J. Mt. Sci. (2022) 19(1): 211-227 e-mail: jms@imde.ac.cn http://jms.imde.ac.cn
https://doi.org/10.1007/s11629-021-6911-3

Original Article

A regionalized IO-model to value seasonal recreational ecosystem services in a mountain National Park in Spain

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Citation: Martin Barroso V, de Castro-Pardo M, Fernández Martínez P, Azevedo JC (2022) A regionalized IO-model to value seasonal recreational ecosystem services in a mountain National Park in Spain. Journal of Mountain Science 19(1) https://doi.org/10.1007/s11629-021-6911-3

Abstract: Recreational Ecosystem Services (RES) are among the most frequently evaluated ecosystem services. RES are seen as a major opportunity for sustainable development in areas of high ecological value resulting from the presence of emblematic species, habitats or scenery, often integrated in conservation areas, in particular in mountain areas affected by depopulation, rising environmental risks and poverty. Economically, the assessment of RES has been based on Contingent Valuation and Choice Experiments, methods with limitations related to their subjectivity. Alternatively, Input-Output (IO) models provide a very accurate and effective way of valuation of RES with regional information regarding interindustry transactions. Whilst data on nature tourist expenditure may be only available annually, tourism inflows have a strong seasonal behavior, which impacts the profitability of several local economic activities. In this paper, we firstly constructed a novel regionalized IO-model based on Cross-Industry Location Quotients using employment data and, secondly, based on Monte Carlo simulation, we estimated nature tourist expenditure monthly using data on nature tourism inflows. This method allowed for a more precise RES evaluation, estimating direct, indirect and induced monthly economic impacts of nature-based tourism. The method was applied to the Ordesa and Monte Perdido (OMP) National Park in the Spanish Pyrenees. To estimate the average tourist expenditure, we collected and analyzed spending on commerce, hospitality and restaurants, leisure, and transport of 385 visitors. Results suggest that using a regionalized IO model leads to a considerable reduction of over-estimation of the economic impact of tourist expenditure estimated by conventional methods. Taking into consideration the direct, indirect and induced effects of tourist expenditure in 2016-2018, the total annual output effect in the OMP National Park amounted to

Received: 25-May-2021
1st Revision: 24-Jul-2021
2nd Revision: 01-Oct-2021
Accepted: 22-Nov-2021

€208.8 million, while the total income effect amounted to €86.29 million. Also, a total of 2,429 jobs were created which indicates that for each thousand annual visitors to the National Park, 3.8 jobs are created in the surrounding area. Overall, the proposed methodology can be easily applied to the remaining National Parks in Spain or other regions in the world, making it a valuable tool to estimate the value of RES in areas affects by strong seasonality, to set priorities and support regional policies for mountain sustainable development.

Keywords: Input-Output; Monte Carlo Simulation; Location quotients; Recreational Ecosystem Services; Nature tourism; Sustainable mountain development

1 Introduction

European mountain regions have been facing increasing depopulation in the last decades (Kohler et al. 2017; Sauter et al. 2019). In Spain, rural depopulation during the 20th century has also been an intense process, for example in the mountain areas of Aragon and Castilla-León where several villages are now uninhabited (Pinilla et al. 2008; Collantes et al. 2014). In mountain areas, depopulation implies both demographic and conservation challenges. The demographic challenge derives mainly from migration of active population to urban centers and aging. Since the beginning of the 21st century, transnational labour mobility in European rural areas has promoted a migration turnaround resulting in a deceleration of local depopulation (Pinilla et al. 2008; Rye 2018). However, this process is far from compensating the migratory deficit in these regions. Mountain regions in Spain and the rest of Europe present extremely low demographic density (Viñas 2019) and the trend is expected to persist in the years to come.

The nature conservation challenge involves problems related to biodiversity loss and changes in the supply of ecosystem services, which are direct consequences of land abandonment driven by depopulation. One of the most critical effects of abandonment in mountain areas is an increase in wildfire hazard (Azevedo et al. 2011; Pais et al. 2020). Although many ecosystem services are benefited by depopulation/abandonment, these processes cause fire risk in mountain areas to increase, in particular in the Mediterranean region, threatening the growing supply of ecosystem services in abandoned landscapes (Sil et al. 2016; Vukomanovic and Steelman 2019).

In addition to depopulation related problems, poverty is often present in rural and mountain communities around the world. Although poverty reduction is an overarching development goal (UNDP 2020), people in rural and mountainous regions suffer from multidimensional poverty (Mohanty et al. 2018). The International Fund for Agricultural Development (IFAD 2001) estimated that over 60% of the poor will still be in rural areas in 2025. Moreover, people living in mountainous regions are more vulnerable and more likely to experience multiple deprivation, assessed by low incomes and basic services as water, energy and sanitation, non-farm employment, poor accessibility, and vulnerability to environmental change (Mohanty et al. 2018). In South Europe, specific policy measures for mountain regions have been implemented to provide compensation for disadvantages derived from low productivity of land combined with small farm size. Despite efforts of some relevant compensation policies, such as the EU's Common Agricultural Policy (CAP), income in mountain areas remains much lower than in lowlands (Zasada and Piorr 2015).

Depopulation, rising environmental risks and poverty can be substantially mitigated in regions of high ecological value. Nature-based tourism provides a lifeguard to economic and social development in regions where (almost) the only income is generated by visitors attracted by natural amenity values, such as emblematic species, habitats or scenery, often integrated in conservation areas. Nature recreation can be a relevant source of income in communities located in protected areas. The most recent assessment regarding the economic impact generated by visits to protected areas around the world was provided by Balmford et al. (2015). They estimated nearly 8 billion visits a year that generate around US$600 billion/year in direct in-country expenditure and US$250 billion/year in consumer surplus. Consequently, demographic-related problems, when promoting degradation, can jeopardize biodiveristy conservation and the potential sustainable development on these regions whose high ecological value is its only chance for development (Fernández et al. 2020).

In this context, Recreational Ecosystem Services (RES) gain special relevance to the maintenance and sustainable development of mountain communities. RES are, broadly, the benefits that people obtain from landscapes and the natural environment through physical and psychological and emotional well-being (Hermes et al. 2018). RES are included in the class/section of Cultural Ecosystem Services both in the Millennium Ecosystem Systems Assessment (MEA 2005) and the Common International Classification of Ecosystem Services – CICES (Haines-Young and Potschin 2018) frameworks. RES are among the most popular ecosystem services in research and management communities, being one of the most often assessed ecosystem services (Czúcz et al. 2018).

The valuation of RES emphasizes the high positive economic impact of well-preserved natural sites on local communities (Armsworth et al. 2007). The economic assessment of ecosystem services has been an important research and policy topic in the last decades that, despite limitations, has revealed to be a very useful tool to stress the need to foster nature conservation (de Castro-Pardo 2019). Driven by the accelerated decline of ecosystem services due to land use change and ecosystem degradation, a high number of studies directed to valuing ecosystem services have been carried out applying a diversity of approaches and methods. RES in mountainous areas have been valued mainly using contingent valuation, travel costs and choice experiment methods. Rewitzer et al. (2017) and Faccioni et al. (2019) applied discrete choice experiments to valuing RES in mountain ecosystems. The former valued cultural ecosystem services in the Swiss Alps and the latter ranked and valued the most important functions of agroecosystems, dairy livestock systems and permanent crops in the Italian Alps, according to the views of population in three policy scenarios. Bernués et al. (2014) applied contingent valuation and discrete choice experiments in Mediterranean mountain agroecosystems in the Aragón region (Sierra y Cañones de Guara) in Spain. They carried out deliberative processes to identify ecosystem services in the study area and collected the preferences of farmers and citizens regarding them. They dealt mainly with cultural services, such as landscape aesthetics and recreation, supporting services, such as biodiversity maintenance, and some regulating services, particularly fire risk prevention. Grigorov and Assenov (2015) applied contingent valuation to assess the economic value of RES in Mala Planina (Bulgaria). Mazzocchi and Ruggeri (2019) collected the preferences of tourists regarding mountain pastures to estimate their willingness to pay for Alpine pastures maintenance. Travel cost methods have also been used to this purpose. Mayer and Woltering (2018) applied this method to valuing RES in 15 German National Parks and Soe Zin et al. (2019) compared two methods to quantify the value of RES in Popa Mountain National Park, Myanmar, using the travel cost method and the Toolkit for Ecosystem Service Site-based Assessment (TESSA).

Some studies estimated the value of RES through the incomes generated by nature-based tourism.

Remme et al. (2015) calculated the average tourist expenditure in the province of Lindburg, Netherlands, to value RES as resource rent generated by recreation in nature. Popa et al. (2016) estimated the value of RES in Maramures Mountains in Romania based on the number of visitors, the percentage of tourists with longer stays and the total expenditure per visit, comprised of direct spending on hotels and meals. Ivanova et al. (2016) selected variables such as the number and capacity of accommodation establishments and site visitation by market price to value RES in the Chepelare Municipality, Bulgaria.

All the methods above have been useful to assess the economic direct impact of recreation, but they do not evaluate the indirect impact of recreation activities on local communities. In order to improve these proxies, some studies have been conducted using alternative methods based on multipliers to quantify direct, indirect and induced economic effects separately. One of these methods is the Input-Output (IO) analysis. Poudel et al. (2017) used IO analysis to estimate economic contributions of wildlife watching recreation expenditures in the US South. Orens and Seidl (2009) used a mixed method based on travel cost, contingent valuation and IO analysis to calculate the economic impact of winter tourism in the Rocky Mountain West, USA. They used tourists' stated expenditure patterns to derive total, direct, indirect and induced impacts of private land use change on the local economy using a county level IO analysis.

The Outspan Group (2011) valued the economic impact of parks in Canada in C$466.8 million with a model applied at the provincial and territorial levels. Souza et al. (2019) used a Money Generation Model (MGM) with national multipliers focused mainly on direct effects with particular attention to income and value added finding that 8 million visitors of 325 federal protected areas (79 million ha) in Brazil contributed to US$1.2 billion in total sales in 2015. Some works solved the problem of the lack of regional information applying IO or MGM models with regionalized multipliers to assess the economic impact of nature tourism. As an example, the U.S. National Park Service reported in 2015, 307 million of visits along with US$16.9 billion in spending in outdoor recreation, using IMPLAN software based on an IO model that uses regionalized multipliers (Cullinane and Koontz 2016).

Although IO models are capable of generating information regarding the overall economic impact of RES in local economies, regional input IO tables are an essential prerequisite for impact assessment. These tables can be built through survey, non-survey and hybrid methods (Lampiris et al. 2019). Non-survey and hybrid are the most applied methods due to their capacity to solve a high number of limitations of survey methods related to the complexity, cost, time-consumption and confidence of the data acquisition processes. In this line, some of the most useful non-survey methods used to regionalize IO tables are based on Regional Multipliers (Siltanen 2017) and Location Quotients (LQs) (Lampiris et al. 2019). Some studies applied a proxy based on MGM that estimate economic impacts as the product of visits, spending per visit and regional economic multipliers (Kumar and Hussain 2014; Siltanen 2017; Souza et al. 2019).

LQs have been used also to construct regional IO tables to value the economic impact of some activities in mountain areas. Huhtala (2007) applied LQ to construct regional IO tables to assess the local economic impacts of tourism in a Finnish National Park. Flegg and Tohmo (2013) modified original LQs adjusting the original quotients with a log-function and a parameter representing regional imports, validated the model and applied it to 20 regions in Finland. Liu et al. (2018) proposed a basin-scale hydroeconomic Input-Output model to calculate water consumption by producers and consumers in the Heihe river basin, China, using LQs. Romero et al. (2019) applied LQs to the assessment of the impact of tourism in a province in the Andean mountains of North-Western Argentina. These studies illustrate the need to adjust traditional IO models according to particular regional characteristics in order to generate the most rigorous information, when local data is missing.

Addressing the vulnerability of local communities in protected mountain areas affected by high levels of depopulation but, simultaneously, of enormous importance in terms of supply of ecosystem services, requires useful and rigorous information and the development of methods and tools able to support decision-making processes. Mengis et al. (2020) presented a systematic literature review on ecosystem services research in mountain regions where they observed that gaps were "methodological uncertainties, lack of data and study on its interplay". Blattert et al. (2017) remarked the importance of decision support systems to the efficient management of mountain sites. Despite the importance of these tools, Grêt-Regamey et al. (2017) found that the most specific case study applications of decision support tools to operationalize ecosystem services were forests or cultivated land. On the contrary, only 4% of case studies were conducted in mountain ecosystems.

In this context, we developed a novel regionalized and seasonal approach to estimate the value of RES based on the assessment of the impact of visitor expending, that we applied in the Ordesa and Monte Perdido (OMP) National Park, a mountain area of very high ecological value in Spain. In the analysis we used a regionalized IO table, through the use of Cross-Industry Location Quotients (CILQ) calculated from regional data on the number of workers affiliated to the Spanish Social Security System by sector of activity at the two-digit level. Furthermore, given the strong seasonality of nature-based tourism in the communities around the National Park, an estimation of monthly visitor spending was obtained following a Monte Carlo approach in which, repeatedly, spending data was split into twelve random samples and the proportion for each sample was calculated using the monthly distribution of visitors to the National Park.

2 Materials and Methods

In this paper we used the (Input-Output) IO approach to value RES and to analyze the economic impact of nature tourism in the Ordesa and Monte Perdido (OMP) National Park in Spain. The approach followed allows us to model the recursive effects of the injection of cash into the local economy through visitor spending on output, income and employment. Visitor spending generates an increase in the final demand of several local economic sectors. This increase, which also translates into income (both for employers and employees) and employment, is known as the direct effect. To satisfy the increase in final demand, those sectors must increase their input purchases from their suppliers increasing the final demand on their suppliers, and so on down the supply chain. This is known as the indirect effect. Lastly, as a result of the direct and indirect effects, the level of household income increases and a proportion of this additional income is spent on final goods and services produced in part by local economic sectors. This is the so-called induced effect. Indirect and induced effects can be calculated, respectively, through Type I and Type II IO multipliers.

The proposed analysis requires in the first place data on the total number of visitors per year and on the amount and nature of visitor expenditure. The Spanish Network of National Parks provides annual and monthly data on the number of visitors by National Park for the 1996-2018 period. However, due to the lack of official data disaggregated at local level, total visitor spending was estimated by means of a face-to-face survey. Secondly, to quantify the impact of spending, the IO multipliers were calculated from the information provided by IO tables.

2.1 Study area

The OMP National Park is located in the north of Spain (Fig. 1), in the autonomous community of Aragón (NUTS2), province of Huesca (NUTS3), along the border between Spain and France, covering a total area of 156.9 km². It received the designation of National Park on 16 August 1918, so that it is the first park to be established in Spain and one of the earliest in the world. The National Park classification overlaps with many other international conservation figures, such as Biosphere Reserve (since 1977), area of Special Protection (SPA) under the Birds Directive (1988) and UNESCO World Heritage site (1997). The socioeconomic area of influence comprises six municipalities belonging of the NUTS4 region of Sobrarbe: Bielsa, Broto, Fanlo, Puertolas, Tella-Sin and Torla-Ordesa. The latest census indicates that more than 1.8 thousand people lives in this area of influence. Tourism is the main driving force behind the economy in the area, together with other services and livestock production, to a lesser extent. The park receives around 600 thousand visitors annually, of which over 50% are summertime visitors. According

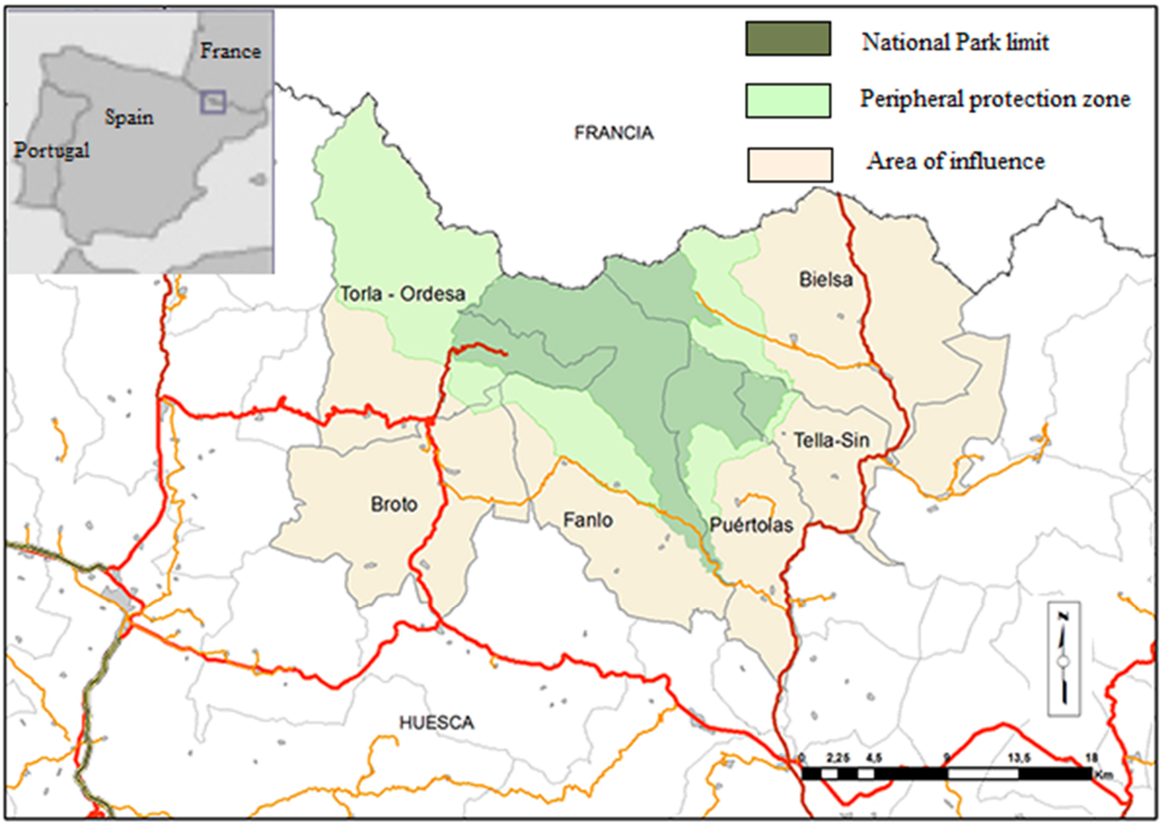

Fig. 1 Location of the Ordesa and Monte Perdido National Park in the Huesca province of Spain with regions with indication of the peripheral protection zone and the socioeconomic area of influence of the park.

to the Statistics Institute of Aragon, the number of bed places in tourist accommodation establishments in the six municipalities of the socioeconomic area of influence exceeded 8,600 in 2018. Campsites and hotels offered 58% and 22% of total bed places, respectively.

The mountain landscape of the National Park is dominated by the Treserols limestone massif, the highest of his kind in Europe, and a relief shaped by the effect of powerful glaciers. Altitude ranges from 700 (Bellós River) to 3348 m asl (Monte Perdido). Due to the presence of strong karstic erosion which avoids water flowing on the surface, there are no large lake formations in the park.

The traditional rural landscape of the OMP was formed by grazing systems and a rural/pastoralism way of life that was predominant in European mountain regions but that has been preserved only on the Spanish side of the Pyrenees (de Castro-Pardo et al. 2020). The cultural landscape is formed by farms, villages, high-altitude pastures and mountain paths. Although livestock persists, the most relevant economic activity today is nature-based tourism. The main challenges of the area are related with depopulation. Population density in the municipalities comprising the OMP is currently lower than 4 inhabitants/km² (García et al. 2012).

2.2 Visitors spending: the survey

In order to estimate visitor spending through an on-site survey, a questionnaire administered by interviewers was previously designed in a three-step process. In the first step we made a review of previous survey-based studies estimating visitor spending in protected areas, in order to design a first draft of the questionnaire (Alló et al. 2010; Mayer et al. 2010; Mayer and Woltering 2018; OAPN 2011; Rosado-Cubero et al. 2021; RPN 2014; Saayman et al. 2009; Saayman et al. 2013; Siltanen 2017). Furthermore, several works on questionnaire design and survey methodology were consulted to ensure that the survey yielded meaningful results (Casas et al. 2003; Krosnick 2018; Saris and Gallhofer 2007). In the second step, we had various meetings with the administration staff and other stakeholders related to the National Park where the draft was presented and discussed. In these meetings we obtained valuable information on other topics relevant for the survey, such as the characteristics of visitors or the main access points to the National Park. In the third step, a pretest was carried where twelve people were surveyed so as to detect possible deficiencies. The final version of the questionnaire consisted of 21 questions classified into three groups. The first group included questions related to the socioeconomic characteristics of the visitors where the following information was collected: age, sex, place of residence, type of transport, educational level, occupation, income, and number and age of all members in the visitor group. The second set included questions related to the characteristics of the visit, basically travel motivation, affinity with the National Park, visitor type (one day stay or overnight visitor), duration of the stay, type of accommodation, and projected recreational activities. Questions in the third group focused primarily on the quantity and structure of visitor expenditure. Specifically, respondents were asked to provide information on the daily expenditure by person in the group in the following items: accommodation, bars and restaurants, grocery, other stores, recreation and leisure, and transport. The questionnaire is available in Appendix 1.

The survey was conducted during two interview periods: June 2019 and July-August 2019. Respondents were randomly selected among visitors of the National Park with a minimum age of 18 years. The interview locations were the main access points to the park, selected in cooperation with the National Park administration. Considering the annual mean number of visitors during the period 2016-2018 and with the purpose to ensure a sufficiently large sample size so as to achieve a maximum sample error of 5% (Taherdoost 2017), a goal to collect at least 300 questionnaires was set, resulting in a total of 403 questionnaires from which 385 were valid (95.5%).

From the information on daily expenditure by visitor collected in the survey, an estimation of annual total visitor spending by component was calculated as follows:

$$VS_j = \sum_i vs_{ij} \times vgs_i \times vef \qquad (1)$$

where vs_{ij} is the spending amount of the visitor respondent i in component j, vgs_i is the group size of visitor i including the respondent himself and the companions over 13 years of age, and vef is the expansion factor. To avoid over-estimation of visitor spending, younger children (13 years and under) were not included in the group size since their expenditure is rather small as compared to adults. The expansion factor was obtained as

$$vef = \frac{Annual\ number\ of\ visitors\ (above\ 13)}{Number\ of\ survey\ respondents\ (above\ 18)} \quad (2)$$

The annual number of visitors over 13 years of age was calculated as the average of available official data for years 2016-2018 (MITECO 2020).

2.3 Estimating the economic impact: the IO multipliers

In order to measure the direct, indirect and induced effects of visitor spending, we use IO multipliers derived from IO tables (Leontief 1986). Fig. 2 shows a very general and simplified representation of an IO table where three different quadrants or matrices are observed. The first (*X*) is an intermediate consumption matrix which records the interindustry transactions. In particular, the *ith* row of *X* registers the goods and services sales of sector *i* to each sector in the economy, while the *jth* column registers the inputs required by sector *j* from each sector in the economy. The second (*Y*) is a final demand matrix which shows the final destination of goods and services, distinguishing between private consumption, public consumption, gross capital formation and exports. The third (*Z*) is a matrix of primary inputs containing the requirements of each economic sector for primary inputs. The quadrant includes the gross value added of each sector (compensation of employees, gross operation surplus and taxes on production) and imports.

The fundamental accounting relationship in the IO table states that the sum of output used as input in sectors and output for final consumption is equal to total produced output. Hence, the IO table can be expressed as a system of linear equations containing the accounting equations for each sector in the economy:

X	*Interindustry transactions sector i*	*Interindustry transactions sector j* $\begin{pmatrix} x_{11} & x_{12} & — & x_{1n} \\ x_{21} & x_{22} & — & x_{2n} \\ \mid & \mid & & \mid \\ x_{n1} & x_{n2} & — & x_{nn} \end{pmatrix}$	*Y*	*Final demand* $\begin{pmatrix} Y_1 \\ Y_2 \\ \mid \\ Y_n \end{pmatrix}$
Z	*Primary inputs*	$\begin{pmatrix} Z_1 & Z_2 & — & Z_n \end{pmatrix}$		

Fig. 2 A general IO table representation.

$$\begin{aligned} X_1 &= x_{11} + x_{12} + \cdots + x_{1n} + Y_1 \\ X_2 &= x_{21} + x_{22} + \cdots + x_{2n} + Y_2 \\ &\ldots \ldots \ldots \ldots \ldots \ldots \\ X_n &= x_{n1} + x_{n2} + \cdots + x_{nn} + Y_n \end{aligned} \quad (3)$$

where X_i is total output from sector i, x_{ij} is the value of input required by sector j from sector i, and Y_i denotes the final demand in sector i.

The first step to obtain IO multipliers from the IO table for impact analysis is to convert the monetary values of the intermediate consumption matrix *X*, into a matrix *A* of technical coefficients. The technical coefficients are calculated by dividing the different elements of the intermediate consumption matrix *X* by the total production of sector *j*:

$$a_{ij} = \frac{x_{ij}}{X_i} \quad (2)$$

Each technical coefficient represents de proportion of inputs required from sector *i* to produce a unit in sector *j*. Combining Eq. (3) and (4) results in the following system of equations,

$$\begin{aligned} X_1 &= a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n + Y_1 \\ X_2 &= a_{21}X_1 + a_{22}X_2 + \cdots + a_{2n}X_n + Y_2 \\ &\ldots \ldots \ldots \ldots \ldots \ldots . \\ X_n &= a_{n1}X_1 + a_{n2}X_2 + \cdots + a_{nn}X_n + Y_n \end{aligned} \quad (5)$$

which in matrix form can be expressed as:

$$X = AX + Y \quad (6)$$

Solving for *Y*, we obtain:

$$X = (I - A)^{-1}Y \ \rightarrow X = BY\ ; B = (I - A)^{-1} \quad (7)$$

where I is the identity matrix and B denotes the Leontief inverse. Each element of this matrix b_{ij} indicates the increase in the production of sector *i* that is needed to satisfy an increase of one unit in the final demand of sector *j*.

If we include the domestic economies in the model as an additional sector, by adding a row with the compensation of employees and a column with the consumption of resident households, an extended technical coefficients matrix (AE) is obtained. After that, the extended inverse Leontief matrix can be calculated as follows:

$$B_E = (I - A_E)^{-1} \quad (8)$$

At this point, the Type I output (OM), income (IM) and employment (EM) multipliers for each sector *j* can be obtained straightforwardly by:

$$OM_j(Type\ I) = \sum_i b_{ij}$$
$$IM_j(Type\ I) = \sum_i v_i b_{ij} \quad (9)$$
$$EM_j(Type\ I) = \sum_i l_i b_{ij}$$

where v_i is the ratio of value added to output in sector i, which measures the capacity of income generation by unit of output by sector i, and l_i is the ratio of employment to output in sector i, which measures the capacity of employment generation (measured in terms of full-time equivalent employment, FTE) by unit of output by sector i. The Type I output (income, employment) multiplier of sector j shows the amount of direct plus indirect output (income, employment) created in the overall sectors of the economy created by an additional monetary unit of final demand in sector j.

Similarly, and making use of the elements of the extended inverse Leontief matrix, Type II output (OM), income (IM) and employment (EM) multipliers for each sector j are calculated as:

$$OM_j(Type\ II) = \sum_i b^E_{ij}$$
$$IM_j(Type\ II) = \sum_i v_i b^E_{ij} \quad (10)$$
$$EM_j(Type\ II) = \sum_i l_j b^E_{ij}$$

The Type II output (income, employment) multiplier of sector j shows the amount of direct plus indirect plus induced output (income, employment) created in the overall sectors of the economy created by an additional monetary unit of final demand in sector j.

2.4 Regionalizing the IO table

Methods to obtain regional IO tables can be broadly divided into survey, non-survey, and hybrid methods. In survey methods, regional IO tables are constructed from the information obtained from surveys to different economic agents from the region. In non-survey methods, regional IO tables are obtained through the modification of national IO tables, while in hybrid methods a mixed of survey and non-survey approaches are followed.

While the survey approach is probably the best method to obtain the required information to construct a regional IO table, it can be in many cases a prohibitively expensive and time-consuming process, hence non-survey approaches were used in our research. In this sense, a regional matrix of technical coefficients was constructed by adjusting the national matrix of technical coefficients (A) from the national IO table in order to take into account the potential for satisfying input requirements regionally. Among the existing approaches, a straightforward way of regionalizing a national IO table is to use the well-known LQ method (Mayer and Pleeter 1975; Richardson 1972). The purpose of these quotients is to quantify the specialization of a particular industry or sector within a certain territory (a region, for example) compared with a larger geographic area (such a nation) (Lamonica and Chelli 2017). The comparison is carried out by using some measure of economic activity (e.g. output, employment, value added, or personal income) by industry or sector, available both at the sub geographic and reference levels. The approach is based on the assumption that the production technologies are the same at different geographical levels, but the technical or input coefficients differ in the extent to which several goods and services are not produced in the sub geographic area and must be imported from other areas (Lamonica and Chelli 2017; Lampiris et al. 2019). Among the various LQ methods proposed in the literature (Miller and Blair, 2009), the employment-based Cross-Industry Location Quotients (CILQ) was used in our paper. Against simple location quotients, CILQ allows to take into consideration the relative importance of both producer and purchaser sectors, rather than only the size of purchaser sectors (Flegg et al. 1995). Specifically, the CILQ for sector i and j, where sector i supplies inputs to sector j, is defined as:

$$\mathrm{CILQ}^R_{ij} = \left(\frac{E^R_i/E^N_i}{E^R_j/E^N_j}\right) \quad (11)$$

where E^R_i, E^N_i, E^R_j and E^N_j are employment at the regional and national level in sectors i and j, respectively.

After calculating CILQ, regional technical coefficients are obtained through:

$$a^R_{ij} = \begin{cases} a_{ij} CILQ^R_{ij} & if \quad CILQ^R_{ij} < 1 \\ a_{ij} & if \quad CILQ^R_{ij} \geq 1 \end{cases} \quad (12)$$

As it can be noted from Eq. (11) and Eq. (12) that, if regional employment relative to national employment in sector i is larger than in sector j, we can assume that all input needs of sector j from sector i can be supplied within the region. In this case $CILQ \geq 1$, and the national technical coefficients are not adjusted. Similarly, if in sector i regional employment relative to national employment is larger than in sector j, we can assume that some input needs of sector j cannot be totally supplied by regional sector i, so that some inputs will have to be imported.

Using a non-regionalized IO model would lead to an over-estimation of the economic impact of tourism expenditure. As a measure of the error that would be committed, we calculated the differences (%) between output, income and employment multipliers of the non-regionalized and the regionalized IO model. It can be easily proven that differences in multipliers account for differences in total effects. Departing from the fact that the total effect is calculated as the product of the corresponding multiplier and the direct effect ($TE_j = M_jDE_j$), the difference in percentage between the total effect from the non-regionalized (TE^{NR}) IO model and from the regionalized (TE^R) model is obtained as follows:

$$\frac{TE_j^{NR}-TE_j^R}{TE_j^R}=\frac{M_j^{NR}DE_j-M_j^R DE_j}{M_j^R DE_j}=\frac{(M_j^{NR}-M_j^{NR})DE_j}{M_j^R DE_j}=\frac{M_j^{NR}-M_j^{NR}}{M_j^R} \quad (13)$$

where M^{NR} and M^R are the multipliers and DE^{NR} and DE^R the direct effects from the non-regionalized and regionalized model, respectively.

The main advantage of the regionalized methodology proposed in this study to value RES as opposed to the use of traditional IO models is the better fit of the estimates to the regional characteristics in a relatively easy manner.

2.5 Time disaggregation of visitors spending

In order to obtain an estimation of monthly visitor spending we followed a Monte Carlo approach so that, repeatedly, we split the survey data into twelve random samples (one for each month), where the proportion for each sample is calculated using the monthly distribution of visitors to the National Park. Simple random sampling was applied so that data subsets with a uniform distribution are selected randomly.

Formally, lets denote the total sample as T and the subset for month i as T_i. The probability of an individual x in the survey to be selected in the subset for month i is:

$$P(x\in T_i)=\frac{n_i}{n}=\frac{V_i}{V_T} \quad (14)$$

where n_i is the number of respondents selected in subset i, n is the total number of respondents, V_i the number of visitors to the National Park in month i and V_T the total annual number of visitors. Values for V_i and V_T are set using official monthly and annual data provided by the OMP National Park.

Once the selected number of iterations is reached, total visitor spending by component and month is calculated as the mean of all iterations. The Monte Carlo method allows to distribute the spending monthly while adding uncertainty in the analysis and providing the spending distribution function.

Taking into consideration the large concentration of visitors to the National Park in the summer season and the relatively high cost of on-site face-to-face surveys, we proposed the above methodology as a cost-efficient alternative to collecting surveys in each month. However, this procedure may generate misleading results if visitor spending varies significantly with seasons. For the OMP National Park, two types of visitors with possible different spending behavior were identified after several meetings with stakeholders related to the National Park such as OMP management personal, business associations, business owners, and climbing and mountaineering associations. The first type visits the OMP National Park mainly to rest, enjoy nature and do some hiking and walking (usually in family groups) and the second type visits the National Park to practice mountaineering and climbing. Despite both types of visitors being present in any season, the first type predominates during the summer season, while the second usually avoids visiting the National Park in periods when there are restrictions to access the National Park with private vehicles (August and Easter week). In the case of our research, conducting the survey not only in August but also at the beginning of June ensured a large sample size in both classes of visitors.

3 Results

3.1 Survey data

Table 1 presents data from the survey for main visitor characteristics as well as daily mean spending by visitor. Among visitors, 54% were male and 46% were female, while the mean age was 35.5 years. Mean group size was 2.9 persons, being two persons the most frequent group size, which accounts for 42.1% of visitors. Foreign visitors represented 15% of all visitors, among which 30.4% were French tourists. One-day visitor share was only 5.2%, while for those staying overnight the mean number of nights was 4.2. Among different accommodation types, hotel and similar, and camping and recreational vehicles (RV) were the preferred ones, representing 35.3% and 30.7% of visits, respectively. Furthermore, the survey results

Table 1 Visitor attributes and average spending based on data collected through survey (*n*=385) in the OMP National Park, Spain, in the summer of 2019.

Items		%	Average daily spending by visitor (€)						
			Total(a)	Component					
				Accom.	B&R	Groc.	Other	R&L	Trans.
Total sample		100	64.1	29.9	21.2	7.4	2.3	3.3	53.7
Sex	Male	54	64.1	28.6	22.1	7.1	2.7	3.6	54.5
	Female	46	64.5	32.6	19.7	8.0	1.5	2.7	52.3
Age	below 30 years	31.9	50.7	21.6	16.8	6.6	3.4	2.3	66.9
	30-39 years	21.6	53.4	26.3	18.4	6.3	0.5	1.9	48.7
	40-49 years	25.3	67.6	30.4	21.7	7.8	2.4	5.3	57.8
	50-59 years	13.0	78.5	39.0	26.4	8.9	1.3	2.9	45.3
	60 years and above	8.2	75.1	33.1	24.4	8.0	7.3	2.3	53.4
Nationality	Spanish	85	64.5	30.6	21.5	7.1	1.8	3.5	29.5
	Foreign	15	62.7	26.1	19.7	9.4	5.1	2.4	195.9
Visitor type	Day	5.2	28.5	0	18.8	4.5	4.2	1.0	79.5
	Overnight	94.8	66.2	31.6	21.4	7.6	2.2	3.4	52.3
Overnight stays	1	8.5	51.9	19.7	17.1	6.9	3.7	4.5	168.3
	2-3	42.7	67.4	33.9	23.5	6.2	2.2	1.6	63.4
	4-7	41.4	69.5	33.2	20.6	8.7	2.3	4.7	24.3
	more than 7	7.4	56.6	23.0	18.2	9.4	0.3	5.7	11.9

Notes: (a) Total excludes transport expenditure. Age and sex variables information includes respondent companions. Accom. = accommodation, B&R = bars and restaurants, Groc. = grocery, Other = other stores, R&L = recreation and leisure, Trans. = transport.

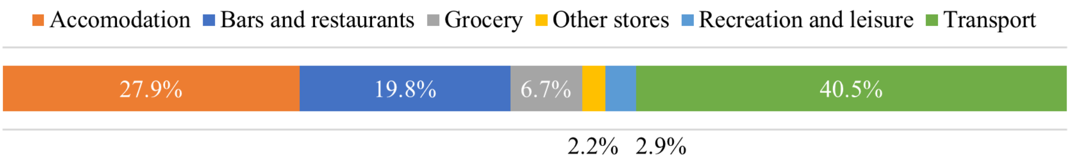

Fig. 3 Structure of visitor spending.

suggest that more than 45% were first-time visitors, while the preferred activity was hiking (54% of visitors).

Without considering spending on transportation, the average expenditure by visitor was €64.1 per day: €29.9 in accommodation, €21.2 in bars and restaurants, €9.7 in grocery and other stores and €3.3 in recreational and leisure activities. Differences in average spending between males and females, and between domestic and foreign visitors were in general low. However, it can be noticed that average expenditure increased with age, from €50.7 for those below 30 years of age, to €78.5 for visitors 50 to 59 years. Considering total visitor spending, apart from spending on transportation, which represents 40.5% of total spending, accommodation, and bars and restaurants made up the largest part of total visitor spending, with a share over total expenditure of 27.9% and 19.8%, respectively (Fig. 3). Spending on grocery stores represented 6.7% of total spending, while only 2.9% of expenditure was spent in recreational and leisure activities, and 2.2% in other stores.

These findings are in consonance with the tourist expenditure data available from the Resident Tourism Survey and the Tourist Expenditure Survey for 2018 prepared by the Spanish National Institute. More specifically, these surveys show that, for resident tourists in Spain, spending on accommodation and spending on bars and restaurants represent 26% and 28% of total spending, respectively, and 18% and 19% for non-residents tourists.

3.2 Estimating direct, indirect and induced effects from visitor spending

The calculation of IO multipliers was assessed on the basis of the 2005 (latest available) IO table of the autonomous community of Aragón. The symmetric table was used in order to compute the matrix of technical coefficients. To regionalize technical coefficients, data for Aragón and the region of Sobrarbe on the number of workers affiliated to the Spanish Social Security System by activity sector at the two-digit level was used. Specifically, averages for the period 2016-2018 were used to calculate the cross-industry location quotients. Furthermore, the correspondence between the classification of economic sectors in the Social Security records and in the IO table of Aragón was established. Multipliers for all available economic sectors were calculated. However, for the impact analysis of visitors spending, the following sectors were the only selected: accommodation, retail trade, recreational activities, and land transport.

Panel A on Table 2 presents Type I and Type II multipliers (output, income, employment) obtained by means of CILQ for Sobrarbe. For comparison purposes, Panel B on Table 2 shows the multipliers calculated from the IO table of Aragón. Percentage differences are rather large ranging from a 6.7% (Type I employment multiplier in retail trade) to a 25.4% (Type I output multiplier in accommodation), suggesting that using a non-regionalized IO model can lead to a considerable over-estimation of the economic impact.

Table 3 summarizes the estimated economic impact of visitors of the OMP National Park, in particular, the estimated direct impact of visitor spending on output, income and employment. Furthermore, it includes the estimated total impact using both Type I and Type II multipliers. The direct impact on output by expenditure component was estimated as the total visitor spending by component following Eq. (1) in section 2.2. Not considering transportation expenditure, total annual visitor spending amounted to more than €84 million. Expenditure on accommodation and bars and restaurants was the largest by far, summing up to near €67.5 million. The estimated total impact of visitor spending on output, considering the direct and the indirect effect, was €90.3 million, indicating that to satisfy visitor demand of good and services, input purchases for a value of €6.2 million had to be made. If we also take into account the impact on output of goods and services purchases by means of the income generated by visitor expenditure, the total impact on output was €208.8 million.

For each spending component, the direct impact on income was obtained applying to the output direct effect the ratio of value added to output in the corresponding economic sector since it is used as a proxy for the capacity of income generation by monetary unit of output. The estimated income directly due to visitor spending amounts to €71.29 million. If we, additionally, consider the indirect impact of visitor spending, the estimated income is €81.71 million, while taking into account also the induced effect results in an estimated total income of €86.28 million. The latter value suggests an annual income of near €29 thousand per capita for the municipalities in the area of influence of the OMP National Park.

Table 2 Output, income and employment multipliers.

Economic sector		Output		Income		Employment	
		Type I	Type II	Type I	Type II	Type I	Type II
PANEL A: Sobrarbe (CILQ)	Accommodation	1.0411	1.3593	0.5708	0.6031	0.0143	0.0149
	Retail trade	1.2024	1.5790	0.7371	0.7753	0.0313	0.0321
	Recreational activities	1.2027	1.5293	0.6314	0.6645	0.0122	0.0129
	Transport	1.2833	1.5905	0.5479	0.5791	0.0162	0.0168
PANEL B: Aragón	Accommodation	1.3060	1.6822	0.6618	0.7034	0.0164	0.0173
	Retail trade	1.4125	1.8628	0.8398	0.8896	0.0334	0.0344
	Recreational activities	1.3422	1.7222	0.7015	0.7436	0.0137	0.0146
	Transport	1.4495	1.8169	0.6241	0.6648	0.0176	0.0185

Table 3 Economic impact of visitor spending in the OMP National Park (RES value estimates are in bold).

Spending component	Output (thousand €)			Income (thousand €)			Employment (workers)		
	Direct	Total		Direct	Total		Direct	Total	
		Type I	Type II		Type I	Type II		Type I	Type II
Accommodation	39,433	41,052	53,600	21,935	22,509	23,783	551	577	591
Bars and restaurants	28,044	29,196	38,119	15,600	16,008	16,914	392	411	421
Grocery	9,469	11,386	14,952	6,027	6,980	7,342	274	296	304
Other stores	3,078	3,701	4,860	1,959	2,269	2,387	89	96	99
Recreation and leisure	4,122	4,958	6,304	2,159	2,603	2,740	40	50	53
Transport	57,198	73,403	90,974	23,613	31,340	33,124	702	925	962
TOTAL	141,344	163,697	**208,810**	71,293	81,707	86,289	2,048	2,356	**2,429**
TOTAL minus transport	84,146	90,293	117,835	47,680	50,368	53,165	1,345	1,431	1,467

To compute the number of jobs (in terms of FTE employment) directly created by visitor spending, we used the ratio of employment to output. The results show that annual visitor spending created a total of 2,048 jobs. Almost 41% of those jobs were created in the accommodation sector, approximately 30% in bars and restaurants. Retail trade (grocery and other stores) accounted for 26.9% of jobs created. The sum of direct and indirect effect implies 2,356 jobs, while the sum of direct, indirect and induced effect resulted in 2,429 jobs. Thus, for each thousand annual visitors to the OMP National Park, there are 3.8 jobs created within its influence area.

3.3 Time disaggregation of visitor spending

The monthly number of visitors to the OMP National Park in the 2016-2018 period (MITECO 2020; Fig. 4) presents a high level of seasonality with a large concentration of visitors during summer. The aggregated data for this period shows that not far below of a quarter of visitors are concentrated in the month of August (23%). Throughout the period, the number of visitors in August has remained close to 150,000, which implies an average daily inflow of more than 4,700 visitors. The month of July ranks second, as it concentrates on average 15.2% of annual visitors. The number of visitors in July has remained above 95,000 in the 2016-2018 period (average daily inflow around 3,100 visitors). September and June were the third and fourth most visited months, with 9.3% and 8.3% of total visitors, respectively. Together, these four months (June, July, August and September) contain, on average, 55.7% of annual visitors.

Based on the average monthly distribution of visitors during these three years (2016-2018), we disaggregated the annual visitor spending as proposed in section 1.3 (Fig. 5). A total of 100,000 iterations where made. As we would expect, the spending pattern is quite similar throughout the year and consistent with the global pattern (Fig. 5).

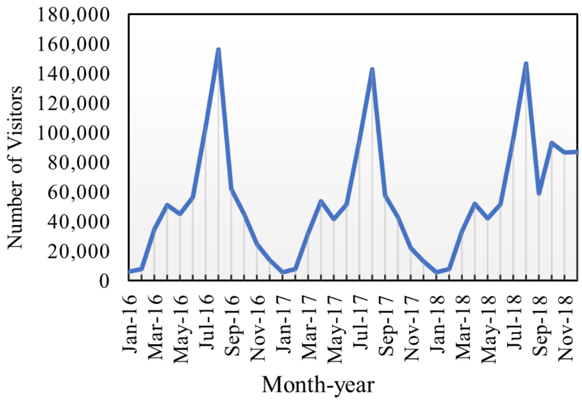

Fig. 4 Monthly number of visitors to the OMP National Park, 2016-2018. Source: MITECO (2020).

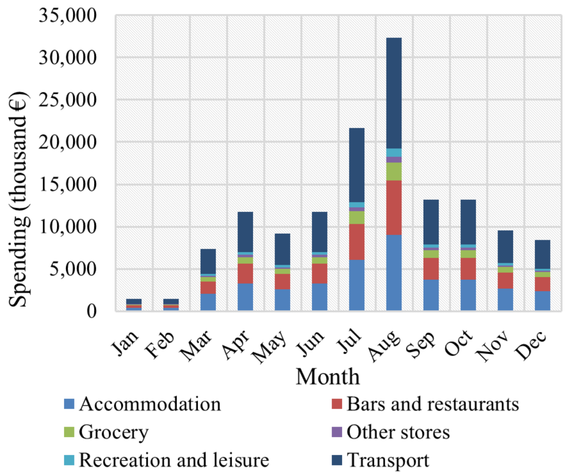

Fig. 5 Estimated monthly disaggregation of visitor spending by component .

4 Discussion

The valuation of RES in protected areas has been profusely studied in the last decade using mostly contingent valuation. This method has received criticism due to the fact that it operates under hypothetical scenarios. There are several studies that have applied different methodologies such as contingent value or travel cost methods in order to value RES in protected areas, although they usually warn about the large limitations of these methods. Martín-López et al (2011) valued RES in the Doñana National Park, a wetland located in the Huelva province of Spain (2,207 km²; 497,873 visitors/year), using this method and reaching estimates between €52 and €55 million. They also found that knowledge and individual behaviour influenced the willingness to pay for sustaining ecosystem services in Doñana. Travel cost methods work with real contexts, substantially avoiding the subjectivity problem of contingency valuation. However, travel costs do not take into account the economic impacts of tourism and recreation. De la Fuente and Vuelta (2004) in the Somiedo Natural Park, a mountain protected area located in Cantabria, Spain (391.6 km²; 75,000 visitors/year), found a difference of €692,250 between estimates of RES using contingent valuation (€471,000) and travel cost methods (€1,166,250).

IO models provide a wider framework to valuing RES when involving direct, indirect and induced economic impacts of nature tourism, although this method has not been directly used to valuing RES. One of the main limitations for the use of IO models in protected areas is the lack of regional information to calculate multipliers.

In this study, using an IO model, we were able to avoid the subjectivity of the estimation of the value of recreational ecosystem services in a mountain National Park in the north of Spain, analyzing the economic impact of visitors in the region. To do so, we estimated visitor spending through an on-site survey which provided both the amount and structure of expenditure. The second step was to estimate the recursive effects on output, income and employment of the injection of cash into the local economy through visitor spending. A regionalized IO model was then applied, requiring the use of CILQ obtained from employment data. The IO model allowed us to estimate Type I and Type II total effects. The use of a regionalized IO model prevented us from over-estimating visitor spending. The calculated differences (Eq. 13) between the estimated effects of visitor spending based on a non-regionalized and a regionalized IO model are presented on Table 4. As it can be noted, the use of a regionalized IO model improved the estimates avoiding an over-estimation above 22% of the total effect of visitor spending on output. By economic sector, the largest improvement for output was found in the accommodation sector (23%-25%), followed by retail trade (17%-18%). The improvement of the estimate on the total effect on income would be in the range of 14%-15%, while on the total effect on employment would account for a fraction between 12% and 13%. The proposed model was able to improve the estimation in €39.095 million (Total Output Type II) regarding the traditional IO model (18.7%). In the literature the use of regionalized IO models applied to mountain protected areas is rather scarce. In fact, the only published paper using the LQ method is Huhtala (2007), which analyzed the local economic impact of tourism in the Pallas-Ounastunturi National Park in Finland. Due to differences in the research areas, multipliers in the work by Huhtala (2007) and ours can't be directly compared. However, in line with our results, the author found large differences between the multipliers obtained from the regionalized IO model from those calculated using the national IO model. In particular, the Type I output multiplier from the national IO model was 32.7% larger than the multiplier from the regionalized IO model in the services sector, 29.5% in the trade sector, 44.6% in lodging and restaurants, and 30.8% in the transports sector (Table 2, page 230, Huhtala 2007).

Another important issue that this paper has addressed is the time-disaggregation of data for estimation of impact of visitor spending. Tourism in the OMP National Park, as well as in other National Parks and, in general, in rural sites, presents high seasonality, with potentially negative effects on the local economy and the local labor market. These negative effects may reduce the potential of tourism, as a sustainable economic activity and a tool of development, in those areas.

Hence, the availability of time-disaggregated data on visitor spending and on its effects is a very valuable instrument to detect potential constrains in the tourism sector and to set priorities and target regional policy actions in order to offset negative effects derived from seasonality. According to the literature, tourism seasonality usually has two main dimensions (Hylleberg 1992; Butler and Mao 1997): natural (e.g. climate, weather, levels of precipitation) and institutional (e.g. holidays, leisure time, travel habits). Most certainly, tourism seasonality in the OMP National Park has both meteorological or climatic and

Table 4 Differences between regionalized versus non-regionalized effects of visitor spending. Values are in percentage. Type I = direct effect + indirect effect, Type II = direct effect + indirect effect + induced effect.

Economic sector	Output (%)		Income (%)		Employment (%)	
	Type I	Type II	Type I	Type II	Type I	Type II
Accommodation	25.4	23.8	15.9	16.6	14.7	16.1
Retail trade	17.5	18.0	13.9	14.7	6.7	7.2
Recreational act.	11.6	12.6	11.1	11.9	12.3	13.2
Transport	13.0	14.2	13.9	14.8	8.6	10.1
TOTAL	18.7	18.7	14.8	15.6	11.0	11.8
TOTAL (minus transp.)	23.4	22.2	15.3	16.0	12.3	12.9

institutional components. In fact, winter seasons are characterized by low temperatures and heavy snowfall, which together with the existing restrictions on several sports and recreational activities (e.g. ski), disincentive tourism. Attending to the negative consequences of tourism seasonality, the uncertainty in annual tourism-related economic activities implies that many businesses close in the off season, so that families and/or individuals must compensate for reduced income by saving during periods of higher activity (Murphy 1985). This effect is particularly serious in mountain protected areas, where natural conditions are extreme in the winter and where nature tourism is often the main source of income of local communities (Fernández et al. 2020). Also, tourism seasonality may imply low annual returns on capital (Butler and Mao 1997) as to discourage private investment. In relation to the labor market, one of the main issues arising from tourism seasonality is the difficulty in recruiting and retaining full-time and qualified staff (Murphy 1985), with most of jobs created being temporary. Although these jobs may represent an opportunity for individuals needing temporary work, such as employees in other economic sectors (e.g. agriculture) or students (Flognfeldt 2001), job seasonality can block the capacity of the tourism sector to mitigate the problem of depopulation, particularly strong in mountain protected areas. Lundmark et al. (2010) found that the positive effect of tourism on the economy and population in mountain municipalities in Sweden was small or nonexistent largely due to seasonality. They showed that the existence of tourism in protected areas did not provide a guarantee to the prosperity of local communities. In this line, the assessment of sustainability of the tourism sector or activity in these sites is key to understand its contribution to local development.

Seasonal nature tourism can have negative effects on nature conservation. The massive flow of visitors in very short periods of time can overwhelm the carrying capacity of parks. Some protected areas in mountain areas, such as the Sagarmatha National Park and the Annapurna Conservation Area in Nepal (Nepal 2000) or the Fjaðrárgljúfur canyon in Iceland (Sorrell and Plante 2021), are examples of protected mountain systems that have suffered the consequences of uncontrolled and massive flow of tourists. In this sense, the analysis of the seasonality of tourism can contribute also to the sustainable planning of tourism in protected areas.

The concept of sustainable tourism, accompanied by the phenomenon of seasonality is part of the guidelines for planning and managing protected areas in the world (Jurdana and Zmijanovic 2014). The Threshold of Sustainability for Tourism within Protected Areas (Drumm et al. 2011) provides a tourism management framework based on the achievement of many of the actions included in the Programme of Work on Protected Areas of the Convention on Biological Diversity, preventing and mitigating protected area threats, developing sustainable finance mechanisms, using protected area benefits to reduce poverty, strengthening management capacity and improving overall management effectiveness. The method we proposed and applied here can contribute to the identification of threats under the "Threshold of Sustainability for Tourism within Protected Areas" since it can provide an exhaustive analysis of the seasonality of the spending and visits to protected areas. This information is very useful to identify the carrying capacity and detailed monthly economic return, and to the improvement of planning and management of sustainable tourism in protected sites.

The valuation of ecosystem services has been criticized because of the vagueness of the concept and the narrow framework derived from the monetization that sometimes involves the complex reality of different human attitudes towards ecosystems (Gunton et al. 2017). However, despite limitations, monetization of natural capital has put in evidence the relevance of nature conservation for societies (de Castro-Pardo 2019). For this reason, it is worth continuing to work not just on the conceptual dimension of value in ecosystem services but also on the evaluation of all components involved in complex socioecological systems to improve methods of estimation of the value of ecosystem services. In this line, the proposed method improves significantly traditional IO-models increasing the accuracy of the estimation of the spending of nature tourists regionally that can contribute to more robust ways of valuing RES in protected areas.

5 Conclusion

In this study we estimated the value of recreational ecosystem services using the economic impact of nature tourism on a mountain National Park in Spain based on a regionalized IO model. Results indicate that this model avoids considerable over-estimation of the economic impact of recreational ecosystem services. Taking into consideration the direct, indirect and induced effects of nature tourist expenditure in the Ordesa and Monte Perdido National Park, the total annual output effect amounted to €208.8 million, while the total income effect amounted to €71.29 million. Also, a total of 2,429 jobs were created which indicates that for each thousand visitors per year to the National Park, 3.8 jobs are created in the surrounding area.

Overall, the methodology proposed in this paper is relatively easy to apply to other National Parks or protected areas in Spain or in the rest of the world to estimate the value of recreational ecosystem services including the economic impact of nature tourism expenditure. Moreover, the temporal disaggregation of spending and visitors can contribute to define sustainable tourism thresholds in protected areas with high seasonality, such as mountain protected areas. This method can provide a valuable instrument to set priorities and target regional policy actions.

Among the limitations of the study, it must be noted that the IO table of the autonomous community of Aragón that we used, although it is the newest, it is relatively old (2005). In fact, updated IO tables at the NUTS2 level in Spain are rather scarce. Although intersectoral relations tend to remain fairly stable over time, the use of outdated IO tables may lead to biased results when computing direct, indirect and induced effects of tourist expenditure. In this sense, future research could make use also of the more recent national IO table of Spain, and compare results from those obtained using outdated IO tables at the NUTS2 level. On the other hand, as mentioned in the paper, the time disaggregation procedure proposed may generate misleading results when visitor spending varies significantly with season. Whilst we were able to identify two types of visitors in the meetings with stakeholders of the National Park, we believe that future research should further investigate the existence of different types of visitors with distinct spending behaviors.

Acknowledgements

We gratefully acknowledge financial support from the Organismo Autónomo de Parques Nacionales (Project V09-Cátedra de Parques Nacionales) to the development of this study. The authors would like to acknowledge the entire staff and the stakeholders of the Ordesa and Monte Perdido National Park for their support in this endeavor.

Electronic supplementary material: Supplementary material (Appendix 1) is available in the online version of this article at https://doi.org/10.1007/s11629-021-6911-3

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