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Sociocultural valuation of ecosystem services in protected areas: A study applied to Southeast Spain

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Abstract

Research background: Protected areas (PAs) play a fundamental role in the maintenance of ecosystem processes and in the flow of ecosystem services (ESs) they provide. However, the management of PAs is complex due to the existence of different stakeholders with disparate and, often, opposed preferences and valuations. The sociocultural assessment of ESs contributes to optimizing the management of scarce resources based on the preferences of the different stakeholders, taking into account the economic, environmental and social dimensions of the analysed area.

Purpose of the article: In this work, a sociocultural assessment of the ESs provided by a PA in southeast Spain is carried out. The objective is to identify which the various ESs provided by this PA are and to establish their degree of importance for all the stakeholders involved.

Methods: For this, different complementary methodologies have been used in successive phases, both qualitative and quantitative. Specifically, a literature review, in-depth interviews and an assessment questionnaire were used.

Findings & value added: Based on the results obtained, a series of measures are proposed to improve the sustainable management of the PA and the socioeconomic development of its environment. The results of this study may be useful for PAs whose management tries to find a balance between conservation measures and the design of models that contribute to the socioeconomic development of their area of influence.

Introduction

Initiatives such as the Aichi Biodiversity Targets set by the Convention on Biological Diversity (CBD Secretariat, 2010), the EU Biodiversity Strategy for 2030 (European Commission, 2020) and the Sustainable Development Goals (UN General Assembly, 2017) have acknowledged the fundamental role of biodiversity and ecosystem services (ESs). However, various pressures, such as population growth, climate change and the progressive depletion of natural resources, have caused profound alterations in ecosystems (Abbass *et al.*, 2022). This alteration has materialized in the spread of invasive species, the transformation of land use, climate variability, increased pollution, as well as a reduction in biodiversity and provision of key ESs (Xu *et al.*, 2017). In this context, the designation of protected areas (PAs) is presented as a mechanism to reduce these threats since they allow the establishment of norms and restrictions aimed at conserving nature and limiting human impact on the environment. PAs have traditionally had the main objective of preserving landscapes, species, their habitats and biodiversity hotspots (Ding *et al.*, 2022). However, they are increasingly considered to also play a key role in the maintenance of ecosystem processes and the provision of ESs (Xu *et al.*, 2017). Additionally, PAs are of great rele-

vance for the promotion of the economic development of the communities located around them (Rastegar *et al.*, 2022). Currently, there are more than 260,000 registered PAs, representing 15.7% of the land surface and 7.9% of marine waters (UNEP-WCMC & IUCN, 2022).

It is necessary to involve citizens in the management of PAs to try to find a balance between conservation measures and the design of models that contribute to their socioeconomic development (Coelho-Junior *et al.*, 2021). For this, information is needed that is useful to formulate policies and define strategies based on the knowledge of the actors involved to maximize the well-being of society as a whole by promoting measures that can be generally accepted and do not find opposition to its adoption (Velasco-Muñoz *et al.*, 2022a). According to Oldekop *et al.* (2016), PAs managed with the participation of the population in decision-making processes provide greater benefits for their area of influence. In this context, determining the reasons and motivations that lead to protecting ecosystems allows us to understand which services are important for the different stakeholders, as well as the trade-offs to consider when making decisions about land use management and harvesting options (Wiesli *et al.*, 2022). The valuation of an ecosystem can vary depending on the interests of the different stakeholders involved. For example, hunters may value the forest for its ability to maintain the abundance of certain species, conservationists for providing a habitat for threatened species, and tourists for its ability to provide recreation and aesthetic enjoyment.

The sociocultural assessment of ESs is a valuable tool for gathering information of interest that is easy to understand and transmit, including less tangible social and ethical concerns (Aznar-Sánchez *et al.*, 2018). The results obtained in evaluations of this type may be useful for the optimization of the management of natural resources by competent authorities, especially in the field of PAs (De Meo *et al.*, 2018). The problem is that this type of valuation is less widespread than those of the biophysical or economic type (Maestre-Andrés *et al.*, 2016) and that the latter are not capable of capturing all types of value of the benefits that ecosystems provide to people (Karimi *et al.*, 2020). Thus, Kyriakopoulos and Kyriakopoulos (2017) state that integrating a socio-cultural perspective into the valuation of ecosystem services requires recognition that socio-cultural values are not limited to cultural ecosystem services, usually related simply to recreation and tourism. Therefore, the sociocultural analysis of ESs is an area of research that still requires further exploration.

To help fill this gap in knowledge, this paper presents a sociocultural assessment of the ESs provided by a PA. The case of the Sierra María-Los Vélez Natural Park, located in southeast Spain, is analysed. It is a relevant case study because it is a representative area of the Mediterranean forest and is subject to different forms of administrative protection. The assessment aims to delve deeper into the social and cultural dimensions surrounding ESs within this PA. The study aims to unravel the intricate interaction between human societies, their cultural values and the various services provided by the forest ecosystem. Moreover, existing administrative protection adds a layer of complexity to the socio-cultural dynamics, making this case study a valuable exploration of the relationships between environmental conservation, cultural practices and the overall well-being of local communities. Through this socio-cultural lens, the paper aims to provide insights that go beyond ecological considerations, providing a more holistic understanding of the interdependencies between nature and society in the context of PAs, which can be used in other regions around the world.

The general objective of this work is to analyse how the declaration of an area as a PA contributes to its conservation and to the improvement of the well-being of the local population from the analysis of the perception of the flow of ESs provided by said space. This general objective is structured around the following specific objectives: i) to identify the main problems that motivated the constitution of the natural park and the evolution of the management developed, ii) to assess the flow of services provided by the park by different groups of stakeholders, and iii) to make management proposals for the sustainable exploitation of the park. To respond to the proposed objectives, a double qualitative and quantitative approach has been used that includes a review of the literature, in-depth interviews and an assessment questionnaire. The use of this combination of methodologies and the involvement of stakeholders in the development of this work from the beginning can give great value to the results obtained as this has allowed the research to be designed based on the perception of the local reality, including issues, concerns, conflicts and livelihoods. On the other hand, in many cases research is conducted in isolation and there is no connection between academic researchers and non-academic end-users (Kyriakopoulos & Kyriakopoulos, 2017). In this sense, the inclusion of policy makers in this work and the development of management proposals in collaboration

with them and based on the results obtained can bring research closer to non-academic end-users and enhance the implementation of the proposals.

After this introduction, a brief review of the existing literature on the socio-cultural valuation of ESs in PAs is provided. Then, the methodology used in this study is presented. This is followed by a presentation of the results. Next, a discussion of the results is included. Finally, conclusions are presented.

Literature review

ESs are defined as the direct or indirect benefits that human populations receive from ecosystems that improve their well-being and quality of life (Velasco-Muñoz *et al.*, 2022b). Examples of ESs include the provision of food through agriculture, the regulation of water quality through wetlands, the support of nutrient cycling through forests, and the provision of recreation opportunities through parks and PAs (De Meo *et al.*, 2018; Ciftcioglu, 2020; Tovar-Tique *et al.*, 2021; Peter *et al.*, 2022). These services are crucial for human well-being, as they provide essential goods and services and help regulate the natural systems upon which human life depends (Hasan *et al.*, 2020). It is important to note that ESs are often interrelated and that changes in one service can have consequences for the provision of other services (Meacham *et al.*, 2022). Therefore, the valuation of ESs is presented as a useful tool to provide stakeholders with useful information for policy formulation, strategic planning and ecosystem management by identifying the services provided by ecosystems and their relevance to society (Velasco-Muñoz *et al.*, 2022b). The undervaluation of ESs and their role in achieving sustainable development, as well as the need to provide policy makers with useful information for developing conservation programmes are some of the reasons why the valuation of ESs is of great importance (Chen *et al.*, 2022).

Despite the importance of further exploiting people's perceptions of ecosystems and ESs, socio-cultural approaches are under-represented compared to other ESs assessment methods, such as biophysical approaches or economic valuation (Ebner *et al.*, 2022; Paing *et al.*, 2022). Dehghani Pour *et al.* (2023) state that the non-inclusion of social science in ESs assessments has led to an inadequate understanding of the complexity of social-ecological systems. Socio-cultural valuation of ESs goes beyond traditional

economic valuation, which focuses primarily on the market values of ESs, to consider the non-market and intrinsic values of these services to human well-being (Walz *et al.*, 2019). The importance of socio-cultural valuation lies in its ability to provide a more comprehensive understanding of the full range of benefits that ecosystems provide to people, including those that are not easily quantifiable in monetary terms (Maestre-Andrés *et al.*, 2016).

The valuation of the services provided by ecosystems as well as their contribution to local well-being is different for each stakeholder, making it essential to include all perceptions in the conservation and management policies developed (Dehghani Pour *et al.*, 2023). Studies have shown that socio-cultural valuation can play a crucial role in informing decision-making related to the conservation and management of ESs, especially in PAs (Coelho-Junior *et al.*, 2021; Velasco-Muñoz *et al.*, 2022c). By taking into account the diverse values and perspectives of different stakeholder groups, socio-cultural valuation can help to ensure that the management of PAs is more responsive to the needs and values of the communities that depend on these ecosystems (Maniatakou *et al.*, 2020).

Oldekop *et al.* (2016) conducted a global meta-analysis of PAs and concluded that their conservation objectives are most often achieved when they empower local people, increase cultural benefits and reduce the costs of living. This highlights the need to involve stakeholders in the decision-making and management of PAs, and to involve them in their development and conservation. To do this, it is necessary to know the population's perception of the benefits generated by these PAs as a starting point. In this sense, Maestre-Andrés *et al.* (2016) carried out a study in a natural park in Catalonia (Spain) that allowed them to know the benefits obtained by the natural park for the population based on the identification of ESs, in addition to finding contradictory points of view in relation to the management of the park among different stakeholders, especially between conservationists and park managers. These authors emphasise that an analysis of this type is of great relevance for proposing appropriate management of natural areas to promote socio-economic development while guaranteeing their protection. Meli *et al.* (2023) conducted an assessment of social preferences for ESs in south-central Chile and found that knowledge of divergent stakeholder perceptions helped minimise unwanted trade-offs and enhance synergies. For their part, Wiesli *et al.* (2022) show that natural parks not only improve people's quality of life in Switzerland through conservation measures, but also do so through the development of activities of different

kinds such as sports or education, the promotion of social contact between residents by providing them with a space in which to interact, as well as generating economic activities such as tourism. According to the study carried out by Coelho-Junior *et al.* (2021) in Brazil, people's involvement depends on their individual experiences but also on the context in which they live, so it is necessary to improve social relations in the environment of PAs in order to generate trust and cooperation between stakeholders to enable effective management. The same authors propose recommendations to improve the sustainable and equitable management of PAs, including strategic land-use planning, the promotion of environmental education programmes, and the study of people's perceptions and valuation of the ESs of PAs. Shishany *et al.* (2022) conclude, in a study in Jordan, that raising local community awareness of ecosystems and institutional actions that recognise the cultural, identity and existence values of forests are essential to help gain the continued support of local communities for PAs.

However, although the literature confirms that knowledge of stakeholders' perceptions is relevant for carrying out management plans for PAs, it does not go into detail on the aspects that should be taken into account to improve such management or how to carry out such plans. Therefore, in addition to identifying and valuing various ESs, this paper presents a management proposal for the sustainable exploitation of a natural park.

Research methods

Study area

The Sierra María-Los Vélez Natural Park was declared as such in 1987. This Mediterranean ecosystem is of great importance as a recreational, leisure and environmental education area. The natural park was established to regulate the use of its resources and achieve a balance between the necessary socioeconomic progress of the community and the conservation of the natural and cultural heritage of the park. It is located in the southeast of the Iberian Peninsula in the northernmost sector of the province of Almería (see Figure 1). It occupies an area of 22,562 ha, is characterized by a forest landscape and is crossed by three mountain ranges, which give rise to a large number of caves and shelters that are part of the valuable archaeological heritage of the region. Internationally, the Natural Park Sierra Ma-

ría-Los Vélez has been included in the Inventory of Protected Natural Landscapes of Andalusia as a Special Protection Area (SPA) under the European Union Directive on the Conservation of Wild Birds (European Commission, 2009) and is also part of the Natura 2000 network (European Commission, 1992). It is also on the list of Sites of Communitarian Importance (ES6110003) (European Environment Agency, 2022) and in the European Charter for Sustainable Tourism (EUROPARC Federation, 2022). At the regional level, the park brings together the figures of a natural park, a protected landscape, a natural monument and a nature reserve.

The region of Los Vélez is made up of the municipalities of Vélez-Rubio, Vélez-Blanco, María and Chirivel. It has an area of 1,152 km², and one-fifth of that territory corresponds to the natural park. The most populated municipality is Vélez-Rubio, which is the administrative capital of the region. In general, the population density is low, especially in the municipalities of María, Chirivel and Vélez-Blanco (9 inhabitants/Km²). The economic potential of the region is defined by its archaeological and historical heritage, its geography and its agricultural tradition. In the second half of the 20th century, the productive model of the region based on traditional agriculture entered into crisis, causing a significant abandonment of farmland and emigration of the local population (Segado-Castro & Zamora-Díaz, 2016). However, in recent years, there has been a change in agricultural activity in which there is an increasing importance of organic farming and the cultivation of almond trees, which are replacing the cultivation of cereals and are promoting the recovery of old farmland and the launch of new ones. Additionally, in recent years, tourism has emerged as an increasingly relevant economic activity.

Methods

In this work, different complementary methodologies were used in successive phases, both qualitative and quantitative. First, a review of the literature was developed. Second, a group of in-depth interviews with experts was conducted. Third, information was collected on the population of the study area by conducting a survey.

The review of the scientific literature on the subject under study was carried out with the aim of synthesizing the previous general knowledge developed at a global level for its application to the case study and establishing the conceptual framework that supports the rest of the analytical

process (Velasco-Muñoz *et al.*, 2022a). The literature review is a fundamental part of any research work since it allows contextualizing the case of analysis and structuring it theoretically based on previous works on the subject studied (Gardas *et al.*, 2019). The review included scientific literature derived from the main databases (Scopus and Web of Science), as well as grey literature consisting of documents published by national and local organizations (López-Felices *et al.*, 2020).

Next, interviews were conducted with experts from the study area to gain a deeper understanding of the evolution and situation of the natural park. The interview is an instrument that allows developing a close relationship with the interviewee, thus obtaining exhaustive and useful answers (Rosenthal, 2016). The number of interviews to carry out depends on the level of knowledge acquired and the verification of the information in each of them (Velasco-Muñoz *et al.*, 2022c). For the selection of experts, the snowball sampling technique was used, so that each person interviewed recommended other possible participants from among their acquaintances. This technique makes it possible to select the right people taking into account the objective of the research, and in addition, the candidate is usually more willing to participate by having the recommendation of an acquaintance (Ochoa-Noriega *et al.*, 2022). To develop the interviews, a script with open-ended questions was used, divided into three blocks. In the first block, information was requested on the relationship of the interviewees with the park and the use they make of it from a personal and/or professional point of view. In the second block, information was collected on different aspects related to the development and management of the park. Specifically, it was asked about the evolution and current situation of the park, the opinion about the administration that is carried out, as well as the main challenges that it will have to face, and the groups of stakeholders involved in the management and use of the park. Finally, in the third block, they discussed the impacts of the park on the socioeconomic activity of the region and possible lines of action to improve its development.

With the information collected in the previous phases, a questionnaire was designed to collect primary information on the perception of the population of the region about the impacts generated by the natural park. The survey is a systematic method to collect information from a sample of individuals to describe, compare or explain their knowledge, attitudes, opinions or behaviours (Groves *et al.*, 2011). The main advantages of this research method are that it allows the results obtained to be extended to the

population, multiple issues can be addressed anonymously and facilitates the replication of the study and its comparison (Nardi, 2018). The questionnaire used in the survey was divided into three sections. The first evaluated the importance of a series of ES (Table 1) using a 5-point Likert scale. Value 1 corresponded to "Not at all important" and value 5 to "Very important". A total of 16 ESs were included that were classified, following the Common International Classification of Ecosystem Services (CICES) proposed by the European Environment Agency (EEA), into three categories: provisioning, regulating and cultural. Specifically, five ESs related to the provisioning category, five to the regulating category and six to the cultural category were analysed. The next section of the questionnaire included three open-ended questions to learn about the impacts and possible additional comments on the natural park. In the last section, demographic and socioeconomic data of the respondents were collected (gender, age, place of residence and group of stakeholders).

To determine the sample size, the following formula was used (Mensah *et al.*, 2017):

$$n = \frac{1}{e^2} p(1 - p) Z_{1-\frac{\alpha}{2}}^2 \quad (1)$$

where n is the estimated sample size, Z is the statistical parameter that depends on the level of confidence (1.96 for $\alpha = 0.05$), e is the margin of error (5%) and p is the proportion of inhabitants who benefit from some ESs. To determine this proportion, the first 20 surveys carried out in each municipality were taken into account. Finally, 194 people were surveyed (22 in María ($p = 98.5\%$), 29 in Chirivel ($p = 98.0\%$), 35 in Vélez-Blanco ($p = 97.7\%$) and 108 in Vélez-Rubio ($p = 93.0\%$)).

The SPSS programme (version 28) was used for data analysis. For ordinal data, medians and modes are calculated. However, as the results obtained with these measures were very uniform, the means are also provided as these can be used with this type of data for information purposes (Stratton, 2018). The responses to the survey were examined with respect to three areas: stakeholder group, municipalities and sociodemographic characteristics of respondent. The most relevant stakeholder groups in relation to the management and use of the park were considered: public administration, various economic sectors (tourism, agriculture, livestock and hunting), the socioeducational community and residents. The data were also analysed according to the four municipalities that are part of the re-

gion. Finally, differences were taken into account based on the sociodemographic characteristics of the participants according to gender (male or female), age group (18–35 years old, 36–45 years old, 46–55 years old, 56–65 years old and more than 65 years old) and educational level (basic, intermediate or higher). To check if there were significant differences between groups, the nonparametric Kruskal–Wallis test was used since the data analysed were ordinal (Pastorella *et al.*, 2016; Bidegain *et al.*, 2020).

Primary data collection

First, the primary data collection process obtained in in-depth interviews with experts is detailed. Regarding the number, it was necessary to carry out a total of ten interviews to reach the saturation level in the acquisition and verification of the information obtained. The profiles of the interviewees included two members of the board of directors of the natural park, a member of the public administration, the director of the entrepreneurship centre, the manager of the visitor centre and the environmental education plan, the teacher and head of the Department of Agronomy and Forestry of the Professional Training Centre on Use and Conservation of the Natural Environment, the director of one of the most important agricultural production and supply companies in the region, a member of the board of directors of an association of farmers and ranchers to promote the protection of the environment and the sustainability of their activity, a rancher with extensive experience and the president of a hunters association. The interviews were conducted in person during the months of September and October 2022 and had an average duration of approximately one hour.

Regarding the questionnaire, it was administered first to the experts interviewed to determine their opinion and verify that it included the most relevant ESs, in addition to verifying the effectiveness of the questions posed, the clarity of the language used and the completeness of the information needed. The survey was then carried out among the local population. The questionnaire was administered independently to each of the participants. The respondents were asked to participate in the study, indicating that it was a survey related to the impacts of the natural park in the region. They were informed that all the answers were anonymous, that the objective was to know their opinion and that there were no correct or incorrect answers. Likewise, the concept of ESs was clarified to the respondents

before they responded to the survey. The surveys were conducted at different points in each of the municipalities that make up the region during October 2022. The average duration of each of the surveys was between 10-15 minutes.

Results

Problems and evolution of the management of the natural park

Through the literature review and in-depth interviews, the main objectives and lines of action related to the management of the natural park were identified, as well as their correspondence with the ESs to be analysed (Table 1). Specifically, four objectives have been highlighted: i) strengthen production structures under criteria of sustainability, innovation and differentiation; ii) conserve and make use of the territory's natural resources in a sustainable way; iii) consolidate the image of the territory, giving value to its cultural, natural and landscape elements; and iv) train and educate as a basis for socioeconomic development and environmental conservation. These four objectives have been structured into 16 priority lines of action, each of which has been associated with an ESs provided by the natural park (Table 1).

The first of the objectives is to strengthen production structures under the criteria of sustainability, innovation and differentiation. Among the lines of action that are part of this objective are the promotion of the main economic activities of the region, as well as the promotion and development of other resources related to the park. Agriculture is the most important economic activity in the region. Rainfed agriculture stands out due to the scarcity of water, and the main crops are almonds (20,327 hectares) and cereals (13,780 hectares) (Instituto Nacional de Estadística, 2022). In addition, as experts indicate in recent years, the area of organic almond trees has increased, which currently represents more than 60% of the total area. Livestock activity within the park has been considerably reduced in recent years due to the scarcity of water. Traditionally, the cattle of the area were sheep and goats, and their exploitation was carried out in a semiextensive regime, using scrubland, pastures and winter cereals. In this sense, the experts indicate that the farms are family-owned, have little technology and need an improvement in both food management and reproductive

management. In relation to this, Toro-Mujica and Riveros (2021) conclude that governmental support strategies should be based on promoting technical and economic improvements focused on animal feeding and technology adoption. In addition, in recent years, pigs and poultry have gained importance with the establishment of intensive farms in the municipalities of the region.

The importance of hunting activity has been increasing over the years and is currently one of the most prominent recreational uses in the region. There are 25 hunting reserves with part of their surface included within the natural park and 5 more located entirely in it. Of the total reserves, 6 are locally owned, 3 are regionally owned and the rest are privately owned. Most of the preserves are for small game, although, as indicated by experts, the species that are hunted under this modality, such as partridge and hare, are at low density levels due to various factors, such as the use of phytosanitary products in crops and the progressive elimination of boundaries in agricultural lands. In the case of big game hunting, permits are granted to carry out hunts in the park to control populations and avoid damage to neighbouring crops. In recent years, actions have been taken to control the populations of wild boar, Barbary sheep and ibex (Giménez-Anaya *et al.*, 2020; Stipoljev *et al.*, 2021). Logging was an important economic activity for the park until the 1980s. However, since the introduction of the restrictions resulting from the creation of the natural park, logging has lost its appeal. Currently, the management of the park pays companies to carry out the maintenance of the forest mass and the collection of wood that must be removed. The experts indicate that the difficult conditions of wood extraction prevent logging from being profitable on most of the surface. In relation to the use of endogenous resources, the development of beekeeping and the collection of aromatic plants stand out. Beekeeping has developed in a timely manner in the park, but experts highlight its potential due to the existence of a large number of floral species. In the case of aromatic plants, a small local distillation industry was developed (Segado-Castro & Zamora-Díaz, 2016), but currently it is a marginal activity, although this activity has great potential due to the variety and abundance of flora.

The second objective focuses on conserving and using the territory's natural resources in a sustainable way. The key lines of action within this objective seek to maintain the main natural resources of the park, such as habitat or soil, as well as preserve water quality and regulate the climate. In relation to the conservation of natural habitats, some measures have been

carried out in recent years, such as the creation of a centre for the recovery of endangered species and a botanical garden, the introduction of closures to grazing in heritage forests, and the development of an inventory of the flora of the natural park. However, experts indicate that the development of inappropriate agricultural and silvicultural practices, as well as overgrazing, has led to the impoverishment of the region's vegetation. In the case of water resources, the region depends directly on groundwater, both for human consumption and for supplying irrigation and livestock. From the hydrological point of view, the area belongs mainly to the Segura Basin (90%) and, to a lesser extent, to the Guadalquivir Basin (10%). The experts show their concern about the state of the underground water bodies, both in quantitative and qualitative terms. In recent years, there has been a global decrease in the availability of underground water resources due to the reduction in rainfall and the proliferation of wells that are not properly controlled, especially those related to agricultural irrigation (Aznar-Sánchez *et al.*, 2020). On the other hand, it is necessary to control the contamination of the water produced by solid residues, by the excrement of the cattle herd and by the nitrates derived from agricultural activity. In the case of erosion, the park is dominated by soils classified as "high erosion". Experts indicate that soil loss levels of 50 Tm/ha/year can be reached in those areas where the materials are softer and the slope is greater. For this reason, the protection of the soil was one of the main reasons why the natural park was created since erosion is an important limitation for the implementation of new policies and the performance of activities in the region. In this sense, considerable resources have been allocated to reforest the park to cover the bare surfaces with vegetation. On the other hand, experts highlight the need to preserve air quality by maintaining the correct state of the park's vegetation, with the aim of guaranteeing the health and well-being of all the inhabitants and living beings of the region. Last, it is necessary to combat the possible effects of climate change, which are likely to materialize in an increase in successive episodes of hot winters and very dry summers and an increase in average and maximum temperatures (Abbass *et al.*, 2022). These changes can negatively affect both vegetation and fauna, leading to a decrease in rainfall and economic activity in the region.

The third objective focuses on consolidating the image of the territory by giving value to its cultural, natural and landscape elements. In relation to this objective, five main lines of action are proposed. The first of these corresponds to the promotion of sustainable tourism development since the

region stands out for rural and active tourism. Tourism is an activity that can improve the economic development of this region (Pérez-Calderón *et al.*, 2022), and according to experts, the natural park is a fundamental actor in achieving this. Most of the visitors come from the province of Almería and the neighbouring region of Murcia. International visits are scarce, although in recent years, the influx of tourists from the Nordic countries who spend the winter in the area has increased. According to the opinion of the experts, to promote tourism, traditional products, the natural environment and cultural heritage should be valued. Quality agri-food products, such as Segureño lamb, traditional gastronomy and products derived from almond and olive trees, are claims to promote tourist visits (Álvarez-Lorente & Entrena-Durán, 2021). In addition, its strategic location, climate, vegetation, fauna and landscape, as well as the rich historical-artistic and archaeological heritage and the traditional festivals of the region, make the park a highly valued enclave, where you can enjoy nature and its interpretation. In relation to the strengthening of the territorial identity and the consolidation of the image of the park abroad, the experts emphasize that the richness of the natural and cultural heritage is well known at the local and regional level, but not so much at the national and international level. Therefore, it would be necessary to work on the creation of a coherent and unified image of the territory, as well as its promotion in the international context using the new channels that emerged from the internet (Gusman & Lois-González, 2021; Panzera, 2022). Finally, it is necessary to strengthen the network of public and cultural facilities. Along these lines, a wide network of trails has been created that allows visitors to explore their lands, and special routes have also been set up for cycling. The park has nine marked trails and five viewpoints and is an ideal place to practice activities such as mountaineering, photography and bird watching. On the other hand, in the region, there are many shelters with cave paintings. It should also be noted that the collaboration that has existed since 1990 between the Sierra María-Los Vélez Natural Park and the Altmühltal Natural Park, located in southern Germany, has promoted the exchange of knowledge and management experiences, as well as numerous activities for different collectives.

The last objective corresponds to training and education as a basis for socioeconomic development and environmental conservation. In this context, the park is part of the programme of awareness and participation of the natural spaces of the Natura 2000 Network (European Commission,

1992), through which education and public awareness of the natural environment are promoted. Additionally, within the park, there is a botanical garden where you can learn about the peculiarities of the flora, in addition to carrying out training and awareness activities.

Valuation of ecosystem services provided by the park

This section shows the average scores, medians and modes obtained by the different categories and ESs based on the different variables analysed: difference between experts and the general public (Table 2), group of stakeholders (Table 3), municipality (Table 4), gender (Table 5), age group (Table 6) and educational level (Table 7). In addition, the results of the Kruskal–Wallis nonparametric test are also included (Table 8).

All groups show a high valuation of the ESs analysed. This is reflected in the fact that in most cases the medians and modes obtained correspond to values of four and five. Therefore, for information purposes, the mean has been used to grade the ESs, as in other studies (Lin *et al.*, 2021; Hochmalová *et al.*, 2022; Meli *et al.*, 2023).

The results obtained in this work show that both experts and the general public attach great importance to the benefits that the park provides to human well-being, represented through the ESs provided. These data indicate that the opinion of the local population about the existence of the natural park has evolved favourably since its creation was the object of criticism and opposition. Several experts commented during the interviews that the creation of the natural park was not well received by the local population and especially by some groups, such as farmers and ranchers, since they considered that the park's regulations were very strict and would limit their activities. The results will be presented based on the category of service analysed to facilitate its monitoring.

A. Regulating Services

In general, it obtained a higher score in all cases, except for those over 65, who scored slightly better on culture. Within the regulating category, most of the surveyed groups give the highest score to the 'Air purification' service. The ES 'Soil quality' obtains the highest score for experts and the socioeducational community, while the public administration, farmers and the group of 36–45 years give it the lowest score. The public administration,

the tourism sector and the inhabitants of Chirivel rate 'Natural habitat' as the most relevant ES. However, this ES has obtained a lower score for the inhabitants of Vélez-Blanco and the age group of 46–55 years. The inhabitants of Vélez-Blanco, the age groups between 46–55 and 56–65 and the group with the highest educational level give a higher score to 'Aquifer Conservation'. Finally, the ES 'climate regulation' obtained the lowest score for most of the groups analysed.

B. Cultural services

It is the second category with the highest score for all groups surveyed, except for farmers and ranchers, who score second in the provisioning category. Within the cultural category, the ES to which a greater number of groups give the highest score is 'Aesthetic values of the environment'. The ES 'Tourism' is the one that has received the highest score from the tourism sector and the general population of Vélez-Blanco, while for experts, the public administration, ranchers, the socioeducational community and the inhabitants of Chirivel, this is the service that gets the lowest score. 'Natural and cultural heritage' is the most valued for the 18–35 age group and the average educational level, but receives the lowest score from all the inhabitants of María. 'Sense of place' has obtained the highest score for the public administration, hunters, the socioeducational community, and the age group between 36–45 years. The ES 'Recreational activities' obtained the lowest score for hunters and age groups between 46–55 and 56–65. The ES with the lowest overall score is 'Environmental education and awareness', although it obtains the highest score for the experts.

C. Provisioning services

For this category, all the groups analysed give the highest score to 'Food from agriculture', except for the ranchers, who give higher scores to 'Food for livestock'. This is not surprising considering that agriculture is the main economic activity in the region. The rest of the provisioning services analysed show lower scores. For the tourism sector and ranchers, the one that obtains the lowest score is 'Raw materials', while for hunters, the group of inhabitants of Vélez-Blanco, the group of men and the age groups between 18–35 and 56–65 is 'Nontimber forest products'. For the rest of the groups surveyed, the ES with the lowest score is 'Wildlife for hunting'.

According to the results of the Kruskal–Wallis test (Table 8), for the provisioning and cultural categories there are only significant differences by municipalities, while for the regulation category there are also significant differences between the groups of variables corresponding to stakeholders, gender, age groups and educational level. If all services are analysed independently, in the case of expert groups and the general public, there are only significant differences for the assessment of 'Air purification' and 'Environmental education and awareness'. By stakeholder group, significant differences are found for 'Wildlife for hunting', 'Raw materials', 'Natural habitat', 'Air purification', 'Tourism' and 'Natural and cultural heritage'. By municipalities, 'Food for livestock', 'Wildlife for hunting', 'Raw materials', 'Air purification', 'Tourism', 'Natural and cultural heritage' and 'Environmental education and awareness' stand out. By gender, significant differences are found in 'Food for livestock', 'Wildlife for hunting', 'Non-timber forest products', 'Aquifer conservation', 'Soil quality', 'Air purification' and 'Climate regulation'. In the case of age groups, 'Aquifer conservation' and 'Climate regulation'. Finally, by educational level, differences are found for 'Raw materials', 'Aquifer conservation', 'Climate regulation' and 'Aesthetic values of the environment'.

Discussion

Regulating services and the well-being of the population

Regulating ESs play a crucial role in enhancing the well-being of the population by providing a range of benefits that directly or indirectly affect the quality of life. The regulation category stands out despite being services that are more abstract and complex to understand for people outside the field of research. These results are consistent with those of other studies in forest environments. For example, in the study carried out by De Meo *et al.* (2018) in a PA in Italy, they conclude that the higher valuation of regulation services is due to the higher level of awareness among the population due to their contact with the PA. Regulating services were also the most highly valued in a study conducted by Asah and Blahna (2020) in the Deschutes National Forest in central Oregon, USA, despite omitting several aspects of regulating services during the participatory identification process. For this reason, these authors conclude that the fact that stakeholders

do not identify certain aspects of nature does not mean that the omitted aspects are of less or no value to them. Janeczko *et al.* (2023) also obtain higher ratings for regulating services in their study in Poland, concluding that this is due to the current importance and widespread concern about climate change.

In line with this, it is not surprising that 'Air Purification' was the highest rated service, as forests play a crucial role in climate change mitigation and adaptation, being one of the main carbon sinks (Janeczko *et al.*, 2023). The importance of air quality for the population has also been reflected in other works conducted in Spain (Martín-López *et al.*, 2012), China (Zhang *et al.*, 2019) and the Czech Republic (Hochmalová *et al.*, 2022). These studies show that the increased appreciation of this service may be due to the availability of more information about it, as well as awareness about climate change and environmental pollution. In fact, a recent study by the European Union highlights that air pollution is an aspect that worries its citizens, considering 47% of the population (62% in Spain) that air quality has deteriorated in the last ten years (European Commission, 2022).

Water management is a global challenge due to water scarcity and pollution of available sources, as well as competing uses by different sectors and communities (Ahmed *et al.*, 2022). In the study area analysed in this work, the main source of water is groundwater, a resource that is being threatened due to increasing demand and contamination. It is, therefore, not surprising that the ES 'Aquifer conservation' has been highly valued. In a study on forest ecosystems in Taiwan, public perception of water conservation was also very high, as these ecosystems provide sufficient water quality (Lin *et al.*, 2021), while in the case of the Philippines people showed importance in water purification and regulation of water flows because they consider water essential for their daily activities, irrigation of farms, as well as knowing the risk posed by polluted water (Paing *et al.*, 2022).

The fact that farmers do not obtain a higher score to the ES 'Soil quality' stands out, since it is essential for the development of their activity. This may be because they consider that the management of the natural park is not improving this ES. According to experts, farmers in the area are increasingly aware of the need to take care of the environment that surrounds them and to manage the soil correctly, minimizing tillage to avoid its degradation. However, this result seems to indicate that it is necessary to support more farmers in relation to soil improvement to guarantee the provision of this service. In this regard, a comparative study of the level of

protection of soil and its biodiversity in the EU concludes that Spain is one of the countries that needs to do most work in this area, as it has few instruments to guarantee soil quality (Köninger *et al.*, 2022). Therefore, in addition to the development of research and policy instruments, the provision of information to farmers as well as economic incentives and the development of awareness must be promoted (Bagheri & Teymouri, 2022; Ingram *et al.*, 2022; Vanino *et al.*, 2023).

One of the most underrated regulating ES is 'Climate regulation'. This may be because the area has a generally warm climate and this means that they do not perceive the influence that the park has on local climate regulation (Zabala *et al.*, 2021).

Cultural services and sustainable tourism development

Other studies also show that regulating and cultural services categories are the most highly valued, for example, the study by Jamean and Abas (2023) on visitors of urban forests in Kuala Lumpur, or by Zoderer *et al.* (2016) in the Central Alps. According to these authors the better perception of regulating and cultural services may be due to their direct relationship with the landscape and multifunctional land uses.

Within the cultural category, 'Aesthetic values of the environment' is one of the highest rated ESs, as in other studies in China (Hochmalová *et al.*, 2022), Malaysia (Jamean & Abas, 2023) or Iran (Dehghani Pour *et al.*, 2023). This differs from the results obtained by Purwestri *et al.* (2023) in the Czech Republic, which may be due to the fact that the forests there are being subjected to prolonged drought, low rainfall and high temperatures.

Tourism, despite its economic potential, receives a lower score from experts and the public administration. This may be due to the fact that these groups consider other areas related to the maintenance of natural resources and heritage to be priorities. However, in Vélez-Blanco, tourism is very important, which may be due to the Renaissance and Mudejar buildings and the fact that it has more than 40% of the tourist places in the area. In Chile, a low valuation of tourism was also obtained, which may be due to the fact that information and recognition of cultural benefits for human well-being is limited, especially in terms of information needed to support decision-making processes (Meli *et al.*, 2023). On the other hand, Dou *et al.* (2017) states that when tourism-related cultural services are accessible free of charge, they are often undervalued. Tourism represents an activity of

great importance for rural environments as a driver of economic development (Streimikiene *et al.*, 2021). In fact, nature-based tourism represents approximately 20% of the global tourism market (Silva *et al.*, 2023). In this sense, sustainable tourism should be one of the bases of local development in the area. This in turn can strengthen the community by encouraging participation and cultural exchange, as well as ensuring the conservation of cultural and natural heritage (López-Sanz *et al.*, 2021; Vrontis *et al.*, 2022).

Purwestri *et al.* (2023) and Janeczko *et al.* (2023) state that older age groups perceive the ESs related to cultural heritage. However, in this study, the younger group values the 'Natural and cultural heritage' more highly. This indicates that the constitution of the park has made it possible to maintain the values and tradition in the territory. Coelho-Junior *et al.* (2021) state that Cultural Heritage and Sense of place play a key role in providing and promoting public support for the conservation of the natural environment, as well as fostering social relations between neighbours and visitors. However, it should be borne in mind that these ESs are subjective and are only appreciated when people recognise and understand their value for the benefit of human well-being (Meli *et al.*, 2023). As a result, these ESs have been less valued in previous studies (Hochmalová *et al.*, 2022; Janeczko *et al.*, 2023).

Low values for 'Environmental education and awareness' shows that the population does not consider that the existence of the park is improving the awareness and education of the population; therefore, it is necessary to strengthen the environmental awareness programme developed in relation to this natural space. These results differ from those obtained by Dehghani Pour *et al.* (2023), Pérez-Sánchez *et al.* (2021) and Jamean and Abas (2023). The development of awareness programmes would increase recognition of ecosystems and the services they provide (Dehghani Pour *et al.*, 2023). In addition, school curricula in the area should include outdoor learning in natural environments to encourage contact with and appreciation of these spaces (Kičić *et al.*, 2022). Social media and the emergence of influencers can therefore help with the task of raising awareness by bringing nature closer to the public. In this sense, public interest in plant-related topics has increased in recent years thanks to the emergence of influencers who promote this topic (Burke *et al.*, 2022).

Provisioning services and sustainable rural development

The economic development of the area depends to a large extent on provisioning services. However, this category was the least valued of all. This differs from the results obtained in other studies conducted in Chile (Meli *et al.*, 2023) or the Czech Republic (Purwestri *et al.*, 2023). This result may be due to the fact that the population does not clearly associate the existence of the park as favouring the provision of raw materials other than food. In fact, 'Food from agriculture' is the most valued ES in this category. This is because the economic activity of the area is heavily dependent on agricultural activity. However, ESs related to raw materials, non-timber forest products and wildlife for hunting are less relevant. In the case of raw materials, the forest analysed in this study has not traditionally been used for timber exploitation. In the same context, Lin *et al.* (2021) state that the low valuation of timber and raw material provision in a study in Taiwan is due to the lower economic dependence on this resource, as well as the attitude and preferences of the population towards the conservation function of forests.

In the case of hunting, it is an activity that has traditionally been practised in the region, but the population considers that it is losing relevance. This result is similar to that obtained in the study by Maestre-Andrés *et al.* (2016) in Catalonia. On the other hand, Acharya *et al.* (2019) conducted a study on the local and stakeholder perception of ESs in Nepal and found that hunting is the least valued cultural service, which may be due to existing restrictions on the hunting of wild animals.

Taking into account the results obtained in this category, it is clear that there is a need to guarantee the agricultural activity in the area, which should advocate the promotion of sustainable and environmentally friendly production methods such as organic farming. Thus, the development of economic activities based on other types of services provided by the forest, such as aromatic plants or honey, should be encouraged. In this sense, Dehghani Pour *et al.* (2023) concluded that economic dependence directly and significantly improved the perception of regulating services in Iran.

Ecosystem services and the circular economy

Economic development requires continuous improvement of environmental quality and sustainability. This will require changing the current

model of extensive economic growth characterised by high energy consumption, improving technological innovation and efficiency (Kyriakopoulos *et al.*, 2020). The Circular Economy (CE) is a closed-loop economic system in which raw materials, components and products retain their quality and value for as long as possible, and where systems are preferably supplied by renewable energy sources (Velasco-Muñoz *et al.*, 2021). Kapsalis *et al.* (2019) conclude that the integration of the CE and ESs is a key factor in achieving an optimal balance of economic, social and environmental benefits for the inter-organisational network.

The application of the CE concept to forests implies the reduction of the use of virgin natural resources in production processes, the reduction of CO₂ emissions, the reuse and the extension of the life span of the products that this ecosystem offers (Lazaridou *et al.*, 2021). This approach offers opportunities for the forestry sector, while contributing to environmental preservation, employment generation and economic development. The application of the CE in forestry can protect the ESs that forests provide (Baciu *et al.*, 2021). In the context of a linear economy, forest resources such as water or wood could be depleted due to constant extraction. However, the circular approach aims to ensure the future provision of all resources through rational use and the application of practices that maximise the use of resources. However, the existing literature on this topic focuses mainly on the wood sector (Lazaridou *et al.*, 2021). Therefore, the circular approach should be applied to other forest-based activities such as agriculture and tourism. For example, in the study area analysed in this paper, agrotourism projects are being developed, in addition to maximising resource use by jointly exploiting livestock and agricultural activity.

Policy implications

Based on the results obtained in this work, a proposal is made to improve the management of the natural park and achieve sustainable use of its resources based on the four identified objectives. The first objective is to strengthen production structures under the criteria of sustainability, innovation and differentiation. Agricultural activity is the main economic engine of the region. However, this activity is being affected by a gradual ageing of farmers and ranchers and the lack of generational change. In the region, 40% of those responsible for the farms are over 65 years old, while those under 44 years old represent only 15% (Instituto Nacional de Es-

tadística, 2022). The ageing of the agricultural business fabric is a factor that negatively affects the prospects of the sector. Therefore, it is necessary to promote the generational renewal of agricultural activities by supporting young farmers and ranchers (Coopmans *et al.*, 2021). This support must be based on the transmission of the necessary knowledge to start the activity, as well as on the availability of financing that allows to modernize the farms and adopt new forms of production that improve profitability and ensure a level of profit that is attractive compared to other economic activities.

In addition, to attract the young population and address rural depopulation, new forms of business and activities must also be promoted to revitalize the regional economy. These activities include recreational hunting, as it generates economic income that can be an incentive for the inhabitants to conserve wildlife. In this sense, the existence of Barbary sheep in the natural park — a species from North Africa and the Sahel that was introduced in Spain for sport hunting in the mid-1960s — attracts hunters from other geographical areas (Anadón *et al.*, 2018). Projects are also being analysed to take advantage of biomass markets, for whose start-up it is necessary to negotiate harvesting contracts in accordance with the regulations that regulate logging in the natural park. In this regard, the population of the area considers that better maintenance of the park's vegetation should be carried out, and an attempt should be made to make use of the resulting wood, since uncontrolled vegetation poses a greater risk of fires. On the other hand, non-wood forest products are presented as an opportunity for the area but have not yet been fully developed. These include the collection of aromatic plants and beekeeping. To promote the development of entrepreneurial initiatives in all these areas, it is necessary to reinforce mechanisms for adequate advice and training and to promote programmes that enable the tutelage and accompaniment of entrepreneurs (Mann *et al.*, 2021).

The second objective corresponds to conserving and taking advantage of the natural resources of the territory in a sustainable way. To achieve this objective, the extension of ecological and regenerative forms of production should be promoted to guarantee the sustainability of economic activities while making responsible use of natural resources. In this context, an association has been launched that aims to mobilize local society and transmit the vision that a self-sufficient, dignified geographical region is possible, full of life and prosperity, betting on ecological agriculture and

livestock that improve soil fertility and water management (Schoonhoven & Runhaar, 2018). Nevertheless, there are still various technical and social barriers that hinder further progress in this regard. Among the technical barriers, we must highlight the ignorance of the certifications or differentiated quality seals, the legal procedures and paperwork, and the incentives and subsidies for organic production. Among the social barriers, it is necessary to mention the ageing of the population that sometimes equates to a lower interest in innovating or undertaking, the pressures of the social environment, both family and union, against change strategies, and the need for greater support from structures organizational characteristics of the persons or entities that own agricultural and livestock holdings. For this reason, training programmes should be designed for farmers and ranchers and help promote these forms of production through the development of demonstration days in which the good results obtained are shown (Mills *et al.*, 2017; Sapbamrer & Thammachai, 2021).

Another aspect of great importance in relation to this objective is the management of water bodies. Belonging to two different river basins generates conflicts when managing water resources. In addition, in recent years, there has been an increase in intensive horticultural crops in the region by companies from other nearby regions. However, park managers and local authorities do not have competence in this matter or the power to grant water extraction permits. In addition, the contamination of the water bodies is also a matter of concern in the area, as two bodies of groundwater in the region have been found to be significantly affected by the presence of nitrates of agricultural origin. Therefore, it is necessary to give priority to the control and monitoring of the water withdrawals that are carried out in the natural park and its area of socioeconomic influence, as well as to the inspection of the sources of contamination to preserve and recover the water reserves stored in the aquifers of the region (Segado-Castro & Zamora-Díaz, 2016).

On the other hand, sustainable rural tourism should be promoted (Pérez-Calderón *et al.*, 2022). Tourism is an activity that can improve the economic development of this area, for which it is necessary to carry out actions that allow the generation of a solid tourist offer and that reinforce the image of the territory while preserving the natural space. The region has a set of potentialities that must be adequately exploited in the planning and design of an attractive, quality and differentiated tourist product that contributes to enhancing the natural and cultural values of the region.

The third objective is to consolidate the image of the territory by giving value to its cultural, natural and landscape elements. In relation to it, it is necessary to create a distinctive characteristic of the region that allows differentiation. For this, a coherent and unified image of the territory must be created that allows its natural and cultural heritage to be easily identified. This can facilitate social cohesion and the generation of more integrated and collaborative processes between people and companies, promoting greater wealth, diversity and complexity in the associative and economic fabric (Meli *et al.*, 2023). Thus, from the point of view of outwards orientation, a recognizable territorial brand is beneficial to increase the tourist attraction of the region and its ability to penetrate national and international markets. In this context, it is also necessary to promote unity between the different municipalities, taking advantage of the existence of the natural park as a common link. The existence of various administrative units and initiatives in the different municipalities that are part of the region supposes a brake on its sustainable development. For this reason, the creation of a body related to the park should be promoted that acts as an axis of union and carries out actions that promote the values and feelings of belonging of the inhabitants with the region and not only with their respective municipalities. In this way, efforts are integrated to develop new business models, conservation programmes and training actions, and the benefits obtained are multiplied (Asah & Blahna, 2020). In addition, it is necessary to articulate actions that help to consolidate the joint image and that allow transmitting its values to the environment in an attractive, coherent and easily recognizable way. For this, you can use new communication channels arising from the development of the internet and social networks.

Finally, the fourth objective pursues training and education as a basis for socioeconomic development and environmental conservation, as this is a fundamental aspect to improve knowledge about the relevance of the park for the region and the need to take care of the environment and make correct use of it. Educational actions, formal and informal, should be aimed at promoting the change of attitudes and behaviours in the population in the most tangible and daily aspects, emphasizing new formulas of production and consumption that can become demonstrative examples that one can live in a more balanced, rational and respectful way with the environment. The tools for transmitting this knowledge and values can be varied, either in strictly educational settings or through the development of spaces

for participation, opinion and debate and favouring more general awareness campaigns (Burke *et al.*, 2022; Kičić *et al.*, 2022).

Conclusions

This study has allowed us to determine the main impacts that the creation of a natural park is generating in its immediate surroundings from the analysis of the perceptions of the inhabitants of the area in which it is located. A differentiation has been made between the group of experts and the general public, as well as between different types of stakeholders, municipalities and groups with different socioeconomic characteristics. In general, the ESs category that obtains the highest score is regulation, followed by cultural and provisioning. The results of this work have also shown the main objectives to be pursued to improve the management of natural park resources, which are based on i) strengthening production structures under criteria of sustainability, innovation and differentiation, ii) conserving and taking advantage of sustaining the natural resources of the territory, iii) consolidating the image of the territory, giving value to its cultural, natural and landscape elements, and iv) training and education.

In the case of the first objective, it is necessary to promote the generational renewal of traditional activities, as well as to promote new forms of business and activities to revitalize the economy of the area through the development of plans to promote entrepreneurship, training and financing. To achieve the second objective, it is necessary to continue betting on the conservation of natural resources while encouraging economic development. For this, the extension of ecological and regenerative forms of production, as well as sustainable and rural tourism, should be promoted. In the case of the third objective, it is necessary to bet on the creation of a distinctive characteristic of the region that allows its differentiation, in addition to promoting unity between the different municipalities, taking advantage of the existence of the natural park as a common element. Finally, to achieve the fourth objective, a greater amount of information of an environmental nature must be made available to the population in relation to the management and regulations of the park to improve their involvement with it.

This study also has some limitations. Firstly, not all of the ESs analysed in this paper may be representative in other case studies, as the selection of

these has been made partly by conducting interviews with experts from the case study analysed. On the other hand, the results obtained are based on people's perceptions, which may be conditioned by their economic and cultural context. Moreover, people's perception and relationship with nature and its contribution to human well-being are complex, which may make it difficult to apply the results to other contexts. Finally, the use of the Likert scale and the obtaining of fairly homogeneous results in the medians and modes has made it necessary to use mean values to grade the importance of the services, results that are only valid for information purposes.

Although the results of this study may have limited external validity and could be generalised only to other PAs in the Mediterranean area, the process and the set of methodologies used in this work can be adapted and used as a guide to make decisions in different contexts. In addition, the results obtained in this study can be used in other PAs as a starting point to evaluate the effectiveness of current conservation measures, identify areas for improvement and develop sustainable management plans that simultaneously meet the protection objectives and promote the socioeconomic development of their area of influence. In this sense, by taking into account social needs and preferences and favouring the participation of the stakeholders involved in the PAs, it is possible to increase awareness and knowledge, in addition to facilitating communication between the different groups.

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Annex

Table 1. Objectives, lines of action and ESs of the Sierra María-Los Vélez Natural Park

Objectives	Lines of Action	Ecosystem service	Category
Strengthen production structures under criteria of sustainability, innovation and differentiation	Promotion of sustainable agriculture	Food from agriculture (especially almonds)	Provisioning
	Promotion of sustainable livestock	Food for livestock	Provisioning
	Sustainable hunting management	Wildlife for hunting	Provisioning
	Timber exploitation	Raw materials (wood and firewood)	Provisioning
	Use of endogenous resources	Nontimber forest products (beekeeping and aromatic plants)	Provisioning
Conserve and sustainably use the natural resources of the territory	Conservation and improvement of natural habitats	Natural habitat	Regulating
	Preservation and restoration of water resources	Aquifer conservation	Regulating
	Control of erosion and desertification and restoration of degraded ecosystems	Soil quality	Regulating
	Preservation of air quality	Air purification	Regulating
	Combat the effects of climate change	Climate regulation	Regulating
Consolidate the image of the territory giving value to its cultural, natural and landscape elements	Planning and promotion for sustainable tourism development	Tourism	Cultural
	Traditional products, the natural environment and cultural heritage	Natural and cultural heritage	Cultural
	Strengthening the territorial identity associated with the natural park	Sense of place	Cultural
	Consolidation of the image of the natural park abroad as a marketing tool	Aesthetic values	Cultural
	Network of facilities for public and cultural use	Recreational activities	Cultural
Training and education as a basis for socioeconomic development and environmental conservation	Environmental training for the protection of the natural environment	Environmental education and awareness	Cultural

Table 2. Valuation of ESs by experts and the general public

	Experts (n = 10)			General public (n = 194)		
	M	Q2	Mo	M	Q2	Mo
Provisioning Services	4.16	5	5	4.06	5	5
Food from agriculture	4.82	5	5	4.71	5	5
Food for livestock	4.27	5	5	4.39	5	5
Wildlife for hunting	3.73	4	4	3.52	5	5
Raw materials	3.82	5	5	3.89	5	5
Nontimber forest products	4.18	4	5	3.80	5	5
Regulating Services	4.60	5	5	4.53	5	5
Natural habitat	4.55	5	5	4.58	5	5
Aquifer conservation	4.64	5	5	4.57	5	5
Soil quality	4.91	5	5	4.42	5	5
Air purification	4.27	5	5	4.75	5	5
Climate regulation	4.55	5	5	4.36	5	5
Cultural Services	4.48	5	5	4.28	5	5
Tourism	4.09	4	4	4.29	5	5
Natural and cultural heritage	4.64	5	5	4.34	5	5
Sense of place	4.36	5	5	4.29	5	5
Aesthetic values of the environment	4.73	5	5	4.53	5	5
Recreational activities	4.45	5	5	4.21	5	5
Environmental education and awareness	4.73	5	5	4.00	5	5

Note: M=Mean; Q2= Median; Mo=Mode.

Table 3. Valuation of the ESs based on stakeholder groups

	Public administration (n = 15)			Tourist sector (n = 25)			Hunters (n = 11)			Farmers (n = 26)			Ranchers (n = 5)			Socioeducatio nal community (n = 24)			Residents (other sectors) (n = 88)		
	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo
Provisioning Services	3.93	4	5	4.00	4	5	4.33	5	5	3.88	4	5	4.12	5	5	4.05	4	5	4.13	5	5
Food from agriculture	4.60	5	5	4.60	5	5	4.91	5	5	4.77	5	5	4.60	5	5	4.71	5	5	4.74	5	5
Food for livestock	4.20	5	5	4.52	5	5	4.73	5	5	4.00	4	5	4.80	5	5	4.38	5	5	4.42	5	5
Wildlife for hunting	3.33	3	3	3.88	4	5	4.45	5	5	3.38	4	4	4.00	4	5	3.21	4	4	3.47	4	5
Raw materials	3.40	3	3	3.44	4	4	4.18	5	5	3.50	4	5	3.80	5	5	3.83	4	4	4.19	5	5
Nontimber forest products	4.13	5	5	3.56	4	4	3.36	4	5	3.73	4	5	4.00	4	4	4.13	4	5	3.84	4	5
Regulating Services	4.79	5	5	4.57	5	5	4.53	5	5	4.14	5	5	4.56	5	5	4.63	5	5	4.58	5	5
Natural habitat	4.93	5	5	4.76	5	5	4.55	5	5	4.19	4	5	4.60	5	5	4.63	5	5	4.57	5	5
Aquifer conservation	4.80	5	5	4.56	5	5	4.45	5	5	4.31	5	5	4.40	5	5	4.67	5	5	4.60	5	5
Soil quality	4.67	5	5	4.48	5	5	4.64	5	5	3.81	4	5	4.80	5	5	4.71	5	5	4.47	5	5
Air purification	4.80	5	5	4.68	5	5	4.91	5	5	4.35	5	5	4.80	5	5	4.58	5	5	4.85	5	5
Climate regulation	4.67	5	5	4.36	5	5	4.18	5	5	4.04	4	5	4.20	4	4	4.54	5	5	4.40	5	5
Cultural Services	4.40	5	5	4.48	5	5	4.36	5	5	4.01	4	5	4.07	4	5	4.01	4	4	4.38	5	5
Tourism	3.93	4	4	4.72	5	5	4.27	5	5	4.08	4	5	3.80	4	4	3.71	4	4	4.47	5	5
Natural and cultural heritage	4.60	5	5	4.52	5	5	4.45	5	5	3.96	4	5	4.40	4	4	4.04	5	5	4.48	5	5
Sense of place	4.67	5	5	4.36	5	5	4.55	5	5	3.85	4	5	3.80	4	5	4.33	5	5	4.33	5	5
Aesthetic values of the environment	4.53	5	5	4.60	5	5	4.55	5	5	4.35	5	5	4.40	5	5	4.29	5	5	4.65	5	5
Recreational activities	4.20	4	5	4.40	5	5	4.09	5	5	4.08	5	5	4.00	5	5	3.79	4	5	4.36	5	5
Environmental education and awareness	4.47	5	5	4.28	5	5	4.27	4	4	3.73	4	5	4.00	4	5	3.88	5	5	4.00	4	5

Note: M=Mean; Q2= Median; Mo=Mode.

Table 4. Valuation of ESs by municipality

	María (n = 22)			Chirivel (n = 29)			Vélez-Blanco (n = 35)			Vélez-Rubio (n = 108)		
	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo
Provisioning Services	4.19	5	5	3.72	4	5	4.15	5	5	4.10	5	5
Food from agriculture	4.91	5	5	4.79	5	5	4.69	5	5	4.67	5	5
Food for livestock	4.36	5	5	4.00	4	5	4.57	5	5	4.43	5	5
Wildlife for hunting	3.45	4	5	3.00	3	4	4.20	5	5	3.48	4	4
Raw materials	4.36	5	5	3.00	3	2	3.71	4	5	4.08	4	5
Nontimber forest products	3.86	5	5	3.83	4	3	3.60	4	5	3.89	4	5
Regulating Services	4.53	5	5	4.48	5	5	4.42	5	5	4.59	5	5
Natural habitat	4.45	5	5	4.59	5	5	4.29	5	5	4.69	5	5
Aquifer conservation	4.68	5	5	4.52	5	5	4.63	5	5	4.54	5	5
Soil quality	4.36	5	5	4.52	5	5	4.26	5	5	4.50	5	5
Air purification	4.82	5	5	4.45	5	5	4.63	5	5	4.81	5	5
Climate regulation	4.32	5	5	4.34	5	5	4.34	5	5	4.39	5	5
Cultural Services	4.40	5	5	3.86	4	5	4.38	5	5	4.35	5	5
Tourism	4.27	5	5	3.52	4	4	4.63	5	5	4.38	5	5
Natural and cultural heritage	4.14	4	5	3.72	4	5	4.57	5	5	4.52	5	5
Sense of place	4.68	5	5	4.14	5	5	4.20	5	5	4.29	5	5
Aesthetic values of the environment	4.68	5	5	4.21	5	5	4.60	5	5	4.57	5	5
Recreational activities	4.32	5	5	3.90	4	4	4.17	4	5	4.31	5	5
Environmental education and awareness	4.32	5	5	3.69	4	5	4.09	4	4	4.06	5	5

Note: M=Mean; Q2= Median; Mo=Mode.

Table 5. Valuation of ESs by gender

	Male (n = 99)			Female (n = 95)		
	M	Q2	Mo	M	Q2	Mo
Provisioning Services	4.00	4	5	4.13	5	5
Food from agriculture	4.67	5	5	4.77	5	5
Food for livestock	4.26	5	5	4.51	5	5
Wildlife for hunting	3.76	4	5	3.31	4	4
Raw materials	3.75	4	5	4.03	4	5
Nontimber forest products	3.60	4	5	4.06	4	5
Regulating Services	4.39	5	5	4.69	5	5
Natural habitat	4.46	5	5	4.69	5	5
Aquifer conservation	4.37	5	5	4.77	5	5
Soil quality	4.31	5	5	4.58	5	5
Air purification	4.61	5	5	4.85	5	5
Climate regulation	4.19	5	5	4.55	5	5
Cultural Services	4.26	5	5	4.32	5	5
Tourism	4.26	5	5	4.31	5	5
Natural and cultural heritage	4.31	5	5	4.42	5	5
Sense of place	4.28	5	5	4.31	5	5
Aesthetic values of the environment	4.53	5	5	4.55	5	5
Recreational activities	4.17	5	5	4.27	5	5
Environmental education and awareness	4.00	4	5	4.07	4	5

Note: M=Mean; Q2= Median; Mo=Mode.

Table 6. Valuation of ESs by age group

	18-35 years old (n = 48)			36-45 years old (n = 52)			46-55 years old (n = 34)			56-65 years old (n = 31)			More than 65 years old (n = 29)		
	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo	M	Q2	Mo
Provisioning Services	4.08	4	5	4.17	5	5	4.10	5	5	3.92	4	5	3.94	5	5
Food from agriculture	4.71	5	5	4.81	5	5	4.82	5	5	4.65	5	5	4.55	5	5
Food for livestock	4.29	5	5	4.44	5	5	4.55	5	5	4.29	5	5	4.31	5	5
Wildlife for hunting	3.85	4	5	3.48	4	4	3.27	4	4	3.48	4	4	3.48	4	5
Raw materials	3.90	4	5	3.96	4	5	4.00	5	5	3.81	4	5	3.66	4	5
Nontimber forest products	3.73	4	5	4.17	4	5	3.88	4	5	3.39	4	5	3.72	4	5
Regulating Services	4.53	5	5	4.68	5	5	4.66	5	5	4.50	5	5	4.16	5	5
Natural habitat	4.71	5	5	4.63	5	5	4.42	5	5	4.65	5	5	4.34	5	5
Aquifer conservation	4.48	5	5	4.69	5	5	4.82	5	5	4.58	5	5	4.17	5	5
Soil quality	4.48	5	5	4.56	5	5	4.70	5	5	4.42	5	5	3.90	5	5
Air purification	4.71	5	5	4.85	5	5	4.79	5	5	4.65	5	5	4.55	5	5
Climate regulation	4.29	5	5	4.65	5	5	4.64	5	5	4.16	5	5	3.86	4	5
Cultural Services	4.31	5	5	4.29	5	5	4.37	5	5	4.25	5	5	4.17	5	5
Tourism	4.31	5	5	4.25	5	5	4.30	4	4	4.23	5	5	4.31	5	5
Natural and cultural heritage	4.48	5	5	4.35	5	5	4.61	5	5	4.19	5	5	4.10	5	5
Sense of place	4.38	5	5	4.46	5	5	4.36	5	5	4.13	5	5	3.93	5	5
Aesthetic values of the environment	4.46	5	5	4.44	5	5	4.58	5	5	4.68	5	5	4.62	5	5
Recreational activities	4.19	4	5	4.27	5	5	4.18	5	5	4.13	4	4	4.31	5	5
Environmental education and awareness	4.04	4	5	4.00	5	5	4.18	4	5	4.16	5	5	3.76	4	5

Note: M=Mean; Q2= Median; Mo=Mode.

Table 7. Valuation of ESs by educational level

	Basic (n = 74)				Intermediate (n = 65)				Higher (n = 55)			
	M	Q2	Mo		M	Q2	Mo		M	Q2	Mo	
Provisioning Services	4.11	5	5		4.07	5	5		4.00	4	5	
Food from agriculture	4.73	5	5		4.67	5	5		4.75	5	5	
Food for livestock	4.45	5	5		4.52	5	5		4.14	5	5	
Wildlife for hunting	3.66	4	5		3.39	4	5		3.54	4	4	
Raw materials	4.07	5	5		3.95	4	5		3.57	4	4	
Nontimber forest products	3.66	4	5		3.86	4	5		4.00	4	5	
Regulating Services	4.40	5	5		4.64	5	5		4.60	5	5	
Natural habitat	4.54	5	5		4.61	5	5		4.59	5	5	
Aquifer conservation	4.43	5	5		4.63	5	5		4.68	5	5	
Soil quality	4.19	5	5		4.59	5	5		4.61	5	5	
Air purification	4.68	5	5		4.89	5	5		4.61	5	5	
Climate regulation	4.18	5	5		4.47	5	5		4.50	5	5	
Cultural Services	4.31	5	5		4.31	5	5		4.25	5	5	
Tourism	4.42	5	5		4.28	5	5		4.11	4	5	
Natural and cultural heritage	4.31	5	5		4.48	5	5		4.30	5	5	
Sense of place	4.19	5	5		4.33	5	5		4.39	5	5	
Aesthetic values of the environment	4.62	5	5		4.41	5	5		4.57	5	5	
Recreational activities	4.36	5	5		4.17	5	5		4.09	4	5	
Environmental education and awareness	3.93	4	5		4.16	5	5		4.04	5	5	

Note: M=Mean; Q2= Median; Mo=Mode.

Table 8. P values of the Kruskal–Wallis test

	Experts-General Public	Stakeholders	Study area	Gender	Age	Education level
Provisioning Services	0.401	0.607	0.009***	0.229	0.648	0.610
Food from agriculture	0.918	0.514	0.328	0.435	0.774	0.114
Food for livestock	0.490	0.409	0.059*	0.095*	0.723	0.144
Wildlife for hunting	0.568	0.094*	0.002***	0.021**	0.204	0.689
Raw materials	0.684	0.009***	<0.001***	0.129	0.764	0.049**
Nontimber forest products	0.400	0.457	0.529	0.008***	0.170	0.269
Regulating Services	0.619	0.019**	0.701	0.001***	0.035**	0.067*
Natural habitat	0.920	0.047**	0.104	0.212	0.303	0.731
Aquifer conservation	0.815	0.306	0.656	0.004*	0.021**	0.062*
Soil quality	0.114	0.100	0.206	0.048*	0.118	0.110
Air purification	0.079*	0.039**	0.005***	0.060*	0.522	0.226
Climate regulation	0.952	0.105	0.951	0.032**	0.007***	0.043**
Cultural Services	0.276	0.269	0.002***	0.573	0.984	0.677
Tourism	0.292	<0.001***	<0.001***	0.898	0.847	0.129
Natural and cultural heritage	0.208	0.091*	<0.001***	0.834	0.335	0.896
Sense of place	0.955	0.486	0.174	0.831	0.336	0.425
Aesthetic values of the environment	0.515	0.683	0.113	0.333	0.126	0.033**
Recreational activities	0.622	0.672	0.234	0.721	0.681	0.140
Environmental education and awareness	0.054*	0.558	0.440*	0.980	0.903	0.506

Note: M=Mean; Q2= Median; Mo=Mode.

Figure 1. Natural Park Sierra María-Los Vélez and the Region of Los Vélez

