

Sustainable tourism entrepreneurship in protected areas. A real options assessment of alternative management options

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Sustainable tourism entrepreneurship in protected areas. A real options assessment of alternative management options.

Tourism entrepreneurship has not received sufficient attention in the context of protected areas (PAs). It needs careful management to avoid conflicts with conservation objectives and positively contribute to regional development. Traditional management approaches based on the strict application of the carrying capacity principle are suboptimal. An adaptive management framework has been demanded, but it has been scarcely adopted in practice or explored in previous research. Moreover, appropriate decision-making tools are lacking. This study proposes a combination of cost-benefit analysis (CBA) and real options analysis (ROA) to support the sustainable tourism entrepreneurship development in PAs under an adaptive management framework. Costs are related to the conservation and restoration activities, and benefits to the use and non-use value placed by visitors on it, measured through visitors' willingness to pay (WTP) for sustainable tourism. The proposed model also explains uncertainty and flexibility, considering visitors' WTP and tourism demand as the primary sources of uncertainty. The analysis of the sustainable tourism management of Ons Island, part of the Marine-Terrestrial National Park of the Atlantic Islands of Galicia, is conducted as a case study to exemplify the power of a combined CBA-ROA approach. This study has implications for policymakers, PA managers, tourism entrepreneurs, and researchers.

Keywords: real options; protected areas; cost-benefit analysis; sustainable tourism entrepreneurship; uncertainty; flexibility

1. Introduction

The contribution of protected areas (PAs) to regional development is a controversial issue (Becken and Job 2014; Mayer 2014). While negative arguments are related to the restrictions and impacts imposed on local communities (Leung et al. 2018; Mandić 2019), favourable ones are mainly based on the potential for promoting tourism entrepreneurship (do-Val-Simardi-Beraldo-Souza et al. 2019; Mayer 2014). The relationship between tourism entrepreneurship and regional development is well acknowledged (Dana, Gurau, and Lasch 2014; Lordkipanidze, Brezet, and Backman 2005). However, tourism entrepreneurship in general, and in PAs in particular, has not received sufficient attention in previous literature related to regional development (Calero and Turner 2020). The contribution of tourism entrepreneurship to regional development in PAs depends on how conflicts between economic and ecological objectives are managed (Mandić 2019; McAreavey and McDonagh 2011; Whitelaw, King, and Tolkach 2014). A focus on the concept of sustainable tourism entrepreneurship (Lordkipanidze et al. 2005), aimed at making economic and ecological interests compatible, could contribute to reinforcing the positive links between PAs and regional development. However, the acceptance and promotion of sustainable tourism ventures in PAs depend on the decisions of the relevant authorities (national, regional, and local governments and park managers) regarding the type and intensity of their tourism use (Jamal and Stronza 2009; Whitelaw et al. 2014).

The management of PAs has been traditionally based on the strict application of the carrying capacity approach that sets a limit on the number of visitors and restricts tourism activities (Chen 2019; Ly and Nguyen 2017). This prevents a sustainable development approach to tourism in PAs (Whitelaw et al. 2014). An adaptive management approach of PAs has been suggested as an alternative appropriate framework to deal with conflicts of interest among

stakeholders and reconcile economic and conservation objectives (Islam, Ruhanen, and Ritchie 2018; McAreavey and McDonagh 2011; Plummer and Fennell 2009). However, to date, its practical implementation and empirical investigation are limited (Islam et al. 2018). Furthermore, visitors' preferences should also be accounted for (Alves et al. 2017; Mandić 2019; Paulrud and Laitila 2013). These preferences can be analysed through contingent valuation (CV) or choice experiment (CE) and concreted in a 'willingness-to-pay' (WTP) measure that proxies the use and non-use value attached by visitors to a PA (Alam 2008; Alves et al. 2017; Togridou, Hovardas, and Pantis 2006).

More research on the management of PAs (Eagles 2014) and new decision-making tools (Duke, Dundas, and Messer 2013; Pascal et al. 2018; Weaver and Lawton 2017) are needed. As far as the contribution to regional development is concerned, the possibility of developing decision-making models based on an economic or monetary valuation of alternative decisions or strategies related to the tourism use of PAs, such as cost-benefit analysis (CBA), is highly interesting (Banerjee, Cicowiez, and Moreda 2019). Moreover, planning on PAs is usually faced with uncertainty about future conservation (Duke et al. 2013). An adaptive management approach would add flexibility to decision-making. The usefulness of traditional approaches based on CBA to make decisions that properly deal with flexibility and uncertainty is limited (Ando and Shah 2016). This paper aims at filling this gap by suggesting the combined application of traditional CBA and real options analysis (ROA) to the analysis of tourism management in PAs. The application of ROA to the analysis of the tourism use of PAs is still lacking. Moreover, to the best of our knowledge, no previous study has treated WTP as a stochastic variable.

Building upon these premises, this work pursues two conceptual objectives and two empirical ones. From a conceptual perspective, the first objective is to claim for more research on tourism entrepreneurship in PAs. The second one is to support adaptive management of this

tourism use which can balance economic and conservation interests, the main concern in the political agenda of governments worldwide, especially in the European Union (McAreevey and McDonagh 2011). Regarding the empirical goals, this study focuses, firstly, on the estimation of tourists' WTP for sustainable tourism in PAs as a means to gain an insight into the use and non-use value which may be attached to them. Secondly, it focuses on the exploration of the applicability of a combined CBA and ROA approach to support adaptive management of the tourism use of PAs accounting for flexibility and uncertainty. This can help to identify appropriate institutional and policy interventions to promote entrepreneurship and regional development based on an economically efficient use of natural resources compatible with their conservation.

To fulfil these objectives, a case study approach seems indispensable. Ons Island, sited in the Atlantic Islands Terrestrial and Marine National Park (Galicia, Spain), has been chosen in this study to analyse how to balance the conflicting demands of stakeholders, namely tourism entrepreneurs (economic development), residents, and society (conservation goals). The island lacks some basic services (water supply, electricity supply, and sewage). The decision to invest in the improvement of these infrastructures is hindered by budgeting restrictions and the uncertainty surrounding the future development of the island.

The rest of the paper is organized as follows: Section 2 provides the conceptual framework of the study. Section 3 sets out the methodology and presents the study area chosen to exemplify the research problem. Section 4 presents the results and findings obtained, while Section 5 provides their discussion. Section 6 concludes with remarks in the form of policy recommendations as well as suggestions for future research.

2. Conceptual background

2.1. Tourism entrepreneurship and regional development in PAs

The contribution of PAs to regional development is fundamentally reliant on tourism entrepreneurship (do-Val-Simardi-Beraldo-Souza et al. 2019; Mayer 2014). It is generally agreed that tourism entrepreneurship positively contributes to regional development (Calero and Turner 2020; Dana et al. 2014; Lordkipanidze et al. 2005), decreasing income inequalities (Lecuna 2019) and is a source of income diversification, particularly in rural and/or peripheral areas (Currie and Falconer 2014; Polo-Peña, Frías-Jamilena, and Rodríguez-Molina 2012).

Although tourism entrepreneurship is a well-established research field, it has not received the deserved attention in scientific research related to regional development (Calero and Turner 2020). Recent reviews on tourism entrepreneurship (Fu et al. 2019; Ratten 2019; Solvoll, Alsos, and Bulanova 2015) acknowledge the particular attention devoted to sustainability, but they do not identify any particular strand of literature focused on protected natural areas. An explicit focus on an entrepreneurial perspective in the specific context of PAs is almost absent in previous literature. Scattered studies have analysed successful individual or collective ventures (Jamal and Stronza 2009); the role of regulatory, cognitive, and normative features (Iakovleva et al. 2012); women entrepreneurship (Panta and Thapa 2018); sustainability in transport ventures (Bigerna, Micheli, and Polinori 2019); and the business models of the so-called private PAs (Serenari et al. 2017). Note that literature on the visitation of PAs is larger but not specifically focused on tourism entrepreneurship.

PAs involve tensions between economic objectives and social, cultural, and ecological ones (Jamal and Stronza 2009; Mandić 2019). Ferreira, Fernandes, and Kraus (2019) acknowledge that ‘the theory of entrepreneurship should serve as a bridge between economics and the

social sciences' (p. 198). The role of tourism entrepreneurship as a facilitator or an obstacle to reconciling those competing interest should be further investigated. Greater attention could be paid to specific entrepreneurial issues associated to PAs, such as how tourism entrepreneurship in PAs is affected by multiple internal and external conditions (Kallmuenzer et al. 2019) or institutional factors (Ali, Kelley, and Levie 2020; Godlewska and Morawska 2020; Sahasranamam and Nandakumar 2020). There is also room for focus on the personality traits of entrepreneurs (Markowska and Wiklund 2020), who are often members of the local communities affected by the PA. Attention can be paid on how they balance their own competing goals entailing business objectives, lifestyle aspirations, and low environmental impact (Swan and Morgan 2016), as well as how they build on their individual (financial, human, and social) capital (Sahasranamam and Nandakumar 2020). Attention could be also devoted to how the use of rational and emotional arguments by entrepreneurs may influence decision-makers (either governments, park managers, or investors), as analysed by Fernández-Vázquez and Álvarez-Delgado (2019) in the context of entrepreneurial pitches. Tourism entrepreneurship in PAs can also be related to forms of entrepreneurship with a presumably positive link to regional development, such as social entrepreneurship (Chirozva 2015; Sahasranamam and Nandakumar 2020) or sustainable entrepreneurship (Gray et al. 2014; Lordkipanidze et al. 2005). Its relation to grassroots innovations (Singh et al. 2019) and community entrepreneurship (Alexander, Ramotadima, and Sanderson 2018; Gray et al. 2014; Jamal and Stronza 2009) also generates special interest. Community-based entrepreneurship in PAs would also provide an interesting field to analyse how entrepreneurial behaviours are transmitted and embedded among community members (Clinton et al. 2020) and affected by community culture into a spatially oriented perspective (Huggins and Thompson 2019). For Hiwasaki (2006), community-based tourism is a 'pathway' to sustainability of PAs.

The features of tourism entrepreneurship in protected natural areas must be analysed under its specific social-spatial context, as recent literature in the entrepreneurship field demands (Müller and Korsgaard 2018; Trettin and Welter 2011). Accounting for the role of social, cultural, and environmental context (Dana et al. 2014), a comparative analysis of tourism entrepreneurship in different PAs could be performed. Furthermore, the analysis of tourism entrepreneurship in protected natural areas brings allows the study of entrepreneurship from the perspective of other important agents apart from entrepreneurs (Claire, Lefebvre, and Ronteau 2019). In particular, the role of the public authorities and PA managers as enablers or obstacles to tourism entrepreneurship deserves greater attention, especially as suppliers of the necessary entrepreneurial infrastructure (Godlewska and Morawska 2020; Lordkipanidze et al. 2005). Public funding restrictions limit park managers' capacity to deal with the impacts of increased tourism pressure, as well as to make the necessary infrastructure investments to provide the appropriate services to both visitors and local communities inside the PA (Plummer and Fennell 2009).

From this stakeholders' perspective, tensions emerge between governmental departments in charge of tourism development and nature conservation, between tourists or tourism entrepreneurs and residents, and even among tourists themselves (Jamal and Stronza 2009; Mandić 2019; McAreavey and McDonagh 2011). PAs and their associated restrictions can positively influence conservation but negatively impact local communities (McAreavey and McDonagh 2011). An increasing tourism entrepreneurship which attracts higher numbers of visitors can create a positive economic impact, but it can also impose a huge ecological pressure on the PA (Alexander et al. 2018; León et al. 2015).

Although tourism in PAs is assumed to be sustainable or ecological, this should not be taken for granted (León et al. 2015; Mandić 2019). Sustainable tourism, ecotourism, and nature-based tourism (Jamal and Stronza 2009; Mandić 2019; Swan and Morgan 2016) are specific

concepts aimed at reconciling economic and ecological objectives. They could ultimately contribute to reduce conservation costs (Chen, Lupi, and Liu 2017) and manage overcrowding (Rathnayake 2015). Mitchell, Wooliscroft, and Higham (2013) suggest the application of a sustainable market orientation model in national parks management to reconcile the conflicting social, economic, and environmental interests involved.

Furthermore, sustainable tourism entrepreneurship in PAs could open an avenue to analyse how specific sustainable branding orientation can influence the entrepreneurial or growth orientation of local tourism operators (Peters et al. 2010).

2.2. An adaptive management framework of sustainable tourism in PAs

Sustainable tourism entrepreneurship in PAs ultimately relies on how park managers and government authorities approach the management of the number of visitors (Jamal and Stronza 2009; Whitelaw et al. 2014). A recent literature review on studies analysing the management and monitoring of visitors in PAs (Pickering et al. 2018) concludes that monitoring has been the main focus of past research, while visitor management has not raised comparable interest. The management of the number of visitors is, however, a central issue in the governance of PAs (Petrić and Mandić 2014). Apart from its relevance in terms of ecological impacts, it influences the potential income to be collected through entrance fees (Baral, Stern, and Bhattarai 2008; Thur 2010; Whitelaw et al. 2014) and conditions the economic impacts derived from tourism (do-Val-Simardi-Beraldo-Souza et al. 2019). Conservation planning has traditionally considered visitors as a threat more than an opportunity (Mandić 2019; Weaver and Lawton 2017) and has applied the principle of carrying capacity to limit visitor numbers (Chen 2019; Ly and Nguyen 2017), thus preventing a sustainable development approach to tourism in PAs (Whitelaw et al. 2014). Alternative decision-making frameworks, such as ‘limits of acceptable change’ or ‘visitor impact

management', do not effectively contribute to the balance of economic and conservation objectives either (Petrić and Mandić 2014; Watson et al. 2014; Weaver and Lawton 2017) and have a limited application in evaluating social economy (Chen 2019).

More flexible and adaptive management frameworks should be adopted to balance the interests of the different stakeholders affected by the existence of a PA under a collaborative and cooperative model working for sustainable tourism in PAs (Islam et al. 2018; McAreavey and McDonagh 2011; Plummer and Fennell 2009). Adaptive management recognizes the need for flexibility and embraces uncertainty (McAreavey and McDonagh 2011). It is based on complexity, diversity, resilience, adaptive cycle, adaptive capacity, and learning-by-doing (Islam et al. 2018; Plummer and Fennell 2009). Stakeholders' involvement (Heslinga, Groote, and Vanclay 2019) and the reliance on partnerships (McCool 2009) or community-based collaboration (Alexander et al. 2018; Jamal and Stronza 2009) are equally important. The synergetic interactions between stakeholders involved in PAs' governance processes are a precondition for effective benefit-sharing from tourism (Heslinga et al. 2019). The views, knowledge, and suggestions of local entrepreneurs can be valuable for destination planning authorities and determinant to promote sustainable tourism practices (Spenceley and Snyman 2017). However, this adaptive framework has not been extensively adopted in PAs yet; tourism entrepreneurship has often not been explicitly considered; and empirical research on success stories is lacking (Islam et al. 2018).

Visitors' preferences, especially regarding nature-based experiences (Moyle et al. 2017), should also be integrated into PA management (Alves et al. 2017; Mandić 2019). Two main alternative profiles of visitors can be identified: mass or casual tourists, and conservation-focused or eco-tourists (Dabezies and Ballesteros-Arias 2013; Pascal et al. 2018; Viteri Mejía and Brandt 2015). Perceptions of crowding have also been investigated (Barrio and Loureiro 2018; León et al. 2015; Marsiglio 2016; Rathnayake 2015). Previous research has linked

these visitors' preferences to the use and/or non-use values of PAs, mainly investigating visitors' WTP through CEs (Barrio and Loureiro 2018; Chen 2019; Juutinen et al. 2011; León et al. 2015; Paulrud and Laitila 2013; Roberts, Cresswell, and Hanley 2018) and CV studies (Alam 2008; Banerjee et al. 2018; Baral et al. 2008; Bigerna et al. 2019; Lindhjem et al. 2015; Marzetti et al. 2016; Thur 2010; Togridou et al. 2006; Voltaire, Pirrone, and Bailly 2013).

To integrate this monetised approach to visitors' preferences in the adaptive management of the conflicting economic and conservation interests in PAs and to design cost-effective conservation planning (Duke et al. 2013), an economic or monetary approach such as CBA seems to be valuable (Alam 2008; Feuillette et al. 2016). Conservation costs should also receive greater attention in conservation planning (Armsworth et al. 2011), especially in small (Armsworth et al. 2011) and island (Roberts et al. 2018) PAs. Previous research has applied CBA to the analysis of public investments in tourism (Banerjee et al. 2019) to justify the economic value of national parks (Mayer 2014), marine PAs (Pascal et al. 2018), or rural landscapes (Cortignani et al. 2018) and to analyse the feasibility of forest conservation (Lindhjem et al. 2015), coastal management (Alves et al. 2017), and the restoration of contaminated sites (Alam 2008; Paulrud and Laitila 2013).

However, uncertainty and flexibility have not been considered in previous research. The management of the tourism use of PAs has to deal with uncertainty related to tourism inflows (Marsiglio 2016) and ecosystem behaviour and future conservation (Duke et al. 2013; Pascal et al. 2018). The impact of uncertainty has also been acknowledged in the field of entrepreneurship in general (Markowska and Wiklund 2020) and tourism entrepreneurship in particular (Kallmuenzer et al. 2019). CBA does not properly account for flexibility and uncertainty, while ROA can deal with them recognizing that 'flexibility in decision making has value when new information affecting the investment or policy alternative arrives either

periodically or at random intervals in the future' (Ando and Shah 2016, p. 337). ROA has been previously applied to decisions regarding public services (Deng et al. 2013) or land use management (Nelson, Howden, and Hayman 2013; Regan et al. 2015), but not to the specific analysis of management decisions related to the tourism use of PAs. A combination of CBA and ROA, under an adaptive management framework of PAs to foster a sustainable tourism entrepreneurship, could help reinforce the positive contribution of PAs to regional development.

3. Data and methods

3.1. Research design

A multiple research method on a case study allows to acquire relevant information about park management and stakeholders' conflicts and explore the potential of a combined CBA-ROA approach to managing the tourism use of a PA under an adaptive framework. Different data collection methods are used: interviews with park managers; a survey among visitors; and the search for information and data in academic literature, policy documents, online news, and official statistics.

3.2. Study area

Ons Island was chosen to demonstrate the effectiveness of a combined CBA and ROA approach on the adaptive management of the tourism use of PAs. It is included in the Marine-Terrestrial National Park of the Atlantic Islands of Galicia (in the Northwest of Spain) and has a PA of 2,171 marine and 470 terrestrial ha. Created in 2002, this is one of the 6 (out of 15) Spanish national parks involving island areas. It is formed by four archipelagos (Ons,

Cíes, Cortegada, and Sálvora), Ons being the only inhabited island (64 inhabitants according to the January 2019 register). The landscape is predominantly rural, and tourism is the main economic activity (Dabezies and Ballesteros-Arias 2013). The status of national park imposes restrictions on relevant activities (Barrio and Loureiro 2018). In 2019, the Master Plan of Use and Management of the National Park, basing on the carrying capacity of the area, set the following limits to the number of visitors in high season: 300 people lodged in the camping area and 1,300 visitors accessing the island through shipping companies. This raised protests from the shipping companies and the tourism businesses of the island. In low season, only organized groups can access the island.

Park management proposes that overnights should be discounted from the daily quota of visitors, while tourism companies demand additional quota. The potential promotion of more tourism entrepreneurial activity is also controversial. Some inhabitants who own their houses under a concessional regime have started to rent them. It is assumed that 119 of the 135 dwellings of the island could have potential use for lodging. If all these houses were rented, there would be 714 hotel beds (assuming 6 hotel beds per house) adding to the 126 of the three existent guesthouses. If in a day of high season, all the 840 hotel beds were occupied and discounted from the general quota of visitors, the shipping companies could only offer 460 tickets (1,300 - 840).

Although demanded by the resident many years ago, the island lacks permanent electricity supply and proper water supply and sewage systems. In 2013, the Galician government announced that it would undertake these investments, but the decision was delayed due to budgeting constraints. There are also tensions among the different governmental departments in charge of tourism and nature conservation issues regarding the convenience of undertaking these infrastructure improvements. No entrance fees are currently applied at any of the Spanish national parks.

Under an adaptive management framework allowing to deal with these competing socio-economic and nature conservation objectives, the managers of the park could examine different managerial options affecting visitors' quotas. Prioritizing the interests of tourism entrepreneurs, managers could set an additional quota for overnights, rising the potential number of daily visitors to 2,440 (1,300 accessing through the shipping companies, 840 lodged in the accommodation offer, and 300 in the camping). If nature conservation is considered to be at risk, managers could reduce the current quota, thus limiting the entrepreneurial activity. Assuming a 20% reduction, the daily quota of visitors and campers would be set at 1,280. Considering 130 days of high season (from May 15 to September 15 plus seven days of Holy Week), the maximum number of yearly visitors and campers would be of 208,000 if discounting of overnights is maintained ($1,600 \times 130$), 317,200 if overnights are assigned a separate quota and all the potential hotel beds are offered ($2,440 \times 130$), or 166,400 if the quotas are reduced (and overnights discounting maintained).

3.3. Methods

3.3.1. Cost-benefit analysis and contingent valuation

CBA is based on the determination of the net present value (NPV) of the proposed investments, discounting the estimated cash flows (benefits minus costs) at an appropriate social discount rate (SDR), without considering any managerial option or source of uncertainty. Benefits area approached trying to measure the PA use and non-use value (Alam 2008; Alves et al. 2017; Togridou et al. 2006), relying on a CV survey asking on individuals' stated WTP for an improvement in the sustainable tourism management of Ons Island. Through an open-ended format (Lindhjem et al. 2015), respondents were asked about their WTP for a hypothetical daily entrance fee (Baral et al. 2008; Togridou et al. 2006). Question-wording was based on previous studies (Juutinen et al. 2011; Togridou et al. 2006; Voltaire et

al. 2013). The survey presented two options to state the WTP as an exact amount or an interval (with an upper and lower WTP). This was used to calculate the degree of uncertainty of each stated WTP and an uncertainty-adjusted WTP (WTP_{UA}) (Bigerna et al. 2019; Voltaire et al. 2013). This WTP_{UA} is averaged across all the respondents ($MWTP_{UA}$), removing outliers and considering non-willing-to-pay responses as true zeros (Lindhjem et al. 2015). To calculate benefits, $MWTP_{UA}$ has to be multiplied by the expected demand of visitors, modelled under an LG process (Albaladejo and Martínez-García 2015; Forsyth 2000) basing on the current number of visitors per year and the annual maximum number of visitors that island could receive if the additional quota for overnights is set. To analyse the alternatives of maintaining or reducing visitors' quotas, this time series is truncated to adhere to the corresponding constraints about the maximum number of visitors.

The amount of investment in infrastructure improvements (electricity and water supply and sewage system) and the conservation costs are considered deterministic throughout the analysis. Conservation costs are assumed to increase when the tourism pressure on the island increases, and to decrease when the tourism pressure declines.

3.3.2. Real options analysis

Traditional CBA and NPV approaches assume static and passive management of decisions (Regan et al. 2015) without considering the alternative managerial options derived from the presence of uncertainty and flexibility (Ando and Shah 2016). In financial markets, options are financial assets that give the right to buy or sell an asset in the future at a predetermined price. When managerial decisions related to real (non-financial) assets are faced with uncertainty around any of the affecting factors, options (real options) could be identified to manage the decision flexibly adapting to how uncertainty gets resolved through time.

These real options can be related to the possibility of delaying the decision, expanding or reducing the scale of a project, or even abandoning it once launched (Trigeorgis 2004). This flexibility has an additional value to that obtained with CBA or NPV methods (Dixit and Pindyck 1994). ROA is specifically aimed at measuring this additional value, which can even justify investments that would be rejected under the CBA or NPV approaches (Damodaran 2000). Since ROA tries to capture the additional value derived from flexibility in decision-making, it is complementary, not a substitute, of traditional CBA. The value of the real options is added to the NPV obtained in CBA. This value can be decomposed into two parts: the value of uncertainty and the value of flexibility (Deng et al. 2013).

The options to set an additional quota for overnights or reduce the current quotas in Ons Island correspond to the traditional real options to expand and reduce (Trigeorgis 2004). Following Deng et al. (2013), a four-step procedure is applied to develop the combined CBA-ROA: baseline analysis (NPV), uncertainty analysis, flexibility analysis, and sensitivity analysis. The baseline analysis relies on the application of the CBA methodology. Uncertainty analysis is first approached as a way of including the consideration of uncertainty into the analysis. It is then integrated with flexibility analysis to perform an ROA of the project to invest in a sustainable tourism exploitation of Ons Island, considering two alternative managerial options: setting an additional quota for overnights (option to expand) and reducing the current quota of visitors (option to reduce). Finally, sensitivity analysis is aimed at trying alternative hypotheses relating to the uncertain parameters.

The $MWTP_{UA}$ is modelled through alternative stochastic process under the ROA. Geometric Brownian motion (GBM) and mean-reversion (MR) are the most common stochastic processes (Conrad 2018; Kassar and Lasserre 2004). A logistic growth (LG) stochastic process (Forsyth 2000) has been considered in the sensitivity analysis and is also applied to model the expected demand of visitors.

Following Conrad (1997) and Forsyth (2000), the parameters of the GBM, MR, and LG processes were estimated from historical time-series data on the numbers of visitors to Ons Island, and then applied to model both the WTP and the number of visitors per year through the time horizon of the analysis. Data from 2002 to 2017 are used to derive the different stochastic processes' parameters through the corresponding statistical procedures (Conrad and Kotani 2005; Pindyck and Rubinfeld 1998; Reed and Clarke 1990).

The valuation model is developed on an Excel spreadsheet, and Oracle's Crystal Ball add-in is used to perform the simulation processes for the ROA.

4. Results

4.1. Baseline CBA

To estimate WTP, an on-site survey was developed between August and September 2019 at Ons Island's dock when visitors were waiting to leave the island, and 151 useable questionnaires (15.1% response rate) were obtained. Most respondents are female (60.9%), aged 31-50 years (57.6%), with university studies (64.9%), without children (57%), and with a monthly income between 1,001€ and 2,500€. The majority are tourists (96%), from Galicia (49.7%) and other parts of Spain (45%).

Of all respondents, 67.5% are willing to pay, and 33.3% of those willing to pay choose to state their WTP as an exact amount. Table 1 shows the mean WTP that would result from adjusting or not by uncertainty in response, removing or not outliers, and considering or not zero-WTP. Under a conservative approach, the lowest value is chosen.

[Insert Table 1 here.]

The mean conservation cost per hectare for each park as well as the mean number of visitors per terrestrial hectare are derived based on the analysis of the annual capital and operating

expenditures and annual number of visitors to the six Spanish national parks sited in islands for the years 2014 to 2017 (data from the annual reports of the Spanish Network of National Parks and the Spanish Statistical Office). The mean conservation cost of the Atlantic Islands National Park in the 2014-2017 period (310.76€ ha⁻¹) is far below than that of the other five national parks sited in islands (658.22€ ha⁻¹). The mean number of visitors per terrestrial hectare is the highest of the six parks and well above the mean of the other five parks (335.65 visitors terrestrial ha⁻¹ in the 2014-2017 period for the Atlantic Islands, and 169.45 for the six parks). Thus, we assume that keeping current visitors quotas should demand an increase in conservation costs from 310.76€ ha⁻¹ to 658.22€ ha⁻¹, which is 347.45€ ha⁻¹, to guarantee a sustainable management of its tourism use. Roberts et al. (2018) highlight the fragility of island ecosystems and the need for high conservation costs. Armsworth et al. (2011) emphasize the difficulty of profiting from scale economies when conservation actions are developed on small territories. Both these studies justify the assumption of higher costs needed to make conservation and tourism compatible.

The total capital expenditure of the required investments to create an electricity supply infrastructure and improve the water supply and sewage systems is estimated at 12,500,000€ (data provided by technicians related to park management). For simplicity, all these investments are assumed to be made in a single year (2019).

A real SDR of 4% is derived from Campos et al. (2015), who report a 4%-6% range for the SDR employed by the Spanish government in the evaluation of investment projects across different sectors. It is expressed in real terms to avoid accounting for inflation in the estimated cash flows.

Given that in 2010, the Galician government granted the concessions on the island dwellings for a period of 75 years, a time horizon extended to the year 2085 can be illustrative to evaluate the feasibility of the investment in the proposed infrastructure improvements. Thus,

considering 2019 as the investment year, a time horizon of 65 years is assumed for the NPV calculation.

Table 2 summarizes the parameters and input data considered in the baseline NPV calculation.

[Insert Table 2 here.]

Treating the $MWTP_{UA}$ and conservation costs as deterministic (constant) through all the time horizon, and considering the estimated annual number of visitors obtained through a truncated LG process, a baseline NPV of -11,361,796€ is obtained. It indicates that the use and non-use value derived for Ons Island is not sufficient to justify the required investments in infrastructure improvements and the increased conservation costs needed to guarantee a sustainable tourism use of the island.

It is interesting to know the breakeven values that, *ceteris paribus*, would make this baseline NPV positive (Table 3). The use and non-use value per daily visit should increase to at least 7.33€, the conservation cost ha^{-1} should be reduced to at least 161.39€, or the SDR should be negative and higher than -2.14% to make the investments feasible according to the traditional NPV rule ($NPV > 0$).

[Insert Table 3 here.]

4.2. Real options analysis

4.2.1. Uncertainty analysis

Table 4 shows the parameters of the stochastic GBM process considered to generate the 2020-2085 time series for the $MWTP_{UA}$ and the stochastic LG process for the annual number of visitors.

[Insert Table 4 here.]

A Monte Carlo simulation with 2,000 iterations is run to obtain 2,000 different pathways of benefits (Figures 1 and 2) and, consequently, 2,000 NPV estimations and an NPV probability distribution. The expected NPV (ENPV) is their arithmetic mean (Deng et al. 2013). Figure 1 shows 2,000 possible paths for the $MWTP_{UA}$ time series. Figure 2 shows the results of the LG generation of the annual number of visitors' time series, both non-truncated and truncated with the maximum annual number of visitors of 208,000 (keeping visitors' quotas).

[Insert Fig. 1 here]

[Insert Fig. 2 here]

Table 5 reports the resulting ENPV after 2,000 iterations. The value of uncertainty (VU) can be calculated as the ENPV minus the baseline NPV. To allow a better interpretation of the results, the table shows the 5th and 95th percentiles of the frequency distribution of the 2,000 NPVs obtained through simulation, as well as the average values of the $MWTP_{UA}$ and the annual number of visitors generated by the stochastic processes over the whole 2020-2085 time horizon. Figure 3 shows that considering uncertainty, there is an 88.42% probability of obtaining an NPV higher than the baseline or deterministic NPV.

[Insert Table 5 here.]

[Insert Fig. 1 here]

4.2.2. Flexibility analysis

The consideration of two alternative management options (setting an additional quota for overnights and reducing current quotas) does not affect the stochastic generation of the time series on the $MWTP_{UA}$ for the 2020-2085 period. However, it requires creating two additional time series to reflect the evolution of the annual number of visitors under these two alternative management options. This is done by simply truncating the non-truncated stochastic LG time series with the maximum annual number of visitors that would be allowed under each management option (317,200 for the expansion option to create the time series V_t^E , and 166,400 for the reduction option to create V_t^R). In this way, there are different streams of benefits under each one of the options ($MWTP_{UA_t} \cdot V_t^E$ for the expansion option and $MWTP_{UA_t} \cdot V_t^R$ for the reduction option).

Regarding conservation costs, the exercise of the expansion and reduction option should lead to increased costs and lower conservation costs, respectively. From an incremental cash flow perspective, and considering that keeping the current quotas demand an increase in conservation costs of 347,45€ ha⁻¹ (considered in the baseline and uncertainty analysis), the higher (lower) cost increment that should be applied in the expansion (reduction) option is calculated proportionately to the increase (decrease) in the maximum number of visitors per year. Thus, the option to expand could increase conservation costs in 529.87€ ha⁻¹, while the option to reduce could justify a lower increase of 277.96€ ha⁻¹. Table 6 summarizes all this information.

[Insert Table 6 here.]

To integrate the proposed management options into the CBA, at each decision period t of the analysis time horizon, a decision rule compares the cash flow with flexibility (CFF) that would result from keeping current quotas or exercising the options to expand or reduce, and chooses the maximum value as reflected in Equation 1, where super indices correspond to the options to keep (K), expand (E), or reduce (R) the current quotas, and C stands for conservation costs.

$$CFF_t = \text{Max}(MWTP_{UA_t} \cdot V_t^K - \Delta C_t^K, MWTP_{UA_t} \cdot V_t^E - \Delta C_t^E, MWTP_{UA_t} \cdot V_t^R - \Delta C_t^R) \quad (1)$$

Calculating the NPV of this CFF time series under a Monte Carlo simulation with 2,000 iterations, the expected NPV with flexibility (ENPVF) is derived, so that the value of flexibility (VF) can be calculated as the difference between this ENPVF and the ENPV obtained in the uncertainty analysis. The joint value of the expansion and reduction real options (VRO), derived from the simultaneous consideration of uncertainty and flexibility, results from Equation 2.

$$VRO = ENPVF - NPV = VU + VF \quad (2)$$

Table 7 reports the results for the ENPVF and additional information to enable a better interpretation of these results. This table also compiles the results from the previous steps to clarify the relation between VU, VF, and VRO. The value of the two alternative management options (expand and reduce) has been also separately computed, just splitting Equation 2 in two, comparing the cash flows derived from each option with the cash flows from the uncertainty analysis. The VF is the sum of the value of flexibility of the two options. The expansion option contributes a higher value because it allows a higher number of visitors with a moderate cost increase, while the reduction option limits the number of visitors with a moderate cost decrease.

[Insert Table 7 here.]

Figure 4 also shows the interrelation among the three NPVs (baseline, with uncertainty, and with flexibility). There is a very low probability of obtaining NPVs with the consideration of uncertainty and flexibility lower than the baseline NPV.

[Insert Fig. 4 here]

4.3. Sensitivity analysis

An initial approach to developing a sensitivity analysis of the previous results is to account for the effect of different stochastic processes to model the time series on the $MWTP_{UA}$. Firstly, a GBM with zero drift (Mari 2018) is tested, implying that the stochastic process has a constant mean. Then an MR process is tried, using a mean reversion value of 5.93, a reversion speed of 0.023, and a standard deviation (SMR) of 0.17. Similar to Forsyth (2000), a stochastic LG process is also considered, using the same parameters applied in the generation of the time series on the annual number of visitors, and considering a maximum value for the $MWTP_{UA}$ of 10.54€ (corresponding to the maximum stated WTP from the survey without accounting for uncertainty in responses, zeros, and outliers). Table 8 shows the results, allowing for comparison with initial results in the first column. Note that all the alternative stochastic processes have been simultaneously run in a single Monte Carlo simulation with 2,000 iterations, so that the mean average number of visitors for the 2020-2085 period is the same throughout all the processes.

[Insert Table 8 here.]

All the alternative stochastic processes yield lower values of the real options, with the MR process yielding the lowest as it generates the lowest average use and non-use values for the whole 2020-2085 period. The value of uncertainty is negative in the stochastic processes that generate the lower use and non-use-values, something logical as this allows for lower values to the initial 4.86€ considered as deterministic in the baseline NPV. A stochastic LG process yields the second higher average use and non-use values for the 2020-2085 period, and so the second higher value of the real options to expand and reduce the visitors' quotas.

A second approach to the sensitivity analysis consists in studying the effect of varying in the same percentual amount some of the input parameters considered of major importance due to their influence on results. The more relevant parameters that can be understood as a measure of the entrepreneurial intensity of the tourism activity in the island are SDR, $MWTP_{UA}$, the incremental costs of the three management options (keeping, expanding, or reducing quotas), and the number of dwellings offered for lodging visitors. Figure 5 shows the impact on the ENPVF of a $\pm 50\%$ variation in the initial values of these parameters.

[Insert Fig. 5 here]

The SDR and the $MWTP_{UA}$ are, as expected, the most influential factors. The influence of the rest of the parameters seems unimportant, but further analysis of the flexibility value separating the two real options (expansion and reduction) allows for a better understanding of their impact. As an example, Figure 6 presents the impact on VF of a $\pm 50\%$ variation in the incremental costs ha^{-1} of the two management options. *Ceteris paribus*, greater costs of the

expansion option have a higher effect on the reduction of VF. If this increase in costs is very high, the expansion option would contribute no flexibility value, and all would be derived from the reduction option. The lower the costs of both options, the higher the VF.

Figure 7 presents the effect of a 100% reduction in the number of dwellings offered for lodging visitors on these real options (*a priori* there is no possibility of increasing this number). It reveals that if residents do not get involved in tourism entrepreneurship, the expansion option loses value, while the reduction option remains valuable for park management.

[Insert Fig. 6 here]

[Insert Fig. 7 here]

5. Discussion

Results have shown that under the traditional CBA method and strict application of the carrying capacity principle, the investments needed in Ons Island to foster a sustainable tourism entrepreneurship would not be justified. The baseline CBA analysis of the decision to invest in infrastructure improvements to allow a sustainable tourism use of Ons Island has revealed that under the established assumptions, the capital expenditure and increased

conservation costs outweigh the benefits, as measured through the stated WTP of visitors. Although results of previous studies support different conclusions (Alam 2008; Lindhjem et al. 2015; Mayer 2014; Pascal et al. 2018), this negative NPV is in line with Cortignani et al. (2018), who find that the perceived benefits of preserving landscape are lower than the costs of the Common Agricultural Policy of the European Union in a particular Italian territory. The estimated WTP is also in line with those obtained in previous studies on visitor's preferences in PAs, as Togridou et al. (2006), which report a mean value of 6.15, or Barrio and Loureiro (2018), with a mean value of 6.38.

Anyway, the negative baseline NPV is conditional on the specific assumptions made on the input parameters. A conservative approach was adopted, for example, regarding the use and non-use value attached by visitors to the island. Table 3 reported a breakeven value of 7.3 for this use and non-use value that would render the NPV positive. As it can be observed in Table 1, different use and non-use value calculations would be above this breakeven point. This should not be considered important as ROA is also valuable when baseline NPV calculations yield values greater than 0.

The reliance on command-and-control measures and in traditional CBA, disregarding uncertainty and flexibility, could lead to suboptimal sustainability outcomes (Watson et al. 2014; Weaver and Lawton 2017). Similar to previous studies that have demonstrated the power of ROA to capture the additional value derived from uncertainty and flexibility when assessing a project or decision (Deng et al. 2013; Nelson et al. 2013; Regan et al. 2015), the application of ROA to the Ons Island case has proved that the options to expand or reduce visitors' quotas have intrinsic value, and justify the infrastructure investments needed to guarantee a sustainable tourism development of the island. Thus, a CBA-ROA combined model can be a useful tool for both park managers and government. Park managers will be able to deal with the conflicting interests of stakeholders under an adaptive management

framework of tourism entrepreneurship (McAreavey and McDonagh 2011; Plummer and Fennell 2009), and governments will be able to subsidize or invest in the development of infrastructures or services that would not be otherwise provided (Currie and Falconer 2014; Garrod, Wornell, and Youell 2006), improving the situation of both local populations and the tourism industry.

This conclusion is also dependent on the underlying assumptions. The sensitivity analysis has shown that different assumptions, both related to input data and the stochastic processes considered to model uncertainty, provoke significant changes in valuation results. More than being a weakness of the proposed analytical framework, this should be considered a strength if the objective is to apply the model for strategic decision-making. Paulrud and Laitila (2013) critique that CBA is not usually applied to support management decisions. Similar to Nelson et al. (2013), this study wants to place the analytical power of real options in the hands of PA managers. Managers are asked to translate their management objectives and the necessary constraints imposed by the socio-economic and biophysical environment into benefits and cost figures, including not only all relevant information but also the consideration of uncertainty and flexibility in their decision-making processes. Although the identification and valuation of benefits and costs are not straightforward (Duke et al. 2013), defining a range of possible values and applying a sensitivity analysis on a CBA-ROA combined assessment of any managerial decision can provide useful information to PA managers and facilitate the adaptive management of the conflicting interests of relevant stakeholders.

Although SDR and the $MWTP_{UA}$ are the most influential factors on the ENVPF, the relevance of other variables as conservation costs or entrepreneurship intensity (number of dwellings offered for lodging in Ons Island) should not be disregarded. Under an adaptive management framework based on a CBA-ROA model to support decision-making,

conservation costs become a management tool that can be used to incorporate relevant data about ecological conditions into the analysis of the decision to increase or not visitors' quotas. As pointed out by Pascal et al. (2018, p.11), 'there is a need to improve the ecological knowledge base in relation to CBAs'. An extremely fragile ecological condition could derive in extremely high conservation costs to absorb the impact of greater tourism pressure, advising not increasing quotas and even decreasing them even when visitors' WTP is high. Roberts et al. (2018) highlight the importance of refining the estimation of costs to take improved management decisions.

But the possibility of assuming higher conservation costs derived from increased tourism use is limited by public budget restrictions (Armsworth et al. 2011). Research on the use and non-use values of PAs, and their relation to conservation costs, could be used to justify the establishment of entrance fees (Pascal et al. 2018; Whitelaw et al. 2014). Previous CBA studies have analysed the potential of these fees to guarantee the financial sustainability of PAs (Baral et al. 2008; Thur 2010). None of the Spanish National Parks has entrance fees, and this self-financing option could be explored through studies similar to the one developed here for Ons Island.

Regarding the intensity of tourism entrepreneurship, as the case study has shown, a CBA-ROA combined approach under an adaptive management of the tourism use of PAs enables managers to make decisions that actively work to seize opportunities for entrepreneurship and contribute to regional development (Dana et al. 2014). Poor management of these opportunities can lead to loss of benefits and biodiversity degradation (Johnstone and Lionais 2004). Properly managed, tourism entrepreneurship in PAs could become an example of a market activity that contributes to biodiversity protection and that 'can be successful in economic, ecological and social terms if it builds on regional production factors and entrepreneurship, occupies a niche market and receives regional support' (Seidl et al. 2003, p.

334). Tourism entrepreneurs and PA managers could work together in the definition and management of nature-based solutions (Mandić 2019) directed towards an eco-tourism segment different from the mass tourism one (Pascal et al. 2018). They should also integrate the analysis of visitor's preferences in their decision-making processes (Mandić 2019; Paulrud and Laitila 2013), that is, accounting for visitors' preferences towards active or passive experiences (Moyle et al. 2017). An orientation towards visitors' preferences can derive in higher use and non-use values or visitors' utility (Paulrud and Laitila 2013), while nature-based tourism can help in controlling conservation costs (Chen et al. 2017), thus contributing to a higher value of the expansion option and, ultimately, to the development of a sustainable tourism entrepreneurship.

With the proposed combined CBA-ROA model, park management could become a relevant agent to promote entrepreneurship even if other local, regional, or state enforcement mechanisms are lacking (Godlewska and Morawska 2020). The views and knowledge of reputable private sector operators should also be considered (Spenceley and Snyman 2017). Public authorities could use this information to design new policies or strategies oriented towards sustainable or nature-based tourism (Iakovleva et al. 2012), encouraging an innovative entrepreneurship based on nature-based-solutions, instead of a merely opportunity-driven entrepreneurship (Ali et al. 2020). The development of an entrepreneurial orientation among local tourism operators is also crucial to allow grassroots innovations based on nature-based solutions that contribute to sustainable tourism (Lordkipanidze et al. 2005) and create both economic and non-economic benefits for entrepreneurs themselves (Singh et al., 2019). Community participation in the design of these nature-based solutions 'is seen to be a fundamental component of landscape sustainability and social equity' (Alexander et al. 2018, p. 351) and could significantly contribute to the sustainable management of PAs (Hiwasaki 2006). The design of nature-based solutions will likely demand both learning and

unlearning processes from entrepreneurs (Clinton et al. 2020) and derive in different entrepreneurial strategies like modelling or experimentation (Markowska and Wiklund 2020). However, care must be taken as traditional profit-oriented entrepreneurs delivering undifferentiated and high-impact nature-based tourism experiences could replace true eco-entrepreneurs (Swan and Morgan 2016).

Whitelaw et al. (2014) refer to the possible link between nature-based tourism in PAs and payments for ecosystem services. Visitor fees can generate income through market-based demand and regulate the inflow of visitors (Baral et al. 2008). Different tourism packages could also be offered at different prices, or short visits penalized at a higher price (Viteri Mejía and Brandt 2015). However, Banerjee et al. (2018) find that management strategies based on improving tourism quality have a bigger impact on the regional economy than adjusting fees. Sustainable tourism in PAs must be competitive, demanding close cooperation between stakeholders to guarantee the quality of the tourism services (Mayer 2014).

An adaptive management framework for sustainable tourism (McAreevey and McDonagh 2011; Plummer and Fennell 2009) would help to resolve conflicts among conservation, visitation, and habitation in Ons Island, also common at other PAs (Jamal and Stronza 2009). This adaptive management demands the development of new managerial capabilities for park managers (Eagles 2014). Under this co-management framework, the possibility of using the results of CBA to support the vested interest of particular stakeholders, signalled by Feuillette et al. (2016), is strongly reduced. It is also important to note that this adaptive decision-making framework for PAs is not incompatible with traditional management strategies based on carrying capacity. On the contrary, ecological, economic, and social carrying capacity criteria under a combined CBA-ROA analytical framework can facilitate the optimal balance between nature conservation objectives and socio-economic development.

6. Conclusion

Highlighting the relevance of tourism entrepreneurship in PAs, this study contributes to the underdeveloped analysis of tourism in relation to economic development and growth (Calero and Turner 2020). It embraces an adaptive management framework of the tourism use of PAs that has been advocated as appropriate to deal with the conflicting economic and ecological interests that converge at PAs, but neither extensively applied nor researched in the past (Islam et al. 2018). New decision-making tools, which can integrate stakeholders' expectations and, particularly, visitors' preferences, and to deal with monetised values of benefits and costs, have been demanded in this context (Duke et al. 2013; León et al. 2015; Pascal et al. 2018; Weaver and Lawton 2017). The case study on Ons Island has shown that a combined CBA-ROA methodological approach can be an effective tool to support a sustainable tourism entrepreneurship development in PAs. ROA application to the tourism management of PAs is, to the best of our knowledge, non-existent, and has been acknowledged to be underutilized in decisions on land use management (Regan et al. 2015), while Nelson et al. (2013) claim on the convenience of increasing the use of ROA in conservation and related natural resources management.

The proposed analytical framework is a flexible, intuitive, and effective tool that can be easily exported to other natural PAs. Under a CBA-ROA method in the context of adaptive management of the tourism use of PAs, decision-makers should focus on the benefits and costs derived from conservation and think about how alternative management strategies could affect them. Researchers, policymakers, and park managers can directly take it as a reference model than can be adapted, completed, and revised to fit particular situations and needs.

Although the 'highly specific spatial and temporal variation associated with costs and benefits of environmental conservation (...) limits the spatial transfer of studies' (Roberts et

al. 2018, p. 1), the combination of CBA and ROA provides an adequate and flexible framework for decision making about tourism entrepreneurship in PAs worldwide.

Among the limitations of these conclusions and their potential applicability in practice, managing PAs under an adaptive framework based on real options is more complex than basing on alternative inflexible strategies, and demands both management capacity (Eagles 2014) and an institutional capacity to execute the options in a timely fashion (Linguisti and Vonortas 2012). The need for permanent monitoring of the use and non-use value attached by visitors to the PA also imposes major concerns, mainly due to the absence of indisputable methodologies for its estimation.

Other limitations are related to the difficulty to set the underlying assumptions to develop a CBA and ROA (stochastic processes, interrelations among the number of visitors, WTP, and conservation costs, etc.). Nevertheless, a combined CBA-ROA method is flexible enough to allow the consideration of alternative input parameters or decision rules and test their impact on results, and here is where its real potential resides, as each decision-maker should define *ad hoc* all these features. The quality of the result will depend on the availability and capacity to timely collect and manage key scientific and socio-economic information (Linguisti and Vonortas 2012).

Some improvements and extensions or alternative perspectives can be considered in further work. Conservation costs have been treated as deterministic in the case study, but they could be modelled through a sort of cost function considering the relation between conservation costs and tourism pressure, thus providing a more accurate assessment of the alternative management options considered concerning visitors' quotas.

On the other hand, given public budgeting restrictions, it is difficult to assume that an increase in conservation costs could be only covered with public funds. Thinking about WTP as a potentially real entrance fee and exploring the self-financing options of PAs is then

straightforward. The analysis considering visitors' WTP as a real entrance fee that provides additional income for park management (Leung et al. 2018; Whitelaw et al. 2014) is not essentially different from the one developed in this study considering visitors' WTP as a proxy for the use and non-use value of the PA. Baral et al. (2008) and Thur (2010) analyse these links between tourism and financial sustainability. Extending these models with the application of ROA could be a valuable contribution. In this context, the relationship between access fees and the number of visitors should be further investigated, paying attention to its role as a tool to manage visitor numbers (Whitelaw et al. 2014), although Baral et al. (2008) and Thur (2010) find no significant impact of the establishment of entrance fees on the number of visitors, and Roberts et al. (2018) signal that an improved quality can attract more visitors and counteract the potential negative effect of increasing fees.

Alternative approaches could also be tested to estimate use and non-use values through other methods, such as CEs (Chen 2019; Juutinen et al. 2011) or neuroscience-based methods (Herbes et al. 2015), paying higher attention to visitors' preferences and their predictors (Mandić 2019). Or a different perspective can be considered to estimate benefits as the valuation of ecosystem services (Pascal et al. 2018).

Exploring these future research avenues could help in refining and improving the proposed CBA-ROA method to provide the appropriate analysis and decision-making framework to both public authorities and park managers, allowing to deal with the competing interests of the different stakeholders and, in particular, contributing to regional development through sustainable tourism entrepreneurship.

Acknowledgements

Funding details

Disclosure statement

Data availability statement

Table 1. Alternative calculations of the mean WTP (standard deviations in parenthesis)

	Uncertainty adjusted		No uncertainty adjusted	
	With outliers	Without outliers	With outliers	Without outliers
With zero-WTP	5.62 (5.92)	4.86 (5.51)	7.81 (8.41)	6.35 (6.99)
Without zero-WTP	8.57 (5.3)	7.41 (5.23)	11.91 (7.68)	10.54 (6.07)

Table 2. Parameters and input data for baseline NPV

Concept	Value
Days of high season per year (a)	130
Current daily visitors' quota in high season (b)	1,300
Current daily camping quota in high season (c)	300
Maximum annual no. of visitors ((b + c) × a)	208,000
No. of visitors in 2019	150,000
No. of dwellings with potential tourism use (d)	119
No. of accommodation places per dwelling (e)	6
Current accommodation places in guesthouses (f)	126
Current accommodation places in the camping area (g)	276
Maximum no. of accommodation places (apart from camping area) (h = (d × e) + f)	840
Maximum annual no. of visitors if overnights are not discounted ((b + c + h) × a)	317,200

MWTP _{UA} (€)	4.86
Marine and terrestrial area of Ons Island in the national park (ha)	2,641
Increase in conservation costs ha ⁻¹ for sustainable tourism management (€ ha ⁻¹)	347.45
Total CAPEX in infrastructure improvements (€)	12,500,000
SDR	4%
NPV time horizon (years)	65

Table 3. Breakeven values for the baseline NPV

Concept	Breakeven values
MWTP _{UA}	7.33
Increase in conservation costs ha ⁻¹	161.39
SDR	-2.14%

Table 4. Parameters for the GBM and LG stochastic processes

<i>GBM parameters</i>	
<i>Drift rate (m)</i>	0.02628447
<i>Standard deviation (s_{GBM})</i>	0.09670202
<i>LG parameters</i>	
<i>LG rate (r)</i>	0.04781483
<i>Standard deviation (s_{LG})</i>	0.10113927

Table 5. Results of 2,000 iterations of the Monte Carlo simulation on the NPV with uncertainty (€)

Concept	Value
	13,634,585
ENPV (a) (standard deviation in parenthesis)	(25,573,546€)
P5	-17,071,177
P95	59,216,259
2020-2085 average MWTP _{UA} -GBM (standard deviation in parenthesis)	16.22 (10.46)
Minimum-maximum range of the 2020-2085 average MWTP _{UA} -GBM	2.97-93.67
2020-2085 average non-truncated LG annual no. of visitors	231,223.90
2020-2085 average truncated LG annual no. of visitors	184,732.51
NPV (b)	-11,361,796
VU (a - b)	24,996,380

Table 6. Parameters and input data for flexibility analysis

Concept	Value
Maximum annual no. of visitors (do nothing or keeping current quotas)	208,000
Maximum annual no. of visitors if an additional quota for overnights is set	317,200
Maximum annual no. of visitors if quotas are reduced $((b + c + h) \times a)$	166,400
Increase in conservation costs ha^{-1} for sustainable tourism management under the expansion option (€ ha^{-1})	529.87

Increase in conservation costs ha^{-1} for sustainable tourism management	277.96
under the reduction option (€ ha^{-1})	

Table 7. Results of 2,000 iterations of a Monte Carlo simulation on the NPV with flexibility (€)

Concept	Value
ENPVF (a) (standard deviation in parenthesis)	24,360,551 (36,475,230)
P5	-13,005,105
P95	92,108,929
ENPV (b)	13,634,585
NPV (c)	-11,361,796
VU (b - c)	24,996,380
VF (a - b)	10,725,966
VF of expansion option	8,824,769
VF of reduction option	1,901,197
VRO (a - c)	35,722,346

Table 8. Sensitivity analysis of ENPV and ENPVF under alternative stochastic processes for the MWTP_{UA} (in € miles)

<i>Concept</i>	<i>MWTP_{UA}</i>	<i>MWTP_{UA-}</i>	<i>MWTP_U</i>	<i>MWTP_U</i>
	<i>-GBM</i>	<i>GBM 0%</i>	<i>A-MR</i>	<i>A-LG</i>
		<i>drift</i>		

<i>ENPV (a) (standard deviation in parenthesis)</i>	13,635 (25,574)	-10,953 (10,089)	-11,883 (3,966)	-4,394 (8,881)
<i>P5</i>	-17,071	-24,031	-19,356	-18,933
<i>P95</i>	59,216	7,508	-6,125	10,425
<i>2020-2085 average MWTP_{UA-GBM}</i>	16.22	5.56 (2.81)	5.37	7.42
<i>(standard deviation in parenthesis)</i>	(10.46)		(0.49)	(1.87)
<i>Minimum-maximum range of the 2020-2085 average MWTP_{UA-GBM}</i>	2.97- 93.67	1.25-30.14	3.89- 7.01	2.97- 14.26
<i>2020-2085 average non-truncated LG annual no. of visitors</i>		231,223		
<i>2020-2085 average truncated LG annual no. of visitors</i>		184,732		
<i>NPV (b)</i>		-11,362		
<i>VU (a - b)</i>	24,996	409	-521	6,967
<i>ENPVF (c) (standard deviation in parenthesis)</i>	24361 (36,475)	-7,109 (12,069)	-9,285 (3,498)	167 (10,674)
<i>P5</i>	-13,005	-20,021	-15,435	-14,980
<i>P95</i>	92,109	16,041	-3,615	19,611
<i>VF (c - a)</i>	10,726	3,844	2,598	4,562
<i>VRO (c - b)</i>	35,722	4,253	2,077	11,529

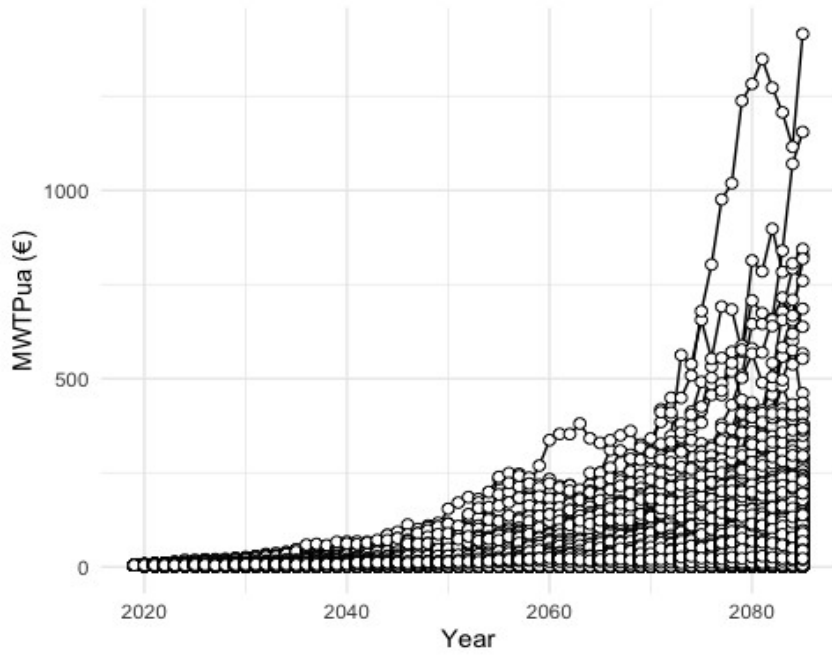


Figure 1

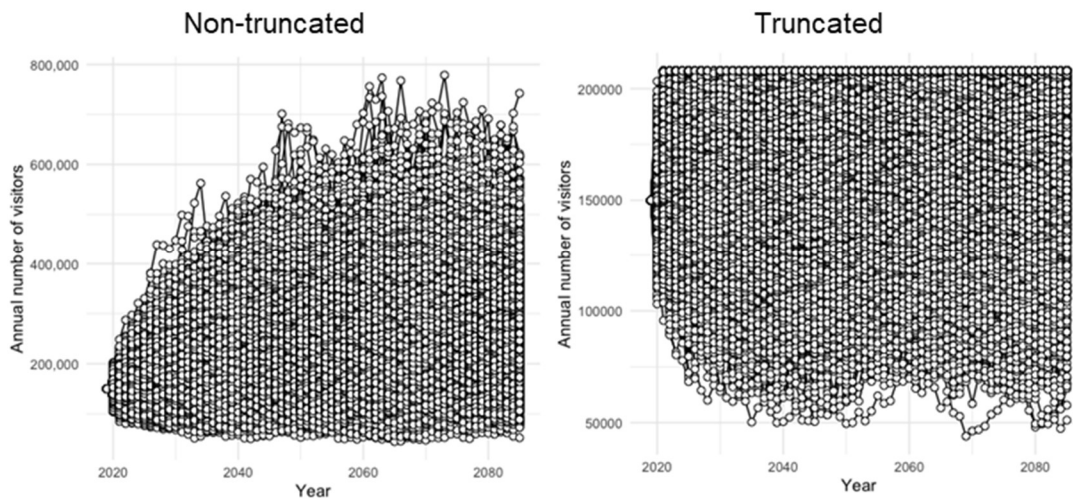


Figure 2

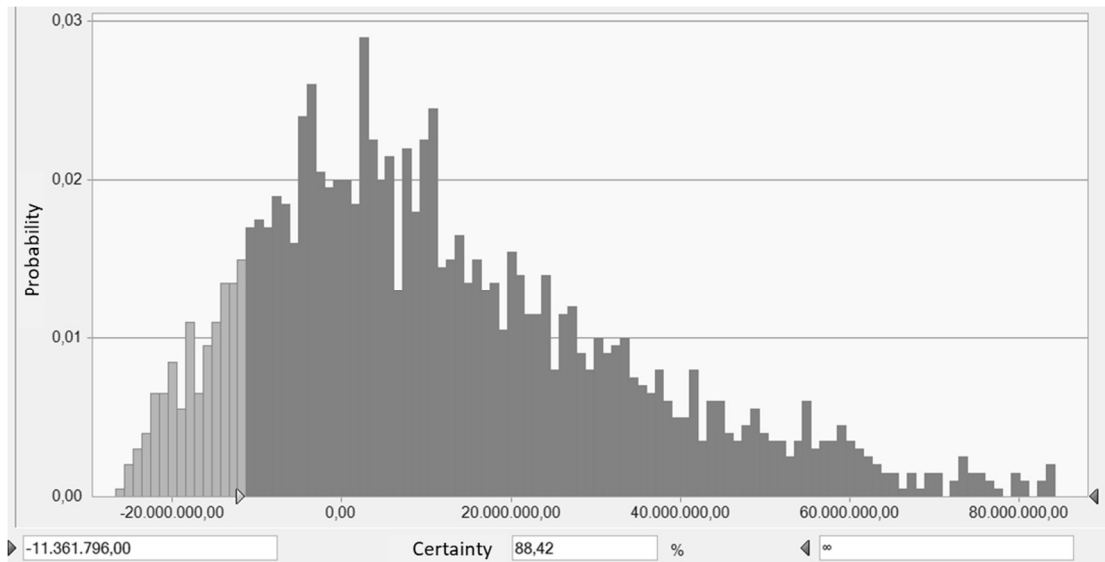


Figure 3

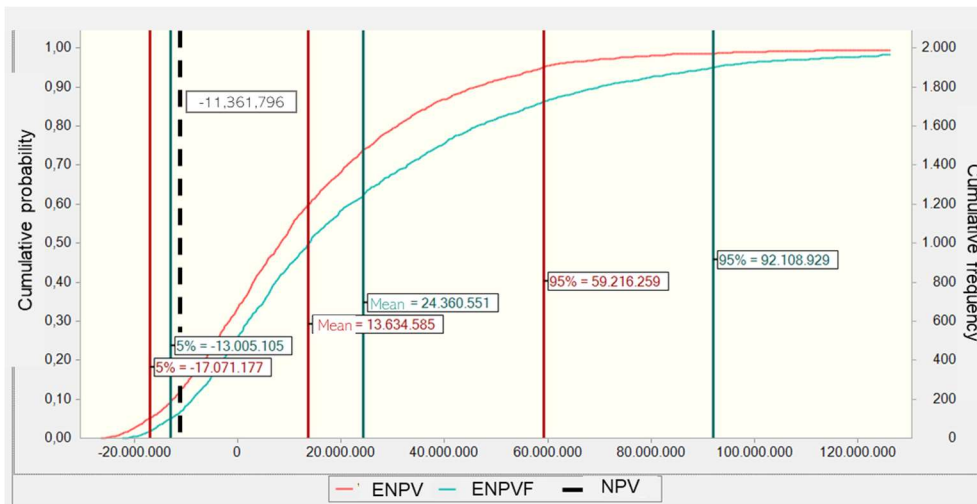


Figure 4

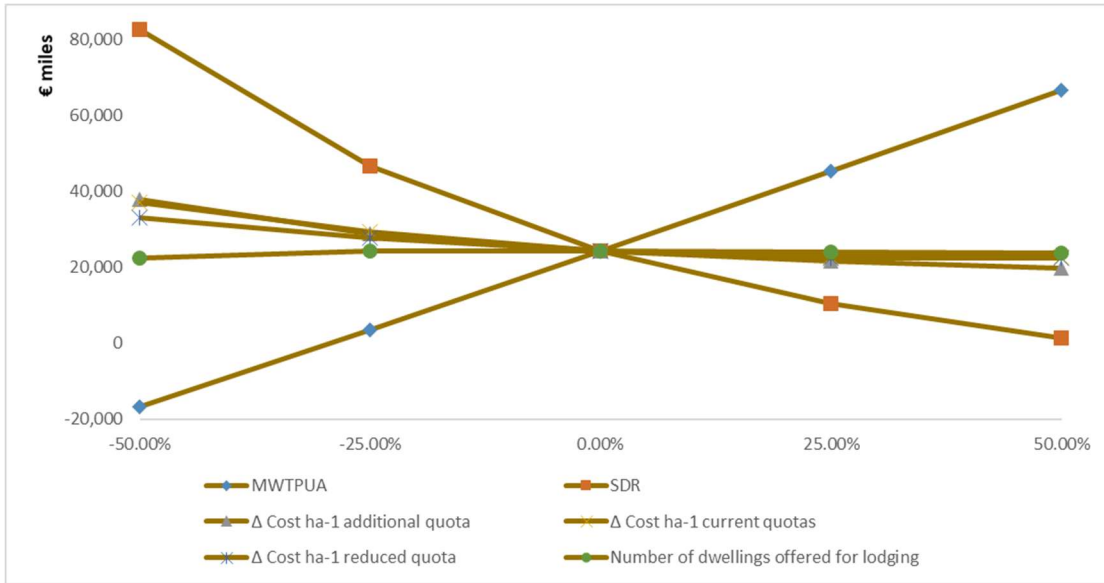


Figure 5

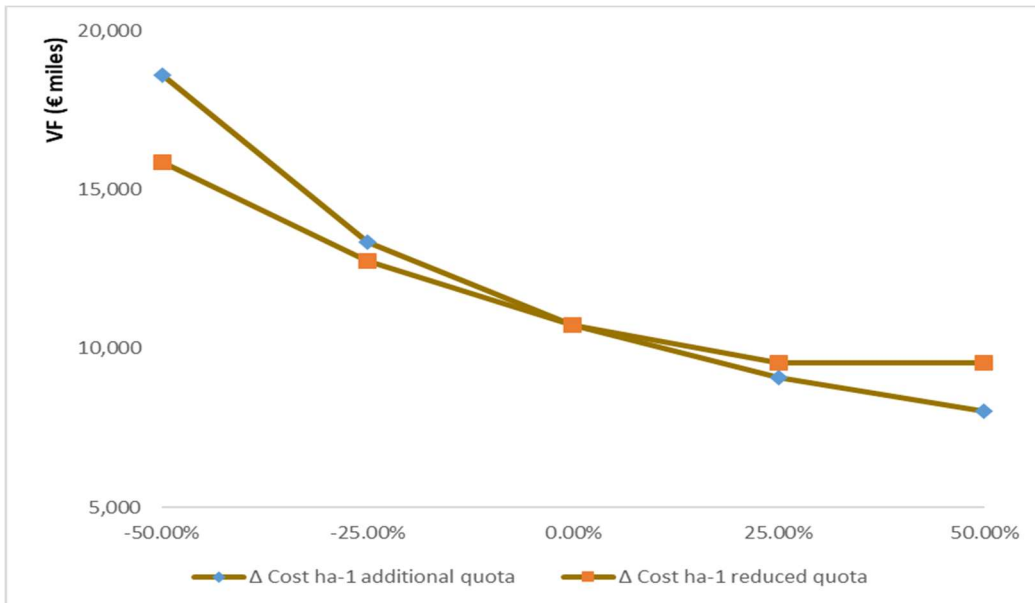


Figure 6

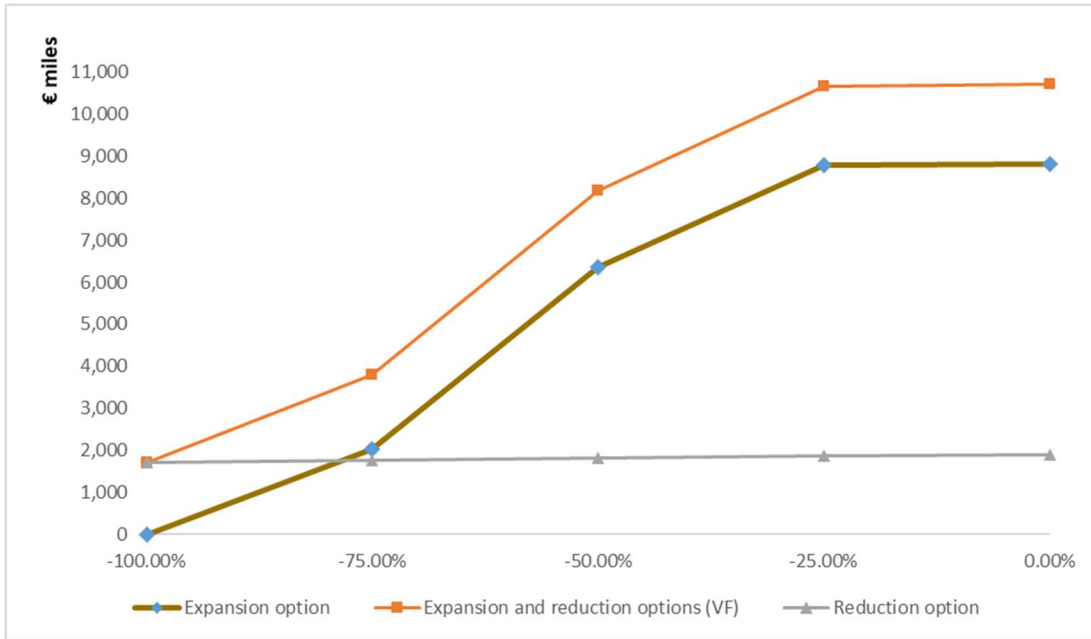


Figure 7

Figure 1. 2,000 paths for the MWTPUA 2020-2085 time series.

Figure 2. 2,000 paths for the 2020-2085 annual no. of visitors (non-truncated and truncated).

Figure 3. NPV with uncertainty frequency chart.

Figure 4. Cumulative distribution functions of NPV, ENPV, and ENPVF after 2,000 iterations.

Figure 5. Sensitivity analysis of ENPVF.

Figure 6. Effect of a $\pm 50\%$ variation in the incremental costs of the expansion and reduction options on VF.

Figure 7. Effect of a decrease in the no. of dwellings offered for lodging on VF.