazing tourism activities. The field work was conducted on the island of La Palma (Canary Islands), which is promoting the territorial development of infrastructures for stargazing tourism. A random sample of 734 tourists were interviewed in person on-site in December 2019 following the methodology discrete choice experiments that enabled an estimation of tourists' preferences and willingness to pay for the implementation of key land resources for stargazing. The data are modeled using a latent class model that allows for the consideration of heterogeneous preferences. The results show that there are three groups of tourists with different preferences for land resources of stargazing observation. These segments are respectively related to the interests in culture, active, and astronomic tourism. Those tourists in the active stargazing segment share the largest proportion of the market and favor the implementation of facilities that allow the combination of active tourism with stargazing. The results are useful for land product development and territorial strategies aimed at positioning destinations in the identified demand niches of stargazing tourism.

Keywords: demand preferences; discrete choice experiments; cultural and active tourist segments; heterogeneous preferences; land resources; latent class; stargazing tourism

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1. Introduction

Tourism development involves the planning of resources in order to satisfy the needs of current and potential tourists. This development process is commonly supported by creativity and innovation in different areas of the territory that support tourist services [1–3]. In this process, there is a need for a spatial implementation of the appropriate infrastructures giving response to tourists' preferences [4–6]. The implementation of attractive resources gives impulse to the development path of the destination by raising the number of infrastructures available for the provision of tourism services.

However, tourism sustainability critically depends on responsible land planning, since it affects the spatial location and specific characteristics of the infrastructures on the territory [7–9]. Some of these infrastructures are related to the provision of complementary activities. For instance, there is a need to plan for theme or thematic parks, sport facilities, cultural attractions, archeological sites, and interventions in natural areas [10,11]. The success of these investments depends on their grounded capacity to generate value and competitiveness for the destination, with implications for attracting tourists and managing them from a sustainability perspective [12].

In the context of planning for sustainable development of new complementary activities, stargazing tourism is becoming a strategic alternative for an increasing number of

destinations aiming at differentiating their tourist products through product innovation by the utilization of natural and land resources, thereby enhancing the wealth of resources and activities offered to tourists [13–17]. Stargazing tourism is considered a type of special interest tourism that involves the implementation of land resources dedicated to enhance the observation of the celestial space [18–21]. Soleimani et al. [22] argue that astro-tourism emerges from the interest of tourists in specific activities related to the observation of the sky that are most often framed into a nature-based context, and therefore requires infrastructure planning on the territory.

Thus, in order to develop stargazing tourism, there is need not only of the necessary natural resource of having clear night sky conditions [19,23], but also of the implementation of key terrestrial resources and infrastructures that provide services to tourists by enabling and enhancing the observational experience [20,21,24–26]. Some tourist destinations in Chile, USA, Spain, New Zealand, and Portugal have invested in innovative stargazing terrestrial infrastructures as a way of providing competitive complementary activities enhancing the choices available to tourists [20,26–28].

The various investment alternatives available for the development of stargazing tourism are costly and may have different impacts on the attractiveness of destinations [29,30]. Thus, there is a need to anticipate the market response to the alternative proposals in order to prioritize according to the expected net benefits for destinations [31,32]. Thus, this paper studies the preferences of tourists for the implementation of terrestrial stargazing infrastructures on the island of La Palma, in the Canary Islands, that has suffered recently because of the COVID-19 pandemic and also a volcanic eruption [33–35]. Because of the island's traditional difficulties in attracting large numbers of tourists compared to its fellow islands in the Canary Islands' archipelago, this case study offers a unique setting on the need for land planning for complementary activities dedicated to increasing the recreational activities offered to visitors coupled with distinguished sky quality observational and astronomical scientific resources. The focus on a niche market such as stargazing may help rebuild the destination, thereby strengthening the resilience of tourism for the future. This information is useful for the design of stargazing experiences at destinations, and for the promotion of those land resources that are most demanded by tourists.

The methodology is based on the market research technique of discrete choice experiments (DCEs), in which tourists are asked to evaluate alternative profiles of stargazing investments on land resources [36,37]. DCE is a research method that is frequently utilized for investigating the potential demand for market products and valuing the social benefits of land resources and collective investments [38–40]. Thus, by investigating the potential demand for stargazing tourism land resources, this paper fills a gap in the literature by providing compelling evidence on the importance of this niche market and the potential benefits that can be offered to destinations by planning for those resources that are demanded by tourists at stargazing destinations.

2. Literature Review

2.1. Stargazing Tourism

Human beings have a special interest in space travel and observation that has not been fully exploited on Earth [21,41–45]. There have been some breakthrough studies aimed at demonstrating the potential market of space tourism as technology makes it possible for humans to travel into space [46–49]. However, this need for space observation and experience can also be supported on terrestrial infrastructure, giving tourists on Earth the opportunity to enjoy sky observation [50,51]. Terrestrial stargazing involves developing land infrastructures that enable and enhance the observation of the stellar objects in the clear sky, normally at night but also in the day to observe the sun [20,21]. The specific projects to be developed in the territory for the observation of the sky should consider the preferences of potential users and tourists that can vary according to different interests [31,52].

Although astro-tourism or stargazing tourism is a worldwide emerging niche market in the tourism context, the scientific literature is still incipient for providing in-depth

analysis towards a thorough understanding of its motivations and planning perspectives [30,53–58]. However, more information can be found for the sister research field of space tourism that is concerned with the study of space travelling for leisure or sky observation, and which has attracted more attention among scholars providing insights from a planning perspective [52,59–65]. There is a need for information about the land product development preferences of stargazing tourists that goes beyond the conceptual aspects about the environments in which the different experiences of tourists may be developed [22], either the extra-terrestrial environment [44,45] or the terrestrial planet Earth [19–21,26,49,66].

Stargazing tourism as a form of special interest tourism (SIT) involves travelling to tourist destinations for celestial observation, thereby visiting sites related to astronomy and archaeo-astronomy, and participating in astronomical activities and the observation of astronomical phenomena [21,22,67,68]. It has been recognized that improving the understanding of tourists' motivations for becoming involved in astronomic observation is necessary in order to adapt the necessary land resources towards market demand and accurately assess economic impacts [20,52,69]. Therefore, to develop stargazing tourism, there is a need for planning policies in order to provide the conditions that makes it possible and successful, which go beyond the principal resource of having clear skies that are not affected by light pollution [20,21,24–26,68,70]. In this sense, astro-tourism has been conceived as a key relevant instrument in the alliance for the defense of the quality of the night sky landscape, together with its human enjoyment through the appropriate land or terrestrial interventions that enhance the observation experience [71,72].

2.2. Special Interest Tourism and Land Use

Special interest tourism involves travelling to destinations for the practice of some particular activity that may be related to culture, sports, religion, or nature [73,74]. Many destinations have found in special interest tourism an opportunity for specialization and differentiation in order to increase competitiveness and generate value for the recipient societies [75,76]. For instance, Chile has managed to position itself as a leading tourist destination for stargazing and astronomy, thereby satisfying those tourists interested in the pursuit of experiences related to the observation of the night sky [22].

Stargazing tourism is one of those activities offering special interest land facilities for observing the dark sky at night [17,45]. Since there is a need for good-quality conditions for dark sky observation, stargazing tourism has been defined as a form of modern ecotourism [22,69]. This has prompted a large interest in research on assessing land and sky resources that may be suitable for the development of successful stargazing tourism destinations, both by instrumenting accurate measurement of the lack of light pollution at night and by determining adequate land enclaves for night sky observation [58,69,77].

The socioeconomic impact of special interest and niche tourism has been documented in other studies [74,78]. It can be expected that those tourists with special interests in visiting a destination have different profiles to the average tourists found in the mass market destinations [79,80]. Studies have found that for some special interest tourism, such as golf tourism or ecotourism, tourists are younger and have greater expenditure at the destination, thereby requiring that they be satisfied with specific services directed to the practice of their interest or activity [79–83].

Special interest tourism is commonly opposed to mass tourism, although some authors have questioned "how special are special interest tourists?", since there is evidence that general mass tourists are also interested in activities which are the objective of special interest tourists [78,84]. Some authors have observed that niche or special interest markets serve various types of tourists, and not only those interested in the special activity or feature to which they are attracted to the destination [68,84]. Thus, the boundaries between specialized market niches and the more general or mass tourism market are difficult to establish, particularly in those destinations that attract large numbers of tourists [68,74].

These boundaries are higher whenever there is a need for some qualified skill or expertise involved in the special interest activity.

There are some land use implications of the different types of tourism that may serve as guidance for the case of land planning for stargazing tourism [55]. Mass tourism has been shown to have a large impact on land resources because it requires large accommodation facilities, while niche market tourism has been associated with a more modest or integrated occupation of the territory, sometimes attending to the concept of carrying capacity as in the case of some ecotourism destinations [85–87]. Thus, in order to focus on sustainable development, stargazing tourism needs to ascertain what are the land use requirements in terms of the facilities demanded by tourists and which need to be implemented in the territory [88].

3. Methodology

3.1. Discrete Choice Experiments

This study utilizes a DCE methodology to assess tourists' interest in land resources development for stargazing tourism. DCE has been applied in tourism and land planning studies to assess the interest and demand of the population of tourists and residents for policies involving the land development or transformation for different types of tourism such as ecotourism.

DCE investigates individuals' preferences by designing constructed questionnaires in which subjects are presented with alternative profiles of the policy proposals or land use interventions to be investigated [38,89]. The policy assessment problem is decomposed in a set of attributes with their respective levels, so that subjects can potentially face a number of alternative combinations of attributes defined by their potential levels.

The principal advantage of DCE is that it can assess the preferences for a set of issues or attributes considered in the assessment problem, such as the proposal of land resources for the development of stargazing tourism [38,49,90]. In the questionnaire, the tourist is presented with a set of alternative options defined by the accomplishment of the stargazing projects. The tourist is asked to choose some of the options from a restricted choice set taken from the potential profiles or combinations of alternatives. For simplicity reasons, this choice set normally contains two options plus the status quo or no choice option, although it can contain as many alternatives as planned by the researcher [91].

3.2. Study Site

The study for assessing the preferences of tourists for the land resources investment for stargazing development was conducted on the island of La Palma (Canary Islands) in 2019. La Palma is one of the smallest islands in the Canary Islands' archipelago, offering visitors quietness, good weather, and stunning green sceneries in natural areas. It received an inflow of about 522,000 tourists in 2019. The island has an opportunity for the development of stargazing tourism because it is endowed with one of the best clear skies in the world and hosts important astrophysics resources managed by an international consortium led by the Canary Astrophysics Institute (IAC), holding the *starlight* certification [28]. The IAC is a leading astronomic institution responsible for coordinating more than 10 international scientific telescopes on the island.

3.3. Field Work

The field work for the design of the questionnaire for the DCE and the final sampling consisted of the following steps:

1. In-depth interviews with experts: Twenty in-depth individual interviews were carried out with experts for the identification of the needed land resources and infrastructures for the development of stargazing tourism. The experts were astronomic scientists, land planners, and stargazing tourism specialists. These expert interviews allowed the specification of the technical aspects of the stargazing projects, making sure that

they would be viable from practical and legal perspectives, abiding by all regulatory frameworks and technical specifications.

2. Experts' workshop: Additionally, the set of land resources for stargazing tourism was successively assessed and discussed in a working group of experts for the definition of the specific projects, taking into account their technical and social viability in the territory. This discussion led to the proposal of a set of investments in land facilities that may be implemented in the territory for the development and promotion of stargazing tourism.
3. Focus groups with tourists: The proposed stargazing land investments were incorporated into a pilot questionnaire that was discussed in two focus groups with tourists visiting the island. Each focus group was conducted by a member of the research team in a different language (Spanish and English), and was formed by eight members from both gender groups and three age intervals. Participants were presented with the materials of the draft questionnaire in order to improve the wording and understanding of the questions, and to check that all the elements of the questionnaire would be correctly understood by potential respondents. The focus groups carefully discussed with tourists the description of the stargazing investment proposals (wording, attributes, and attribute levels), and the number of choice occasions that the respondent was able to answer in the discrete choice questions.
4. Pre-test and final sampling: A pre-test sample of 50 individuals was taken randomly before the launch of the final version. The results of the pre-test showed that the pilot questionnaire was adequate for the objectives of the study, and that respondents were correctly interpreting the questions posed by researchers. The final sample of 734 individuals was taken randomly from the population of tourists visiting the island in December 2019. The sample was representative of the population of visiting tourists in terms of gender, age, and education and income levels.

3.4. Design of the DCE Questions

DCE questions involve presenting subjects with some alternatives to stargazing land resources projects involving different costs, and ask them to choose their most preferred. The choice questions are preceded by a full and communicative description of the projects. Thus, the land resources projects for stargazing tourism were verbally described with the aid of colorful photographs that had previously been tested in focus groups. In addition, each project was assigned a specifically designed icon. The icons of the activities were also utilized in the presentation of choice options in the DCE. These stargazing land projects define the attributes of the DCE questions together with the associated cost attribute. Table 1 presents the verbal descriptions of the stargazing project attributes and their levels for the DCE.

Thus, seven different stargazing land resources projects were presented to tourists: (i) an astronomic park; (ii) a touristic astronomic observatory; (iii) a land network of walking paths for stargazing; (iv) a land network of horse-ridden routes for stargazing; (v) a network of stargazing viewpoints; (vi) an astronomic ship for stargazing observation at sea; and (vii) a network of archaeological sites for astronomic observation and interpretation. The cost attribute was defined as a per person tourist tax contribution for funding these stargazing projects at four alternative levels: 2.5, 5, 7.5, and 10 Euros.

The investigation of tourists' preferences for this set of projects was accomplished by building up a DCE for these proposals so that tourists were asked about different profiles or combinations of these stargazing land resources. Each DCE question presented a couple of alternatives involving different combinations of stargazing resources, plus the status quo or no choice option for which each respondent was asked to pay a per tourist visitor tax to finance their implementation in La Palma.

Table 1. Description and levels for DCE of the stargazing land resource projects.

Projects	Description	Levels
Astronomic Park	Development of an Astronomic Park where you can enjoy an Interpretation Centre of the stars and the sky, with guided visits to the facilities and presentation of scientific discoveries.	Yes No
Tourist Astro Observatory	Development of Touristic Astronomic Observatory where you can observe the sky and the stars through large-aperture telescopes, as well as enjoying a Stargazing Room and a Planetarium with multimedia projection.	Yes No
Astronomic Walking Paths	Development of an astronomic walking paths network in the natural environment that will allow you to enjoy while walking a high-quality contemplation of the stunning night sky with the naked eye under security.	Yes No
Astronomic Horsing Paths Network	Development of an astronomic horsing paths network in the natural environment that will allow you to enjoy while riding a high-quality contemplation of the stunning night sky with the naked eye under security.	Yes No
Astro Viewpoints Network	Development of a network of astronomic viewpoints where there will be facilities for the contemplation of the stunning night sky with specialized equipment.	Yes No
Astronomic Ship Observatory	Development of an astronomic ship that will endow all the specialized equipment for observation and interpretation of the stunning night sky in selected places along the coast of La Palma.	Yes No
Archaeological Sites Network	Development of a network of archaeological sites that will enable you to observe the night sky under the archaeological interpretation of the aboriginal population of the Canary Islands, focusing on the relationships between astronomy and archaeology.	Yes No

Figure 1 shows an example of one of the choice questions. There were six successive questions involving the choice between alternative stargazing land resource projects.

Since there are seven activities (or attributes) with two levels and the tourist tax attribute with four levels, the number of potential alternatives is $2^7 \times 4$. As this number is too large to be evaluated by the respondent, an optimal Bayesian-efficient design was obtained utilizing software *ngene* [92]. The prior distributions of the parameters of interest were uniform and bounded based on the expected signs (positive or negative) following previous recommendations [93]. This led to 24 combinations that were randomly grouped in 12 cards with two combinations. These 12 pairs of combinations were randomly grouped in six choice questions of two alternative combinations plus a status quo or no choice option that was randomly posed to each respondent.

Figure 1. Example of a DCE choice card.

3.5. Modelling

There are different models that can be utilized for representing the preferences of respondents to DCE data. Some models can fit the data more satisfactorily than others, and therefore there is a need to contemplate the possibility of alternative modeling approaches in order to deal with model uncertainty and accuracy. Following the approach of Keane

and Wasi [94], the following models are compared: (i) the conditional multinomial Logit (MNL) [95]; (ii) mixed Logit (MIXL) [96]; (iii) latent class (LC) [97]; (iv) generalized multinomial Logit (G-MNL); and (v) scaled multinomial Logit (S-MNL) [98]. The goodness of fit of the alterative models are compared based on the following statistics: log likelihood, the Aikake information criteria (AIC), the Bayes information criteria (BIC), and the conditional Aikake information criteria (CAIC).

Table 2 presents the results of the goodness of fit statistics for model comparison. The best model is the latent class (LC) model with a log-likelihood of −2676. The other models have a lower performance for representing the sample heterogeneity of the individual preferences for the alternative stargazing land resources. Thus, the LC model was selected from the modeling alternatives.

Table 2. Results of the model selection criteria (AIC, BIC, CAIC) for alternative models.

	Log Likelihood	AIC	BIC	CAIC
MNL	−3066	6356	6207	6210
MIXL	−2754	6544	5944	5744
G-MNL	−2729	6676	6382	5811
S-MNL	−2964	6522	6014	6023
LC	−2676	6194	5622	5456

Discrete choice experiments are based on the random utility theory that assumes that the preferences of respondents are represented by a utility function which is defined as a combination of a deterministic part and a random component [91,97,99,100]. In the LC model, the preferences are assumed to be homogeneous within a class of individuals but are allowed to differ across classes, i.e., the utility a respondent i who belongs to segment s derives from option j of land use resources for stargazing tourism is given by:

$$U_{ij|s} = \beta_s X_{ij} + \varepsilon_{ij|s} \quad (1)$$

where β_s is the segment specific vector of coefficients, X_{ij} is the vector of attributes associated with each alternative option, and $\varepsilon_{ij|s}$ is the random component of utility for each segment. Under the assumption of independently and identically distributed (*iid*) error terms that follow a Type 1 extreme value distribution, the probability that option j is selected by tourist i belonging to segment s is given by:

$$\mathrm{Pr}_{ij|s} = \frac{\exp(\beta_s X_{ij})}{\sum_h \exp(\beta_s X_{ih})} \quad (2)$$

Thus, preference heterogeneity is accounted for by a discrete distribution over unobservable endogenous (latent) classes of tourists. Preferences are assumed to be homogeneous within each class but are allowed to differ across classes of tourists. Membership to a specific segment of tourists is determined by a likelihood function M that classifies respondents to one of the segments with probability P_{is}. The membership likelihood function is given by $M_{is} = a_s Z_i + \xi_{is}$, where Z_i is a vector of socio-economic and other observed characteristics of the respondent and ξ_{is} is an error term. Assuming that this error term is also *iid* and follows a Type 1 extreme value distribution, the probability that a tourist i belongs to segment s is given by:

$$\mathrm{P}_{is} = \frac{\exp(a_s Z_i)}{\sum_s \exp(a_s Z_i)} \quad (3)$$

The joint probability that tourist i belongs to segment s and chooses alternative j is given by:

$$P_{ijs} = (Pr_{ij|s}) * (P_{is}) = [\frac{\exp(\beta_s X_{ij})}{\sum_h \exp(\beta_s X_{ih})}] * [\frac{\exp(a_s Z_i)}{\sum_s \exp(a_s Z_i)}] \quad (4)$$

4. Results

4.1. Preferences for Stargazing Land Resources

Table 3 shows the parameter estimates of the attributes of the LC model together with the mixed logit (MIXL) model for comparison purposes. In terms of significance levels, there are no relevant differences between both models. In the MIXL model, all attributes of stargazing land resource projects are significant in explaining individual utility at the 0.01 level. The cost parameter is also highly significant and has a negative sign. Thus, all project proposals for land resource development increase tourist utility or satisfaction, and the higher the level of cost the lower the level of utility.

Table 3. Parameter estimates of the MIXL and LC DCE models (standard deviations in brackets).

	MIXL	**ML**		
Parameter		**Segment 1 CULTURE**	**Segment 2 ACTIVE**	**Segment 3 ASTRO**
Cost	0.0146 * (0.008)	0.0158 * (0.005)	0.0179 * (0.006)	0.0101 * (0.002)
Astronomic Park	0.1019 * (0.032)	0.1568 * (0.066)	0.0744 * (0.027)	0.0745 * (0.018)
Tourist Astro Observatory	0.0858 * (0.026)	0.0624 * (0.018)	0.0779 * (0.029)	0.117 * (0.034)
Walking Paths Network	0.0930 * (0.031)	0.0263 *** (0.014)	0.1911 * (0.041)	0.0616 * (0.022)
Horsing Paths Network	0.0631 * (0.017)	0.014 * (0.004)	0.1392 * (0.027)	0.0361 * (0.011)
Viewpoints Network	0.0812 * (0.024)	0.0545 * (0.019)	0.0736 * (0.021)	0.1156 * (0.040)
Ship Observatory	0.0665 * (0.025)	0.0178 *** (0.008)	0.1386 * (0.031)	0.0432 * (0.016)
Archaeological Network	0.0613 * (0.018)	0.1311 * (0.040)	0.0399 * (0.011)	0.0312 * (0.009)
Segment size (%)		28.92	52.11	18.97
Membership equations				
Constant		0.302 * (0.108)	0.291 ** (0.120)	0.301 ** (0.139)
Age		0.021 (0.028)	−0.141 (0.010)	0.192 * (0.06)
Education		0.121 * (0.042)	0.183 * (0.036)	0.218 * (0.047)
Family		0.0631 * (0.018)	0.136 (0.023)	0.058 (0.033)
Alone		0.167 (0.114)	0.244 (0.182)	0.273 ** (0.137)

Table 3. *Cont.*

	MIXL	ML	
Parameter	**Segment 1 CULTURE**	**Segment 2 ACTIVE**	**Segment 3 ASTRO**
Friends	0.088 (0.066)	0.251 * (0.085)	0.146 ** (0.071)
Income	0.003 (0.004)	0.003 (0.003)	0.005 * (0.001)
Days	0.071 * (0.016)	0.036 (0.027)	0.078 (0.049)

* Significant at the 0.01 level; ** Significant at the 0.05 level; *** Significant at the 0.10 level.

In the LC model, there are three segments representing sample heterogeneity according to the different preferences for the set of stargazing land resources. For all segments, all attributes and the cost parameter are significantly different from zero at the 0.01 level. Segment 2 has the largest class membership probability, with 52% of tourists being included in this segment, while Segments 1 and 3 share 28% and 18% of the sample, respectively. The cost parameter is negative for all segments, indicating that a higher price for stargazing activities reduces the utility of tourists and thereby their preferences for the proposed projects. The cost parameter is higher for Segment 2 than for the other two segments. Thus, those visitors in Segment 2 are more sensitive to the costs of the stargazing projects.

The three segments of tourists are characterized by favoring different sets of land resources according to their preferences, as shown by the relative values of the model parameters explaining the utility received from the undertaking of the proposed stargazing investments. The largest segment (Segment 2) can be defined as a segment of active tourists because it shows high values for the parameters of land resources dedicated to the enjoyment of the dark sky with some kind of tourism activity, such as hiking, horse riding, and ship tripping.

The second segment in size (Segment 1) includes tourists that prefer those stargazing land resources that enable the combination of culture development and stargazing observation, i.e., facilities for developing a network of archaeological stargazing sites and the astronomic park. For tourists in the third segment in size (Segment 3), the highest utility is raised by the proposed land resources related to observation of the celestial sky with the aid of special telescopes and equipment, i.e., the implementation of a tourist observatory and a network of astronomical viewpoints.

Thus, the three segments clearly show different preferences regarding the implementation of land resources for the development of stargazing tourism. Segment 1 (culture) is more inclined towards those projects that combine the cultural aspects of the stargazing experience, with relatively less importance for the direct observation of the dark sky. Segment 2 (active) is more interested in the observation of the dark sky but with involvement in some activity in the natural environment (either by hiking, horse, or ship), while Segment 3 (astro) is more focused on experiencing the direct observation of the dark sky with specialized equipment.

4.2. Monetary Values (WTP)

Table 4 presents the results of the marginal monetary mean values for each of the projects of stargazing tourism. Confidence intervals are calculated utilizing Krinsky and Robb's [101] parametric bootstrapping procedure with 4000 draws. For the LC model results, the weighted average of the three segments is shown in the last column. The most valued project is the network of walking paths for stargazing observation (EUR 7.20) and the least valued is the network of archaeological sites for stargazing observation (EUR 4.16).

Table 4. Willingness to pay (Euros) for the stargazing projects (confidence intervals in brackets).

		ML			
	MIXL	**Segment 1**	**Segment 2**	**Segment 3**	**Average**
		CULTURE	**ACTIVE**	**ASTRO**	**Tourist**
Astronomic Park	6.99 (5.72; 7.82)	9.96 (8.71; 11.15)	4.15 (3.04; 5.38)	7.39 (6.03; 8.62)	6.45 (5.25; 7.66)
Tourist Astro Observatory	5.88 (4.92; 6.86)	3.96 (2.55; 5.18)	4.35 (3.18; 5.60)	11.61 (10.31; 12.83)	5.61 (4.35; 6.85)
Walking Paths Network	6.38 (5.12; 7.31)	1.67 (0.23; 3.16)	10.67 (9.55; 11.89)	6.11 (4.98; 7.37)	7.20 (5.99; 8.51)
Horsing Paths Network	4.33 (3.26; 5.51)	0.89 (−0.32; 2.04)	7.77 (6.41; 8.97)	3.58 (2.15; 4.71)	4.99 (3.66; 6.16)
Viewpoints Network	5.57 (4.41; 6.82)	3.46 (2.12; 4.67)	4.11 (2.92; 5.46)	11.47 (10.04; 12.78)	5.32 (4.04; 6.62)
Ship Observatory	4.56 (3.29; 5.64)	1.13 (0.11; 2.51)	7.74 (6.54; 8.99)	4.29 (3.17; 5.40)	5.17 (4.03; 6.43)
Archaeological Network	4.20 (3.13; 5.51)	8.32 (6.90; 9.42)	2.23 (1.01; 3.66)	3.10 (2.01; 4.42)	4.16 (2.90; 5.47)
Average value by project	5.42 (4.26; 6.50)	4.20 (2.90; 5.45)	5.86 (4.66; 7.14)	6.79 (5.53; 8.02)	5.56 (4.32; 6.81)

The average value for all the projects with the LC model is EUR 5.56. This average is very close to the average value of the MXL model (EUR 5.42). The ranking of the most value projects is similar for both models, with the most valued projects being the network of walking paths and the astronomic park, while the least valued projects are the networks of archaeological sites and horsing paths.

The average value across all projects is higher for tourists in Segment 3 (EUR 6.79) than for those in Segment 2 (EUR 5.86) and Segment 1 (EUR 4.20). However, there are significant differences in the relative values of the specific stargazing projects across segments. That is, those activities that are most favored and characterize the preferences of each segment show the largest values.

For instance, for the largest Segment 2 of active tourists, the most valued project is the implementation of a network of stargazing walking paths (EUR 10.67), followed by the network of horsing paths (EUR 7.77) and the ship observatory (EUR 7.74). The rest of the activities show comparatively lower economic values.

For Segment 1 of culture-prone preferences, the most valued land resource project is the implementation of the scientific astronomic park (EUR 9.96) and a network of archaeological sites for stargazing interpretation (EUR 8.32). For Segment 3, the most valued project is the tourist astronomic observatory (EUR 11.61), followed by the network of stargazing viewpoints (EUR 11.47).

Thus, the relative values of the specific stargazing projects reflect the preferences of the different segments of tourists favoring their specific implementation. Although the largest segment is given by the group of active tourists interested in combining stargazing observation with some touristic activity involving nature (e.g., walking, horsing, sailing), the largest individual project values are obtained for the segment of those tourists that favor projects concentrating on the observation of the celestial sky with specialized equipment.

4.3. Profiles of Segments of Tourist Stargazing Land Resources

There can be differences between the tourist segments of stargazing land resources in terms of the socioeconomic characteristics and the probability of belonging to each of the segments. Results for membership probability are presented in Table 3. The probability of belonging to Segment 1 significantly rises with education level, the number of days at

the destination, and for those tourists traveling with family. For Segment 2, the probability of belonging to this segment also rises with the level of education and for those subjects traveling with friends. For Segment 3, the probability of belonging to this segment increases with age, years of education, level of income, and for those tourists traveling alone or with friends. Thus, while education level is a variable influencing the segment probability for all segments, a tourist's age and income are significant factors only for Segment 3.

Table 5 presents the socioeconomic profiles of the tourists included in each of the stargazing land resources segments. The differences between the segments are proved by the results of ANOVA and χ^2 tests. The results show that segments have significantly different profiles for all socioeconomic variables and trip characteristics. Segment 1 (culture) is characterized by a female gender with a higher income than the average tourist. Members of Segment 2 (active) are younger than the average tourist, and are mostly males whose income level is below the average visitor. Finally, the probability of belonging to Segment 3 (astro) is positively correlated with being older than the average tourist, German, and with an income larger than the average visitor.

Segment 1 includes a larger share of women (63%) than the other two segments. Segments 1 and 2 also have a larger share of Spanish tourists (58% and 67%, respectively) than Segment 3 (27%). The latter segment shows a larger share of German tourists (54%). Age and income are quite similar across the three segments, although Segment 2 presents the lowest average age (40) and lowest average income (EUR 3465), while Segment 3 shows the highest age (42) and highest income (EUR 3831). Thus, Segment 1 (culture) is characterized by individuals with moderate income and age, who are predominantly women from Spain; Segment 2 (active) includes young and lower-income tourists predominantly from Spain; and Segment 3 (astro) is formed by older tourists with higher income predominantly from Germany.

There are also significant differences in the trip characteristics across the segments of tourists. Segment 2 (active) shows the longest length of stay (12.3 nights) and the largest group size (3.2). The tourists in this segment have also made more previous visits to La Palma, show the highest level of satisfaction, book more in advance than the other segments, and have a higher level of average expenditure per person during their vacation on the island. However, the tourists in Segment 1 (culture) had the shortest length of stay (10.4), the lowest group size (2.2), the lowest average expenditure per person, and booked less in advance than the other segments. Finally, those tourists in Segment 3 (astro) have the lowest satisfaction level and have made fewer previous visits to the island than the other segments.

Table 5. Socioeconomic profile of tourists' segments for stargazing land resources (standard deviations in brackets).

	Segment 1 CULTURE	**Segment 2 ACTIVE**	**Segment 3 ASTRO**	**Average Tourist**	**ANOVA and χ^2 Tests (p-Values)**
SOCIODEMOGRAPHICS					
Age	41.29	40.92	42.12	41.23	
	(7.73)	(8.31)	(10.31)	(8.45)	(0.0047) *
Female	63.4%	45.7%	45.1%	51.42%	
	(0.47)	(0.50)	(0.50)	(0.49)	(0.0006) **
Spain	58.3%	67.2%	27.1%	58.31%	
	(0.52)	(0.49)	(0.47)	(0.50)	(0.0003) **
Germany	23.2%	12.9%	54.6%	23.17%	
	(0.41)	(0.34)	(0.50)	(0.39)	(0.0006) **
Others	19.7%	19.4%	18.2%	19.02%	
	(0.45)	(0.40)	(0.39)	(0.41)	(0.0038) *
Family Income (month)	3615	3465	3831	3570	
	(1912.11)	(1624.71)	(1558.14)	(1703.15)	(0.0002) **

Table 5. *Cont.*

	Segment 1 CULTURE	Segment 2 ACTIVE	Segment 3 ASTRO	Average Tourist	ANOVA and χ^2 Tests (p-Values)
TRIP CHARACTERISTICS					
Number of nights	10.4	12.3	11.9	11.65	
	(4.46)	(7.40)	(4.73)	(6.06)	(0.0009) **
Group size	2.8	3.2	2.8	3.01	
	(1.37)	(01.51)	(1.37)	(1.44)	(0.0025) *
Booking in advance (months)	9.74	11.33	11.13	10.81	
	(6.89)	(7.33)	(7.72)	(7.26)	(0.0002) **
Previously on the island	35.7%	54.1%	45.9%	47.08%	
	(0.48)	(0.50)	(0.50)	(0.49)	(0.0001) **
Number of previous visits	1.06	2.18	0.83	1.62	
	(2.08)	(2.18)	(1.11)	(1.98)	(0.0002) *
Satisfaction	4.37	4.40	4.18	4.36	
	(3.65)	(3.84)	(3.29)	(4.02)	(0.0003) *
Average expenditure per person	443.19	537.19	487.35	500.08	
	(208.71)	(232.25)	(214.16)	(131.73)	(0.0001) *

* Significant at the 0.01 level; ** Significant at the 0.05 level.

5. Discussion

Land management in tourism requires providing for the implementation of the required infrastructures that satisfy tourism demand and special interests [75]. Stargazing tourism is a special interest or niche tourism activity that has been considered to involve a lower number of impacts on the territory [17]. However, its implementation on those destinations attracting large numbers of tourists or mass-market destinations can lead to significant impacts on land resources such as landscapes or ecosystems [79]. Thus, there is a need for planning land resources according to the sustainable management of the flows of tourists, taking into account both their preferences and environmental constraints [55].

This paper has investigated the demand for stargazing tourism on the island of La Palma, as a complementary activity that can be useful for improving the competitiveness and position of the product already offered, characterized by quietness and the quality of its rural and natural environments [33]. The results are consistent with other research that has found that there is not a homogeneous segment of special interest tourists, but there can be found different profiles with different interests [55,68,102]. Thus, the question of "how special are special interest tourists?" needs further investigation in terms of the different motivations that guide tourists to the special interest segment of stargazing tourism [79,103].

The results are also consistent with other research that has shown that stargazing tourism has the potential to raise the competitiveness of destinations, by enhancing the tourist experience and excitement with nature [16,104]. In this regard, planning land resources for stargazing tourism should take care of the environmental impacts that can lead to unsustainable processes of tourism development [87,88,105]. When planning land resources for stargazing tourism, special care should be taken in controlling the flow of tourists so that the valuable experience of night sky observation is not damaged by congestion or environmental impacts.

The interaction of tourism and land resources is not homogeneous and can be deployed in different ways by focusing on some of the different market niches of special interest tourism [77,105]. This means that destinations can target specific segments of the market in order to plan for more sustainably sound land resources development, without the need to transit towards a mass-market destination [22,85]. Focusing on specific market segments

of the special interest tourism can also be a successful strategy for those destinations with fragile territorial resources that can be damaged by an excessive flow of tourists.

6. Conclusions

The development of stargazing tourism requires the implementation of land resource facilities that attract and satisfy tourist demand. Tourist destinations can take advantage of the human desire to observe the sky with the dual aim of acquiring knowledge and enjoying leisure. The planning of the adequate land resources at stargazing destinations needs to anticipate the demand for those land infrastructures that are more suitable both from the point of view of the destination and the expectations of tourists.

This paper has investigated the demand of a set of projects for the development of land resources for stargazing tourism. Following a discrete choice methodology, tourists were asked to choose between alternative land resources projects of night sky observation. The proposed projects were designed for the development of stargazing tourism by offering various tourist experiences involving sky observation.

The results show that tourists' preferences for the proposed stargazing land resources are not homogenous but vary according to the specific interest that tourists have regarding how the experience of sky observation should be accomplished. That is, three segments of stargazing tourists are found with different preferences for the specific land resources to be implemented. Tourists in the segment of active stargazing show a higher preference for facilities that make it possible to combine night sky observation with a tourism activity such as hiking, horse riding, or sailing. The segment of cultural tourists had greater preferences for those land interventions that allow for a cultural experience with the information about the wonders of night sky observation. Finally, those tourists included in the segment of astronomic tourism are more interested in the projects that enable the observation of the dark sky through specialized equipment, i.e., a touristic astronomic park and a network of astronomic viewpoints.

Tourists' average willingness to pay across stargazing land resource projects was highest for those in the segment of astronomic-oriented tourists, followed by those in the active and cultural tourists' segments. Within the three segments, tourists place the highest value on those projects that characterize the segments, i.e., there is a strong preference for the projects favored by each segment. The largest segment is active stargazing tourism, followed by culture and astronomic tourism.

The heterogeneity of tourists' preferences for stargazing land resource projects can be explained because of the different socioeconomic profiles of tourists found in each segment. Those tourists in the segments of astronomic and culture stargazing have a higher average income and higher age than those in the segment of active stargazing. Tourists in the latter segment also had the largest expenditure on their last vacation on La Palma, had been to the island more times, booked in advance more often, had greater satisfaction, and a longer length of stay.

From a policy perspective, the results of this research highlight the need to consider the heterogeneity of tourists' preferences for land resources when planning and designing stargazing experiences. Tourist destinations could plan for the development of stargazing land resources focusing on some of the stargazing segments by implementing and promoting those activities most favored by tourists. In addition, marketing and communication strategies can be adapted to the specific segments in order to improve the positioning of destinations in the stargazing market. Destinations may specialize by investing in those segments that produce the highest socioeconomic benefits and optimal returns, and attract those tourists that have the highest preferences and willingness to pay.

The present research has some limitations that limit the generalizability of the results and calls for more efforts in stargazing tourism research. First, because the study was conducted on the specific destination of La Palma, results may be different in other tourist destinations. Thus, there would be a need to expand the investigation of tourists' preferences for stargazing land resources to other tourist destinations. Second, the evidence

is based on a cross-section of data that does not take account of the potential changes in preferences over time due to the social and cultural impacts of recent events led by the COVID-19 pandemic and the volcanic eruption on La Palma. Thus, there is a need for further studies that investigate the dynamic reactions of the tourist markets to the proposals of stargazing land resources to be developed and the subsequent effects of natural, cultural, and social shocks to tourists' preferences and decisions.

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