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Game theory and governance of protected areas – Peneda-Gerês National Park

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Abstract: The literature shows that integrating tourism management with place governance practices is conducive to harmony and development in urban areas. However, protected areas face peculiar governance and management challenges. This article offers an in-depth study of the governance of the Peneda-Gerês National Park in Portugal. We model the incentive structure of some of its stakeholders through game theoretical techniques and find that early phases were not conducive to cooperation among relevant stakeholders, potentially leading to outcomes that were less than optimal, both to them and to the park. The most recent, co-management, model seems much more promising.

Subjects: Hospitality Marketing; Strategic Management; Tourism Planning and Policy; Public Management

Keywords: Game theory; place governance; stakeholders theory; strategy; tourism

1. Introduction

According to the International Union for Conservation of Nature, there are over 4,000 classified national parks, 500 of which are in Europe. One of the most biodiverse is the Peneda-Gerês National Park (PGNP) in Portugal. Besides its role in preserving biodiversity, this park is also a significant asset to the local economy. It is a singular destination in the region, offering a wealth of opportunities for outdoor recreation and connection with nature. Its attractiveness has fostered regional development, especially through tourism. Indeed, there were 188.605 registered visitors to the park from 2019 until 2021. Globally, in 2022, the PNPG had a total of 493 tourist accommodation establishments, corresponding to an exponential increase (796%) compared to 2011. The protected area has an installed accommodation capacity of around 8.985 users.

Despite significant evidence that integrating tourism management with place governance practices is conducive to harmony and development in urban areas (Mata, 2019), the literature on protected areas is still scant (Gurran & Phibbs, 2017). The governance of parks like the PGNP is particularly challenging. It is asked to consider both the goals that a national park is expected to serve, the preservation of biodiversity, and its effective role in regional development. It, therefore, needs to foster the congruency of both and resolve tensions among stakeholders' aspirations and plans of action. Adding to this complexity, the PGNP overlaps the territory of several political and administrative units. It is governed by no less than five municipalities from three different districts.

In this article, we seek to elucidate the interconnectedness of the plans of action of the five municipalities responsible for the governance of the PGNP. We model their strategic interaction through a game-theoretical perspective. The diversity of the evolving incentive schemes stakeholders faced in the PGNP offers a promising case study (cf., Eisenhardt, 1989; Yin, 1994)). Our

central research question concerns the potential behavioural consequences of the evolving incentive schemes confronting stakeholders. Additionally, we aim to discuss how those consequences potentially impact cooperation and welfare.

To do so, we analyse three scenarios corresponding to different phases in the park's history. First, the municipalities act separately. Second, an association centralizes their interests and promotes their cooperation. Third, municipalities coordinate and work together in a co-management model. Each scenario's incentive and strategic structure is described with an appropriate game. The expected outcomes are analysed and compared. The findings highlight the negative impact of divergent behaviours and attitudes on the outcomes of each stakeholder. In other words, we find theoretical reasons for the claim that the alignment and cooperation among municipalities lead to a better performance for them all, and we also identify mechanisms that aid or hinder that alignment and cooperation (Alonso, 2011; Alonso & Bressan, 2017; Brunori & Rossi, 2007; Carson et al., 2014; Giuseppe, S. Festa et al., 2020b; Rodríguez et al., 2014).

We believe our contribution to be twofold. First, we make a theoretical contribution by illustrating the fruitfulness of game theoretical perspectives in studying the governance of protected areas with strong touristic interest (Lalicic & Weber-Sabil, 2020). This is noteworthy given the paucity of literature studying the governance of those areas. Second, our in-depth case study of this important park makes a practical contribution to its management and governance, but also to those of infrastructures characterized by similar incentive schemes and strategic contexts (see the cases of Drage et al., 2022; G. Festa et al., 2020a; Meng et al., 2022; Rastogi et al., 2010; Wondirada & Ewnetub, 2019).

The next section reviews the relevant literature (Section 2). It is followed by the presentation of the governance models employed through time in the PGNP (Section 3). Then, we explore these different models from a game-theoretical perspective (Section 4). We conclude by reflecting on the impact and limitations of our main findings and suggest future avenues for research (Section 5).

2. Governance and management of protected areas and the challenge of touristic activities

The International Union for Conservation of Nature (IUCN—International Union for Conservation of Nature, 2008) defines a protected area as a specific geographical space that is recognized, dedicated and has a management system implemented that allows long-term nature conservation considering the ecosystem services and local cultural values. The definition of protected areas is an important instrument in conservation strategies.

Protected areas are rife with management and governance challenges (Borrini et al., 2013). To name but a few, there are challenges with the definition of the area, like its geographical space, the resources dedicated to conservation, or the values the area is intended to preserve. There are challenges in defining actors with a legitimate say in management and governance. There are challenges in defining appropriate decision-making and incentive schemes to foster appropriate day-to-day and long-term management of the area.

In recent years, preoccupation with the governance and management of protected areas has grown. While management refers to what is done with specific means and actions, governance refers to who decides the objectives, what to do to pursue them, and with what means, and also how decisions should be taken, who holds power, authority, and responsibility (Borrini et al., 2013).

There is no one-size-fits-all ideal governance and management for all protected areas. Still, several principles and good practices can be adduced. Borrini et al. (2013) study, following

the IUCN, identified a few. Promoting the active engagement of stakeholders in the governance of the area, with the local community treated as a key partner, is relevant (Lalicic & Weber-Sabil, 2020). This implies that whatever institutions are brought to bear should enjoy their acceptance and trust.

Further, thorough information should be easily accessible and actively shared with all stakeholders in a timely manner. Advances in the use of big data could be useful (Shams et al., 2022) as it can consider the contributions and connections between different types of stakeholders. Clear and efficient avenues of communication among stakeholders should be created to foster dialogue and consensus and to solve conflicts, like illegal resource extraction, a common problem (Pulhin et al., 2021). Management should follow a consistent, sustainable, and stable long-term vision that is widely shared and understood. Also, it should be sensitive to new ideas and contributions seeking to deal with new challenges, preoccupations, and aspirations.

National parks are a common example of a protected area. Indeed, national parks are areas of interest for the protection and preservation of the natural environment (Pulhin et al., 2021). They are often also explored for public recreation and as tourist attractions. This generates a peculiar challenge for governance: that of finding a balance between preservation and visitation.

In a study of China's National Park, Meng et al. (2022) investigate the coordination among local government, tourism development enterprises, and residents in protected areas. They employ evolutionary game theory and find that factors like the intensity of regulation by local governments, the degree of compensation to ecotourism development projects by tourism development enterprises, and the participation degree of residents in the projects contribute to stabilization. Considering community participation, the authors highlight how local resident participation is key for tackling firms' often short-sighted behaviour. Indeed, the engagement of all stakeholders has long been recognised as important in solving collective action problems. An interesting recent example is Bridou et al. (2022), who use Ostrom's design principles to contrast three alternative governance forms (Hub-and-spoke governance, leaded role governance, and shared governance), discussing the comparative effectiveness of each depending on the type of joint value creation activities.

In a study of the Corbett National Park in India, Rastogi et al. (2010) identify the relevant stakeholder groups, their relationships, power, and importance. Their study helps managers to formulate and implement new strategies by offering insights into the need for stakeholder alliances to strengthen the welfare of a protected area. They also argue how judicious use of information could alleviate conflicts (Rastogi et al., 2010)

In another study on a National Park in South-eastern Ethiopia, Wondirada and Ewnetub (2019) also highlight the importance of community participation for sustainable tourism. The authors apply Arnstein's citizen participation model to better understand the extent of community participation in tourism development, finding more of a nonparticipation continuum, which could lead to inequitable benefit-sharing. Regarding protected areas, the authors document how governmental and nongovernmental institutions may require land for conservation reasons, which clashes with the needs of the local communities, directly dependent on the same resources for subsistence.[1]

Another study emphasizing trade-offs is that of Drage et al. (2022). Studying the Denali National Park in the US, they discuss the trade-off between the beneficial effects of the aviation industry in bringing visitors to the park and its environmental impact on the protected area. Their results indicate that growth in aviation tourism affects both inside and outside the boundaries of the

national park and identify administrative challenges limiting the ability of the National Park Service to manage the impacts of aviation tourism.

Indeed, several problems arise from the different aims of planning of national parks and those of the tourism industry (McCool, 2009). Tourism relies on the park's natural resources, but stakeholders are often only partially involved in conservation and planning. This generates conflicts (Haukeland, 2010). Identifying conflicts or problems connected to each stakeholder helps formulate or revise public policies or place governance policies (Stanila, 2017).

Tourism planning is essential to ensuring the environmental preservation and maintenance of natural and cultural resources. Planning the management of a national park requires collecting and integrating information about the various aspects of the park, namely physical, biological, and social environmental (Eadens et al., 2009; Pulhin et al., 2021; Stadolin & Yamchuk, 2017). It also depends on the information available (Rosalino & Grilo, 2011).

A few studies have already been developed, but there remains a gap in the literature regarding the governance of these areas. Stadolin and Yamchuk (2017) are an example, concluding, after analysing actual governance models for protected natural areas, that there is a need for further literature on the functioning and managerial problems at a municipal level, a topic we explore below. Another example is the contribution of Stanila (2017), who find a need for extensive contribution to the proper organization and operation of current and future protected areas. They find that appropriate management and sustainable development involves complex forms of governance in protected natural areas, forms requiring collaboration and partnerships, a conclusion that dovetails our use of game theory. The development of the research on governance indicates that cultivating place-based value requires engagement with each place and invariable tensions between different stakeholders (Feuer et al., 2021), so literature tends to reinforce that place-based governance is based on the well-documented phenomenon that these tensions are inevitable.

A final example is that of Pulhin et al. (2021), who notice a need for studies about the governance of protected areas like natural parks that provide a wide range of fundamental services that promote human well-being. As noticed, these areas are susceptible to overuse and degradation and involve multiple stakeholders, which necessitate governance models fostering effective, inclusive, and sustainable management.[2]

3. Governance models employed in the PGNP

3.1. The peneda-gerês National Park

According to the International Union for the Conservation of Nature and Natural Resources (IUCN), a protected area is a recognized, managed geographical area, aiming at the conservation of nature, the provision of eco-services, and the valuation of cultural associations over a long-term horizon (Dudley, 2008).

In 1971, the PGNP was the first protected area created in Portugal, and it remains the only one in the country with the status of national park. PGNP is located in northwest Portugal, bordering Spain. It is part of the Gerês-Xurês Transboundary Biosphere Reserve, as designated by UNESCO, since 2009. It integrates the network of biogenetic reserves of the Council of Europe with the "Matas de Palheiros—Albergaria"—an area currently integrated into the Natura 2000 network (ICNB, 2007). It is also part of the International Network Biosphere Reserve.

This protected area is an essentially granitic region, heavily fractured, although there is an important patch of metasedimentary rocks (schists) and deposits of glacial origin, like

moraines or erratic blocks. It is a mountainous area, with altitudes that reach 1545 m, in Nevosa (serra do Gerês). The National Park area is part of the areas of influence of the Minho, Lima, Cávado, and Homem rivers—the most important ones—that compartmentalize the granite massif, individualizing the different mountains: Serra da Peneda, defined by the Minho and Lima rivers; Serra Amarela, defined by the rivers Lima and Homem; and Serra do Gerês, defined by the Homem and Cávado rivers. 235 species of vertebrates are registered. Of the total, 204 are protected at the national and international levels by specific legislation, and 71 belong to the list of endangered species in the Red Book of Vertebrates of Portugal. In terms of birds, 147 species have been identified, but the diversity varies throughout the year and between different biotopes present in the Park. Indeed, many of these species are migratory. As for bats, 15 species were identified in the Park, 10 of which have a threat status. Of these, 5 are classified as "endangered" with extinction (ICNF, 2021).

The PGNP is one of the last strongholds in Portugal where ecosystems can still be found in their natural state, with little or no human influence (cf. Preamble of the Resolution of the Council of Ministers No. 11-A/2011). This national park also enjoys a rich cultural-historical heritage, with remains dating back to the roman civilizations, a megalithic necropolis, and well-preserved traditional architectural villages.

In a study on the organizations involved in tourism activities at the PGNP, Nogueira (2014) finds that they are usually small-sized, with relevant connections between public and private organizations inside the park, the local community, non-profit organizations, and residents. This study uses Social Network Analysis and identifies structural patterns among different stakeholders (263 links and a density of 12.7%). In another study, that of Nogueira and Pinho (2014), the authors found and studied several types of interaction among those stakeholders, including marketing information (like flyers, tourism information, and information on specific events), administrative resources (logistic or technical support), human resources, training, and financial support.

3.2. Governing the PGNP: 1st Phase (1971-1993)

From the creation of the PNPG in May 1971 until 1993, the Park was managed by a technical advisory committee chaired by the park director. The Director was nominated by the Secretary of State for the Environment based on a proposal of the president of the National Service of Parks, Reserves, and Landscape Heritage. The proposed person was a technician of this Service with training as an agronomist, engineer forester, landscape architect, biologist, veterinarian, or holder of a degree ensuring biology and ecology training. The committee included the presidents of the 5 municipalities whose territories overlap that of the PNPG, a national Government representative, one representative of the regional hunting commission and another from the Northern Regional Fisheries Commission, as well as one representative of civic bodies dedicated to the protection of Nature (art. 9, number 1 of Decree-Law 187/71, of 8 May).

In addition to the technical advisory committee, there was a scientific committee chaired by the director of the park, whose members were representatives of several institutions of higher education and research, several governmental bodies, and one representative of civic bodies dedicated to the protection of Nature (art. 10, Decree 187/71, of 8 May). The technical-consultative commission was responsible for giving opinions on technical, social, tourist, or advertising matters of interest to the Park (art. 6, number 1 of Decree-Law 187/71, of 8 May). The scientific committee gave opinions on matters concerning the pursuit of the scientific objectives of the Park, namely with regard to integral reserves (art. 7, number 1 of Decree-Law 187/71, of 8 May) Table 1.

Table 1. Governing the Peneda-Gerês National Park (1st Phase)

1st PHASE—From May 1971 to Jan 1993
Place Governance Model
- No specific cooperation; The governance of the PGNP is based on a technical advisory committee chaired by the director of the park and a scientific committee
Cooperation Areas
- Long-term scientific planning; Valuing natural resources; Nature preservation/Conservation; Educational, tourist and scientific issues
Penalties
- No penalties are defined

Stakeholders	Interests and Benefits
A – Major stakeholder (decision-making power): technical advisory committee chaired by the director of the park	Policy formulation and Management Preservation/Conservation Law enforcement
B – Secondary stakeholders (no decision-making power): - 5 Municipalities (Arcos de Valdevez Region, Ponte da Barca Region, Melgaço Region, Terras de Bouro Region and Montalegre Region); - Secretary of State for Information and Tourism; - Northern Regional Venatory Commission; - Northern Regional Fisheries Commission; - Associations and foundations created to promote the protection of Nature - Higher Institute of Agronomy; - Higher School of Veterinary Medicine;—Faculties of Science and Letters of Universities from the mainland; —Higher Schools of Fine Arts; - National Agronomic Station; - General Director for National Buildings and Monuments; - General Director for Hydraulic Services; - Lisbon Geography Society; - Associations and foundations to promote Nature protection - Tourists	Infrastructure Security Controlled Management External promotion Territory occupation Cultural heritage Use of the land Access to protected areas Residence license

3.3. Governing the PGNP: 2nd Phase (1993-2021)

The second phase began in February 1993 and lasted until March 2021. Due to conflicts connected to governance, nature protection, and local development, there was a need for a new governance model. An association, ADERE, was created to help the governance of the PGNP. ADERE, in its constitution, included the 5 municipalities. It also partnered with other stakeholders for specific projects, like the Northern Regional Coordination and Development Commission or local cultural and recreational associations. The main areas of place governance of ADERE were local, regional, and cooperation development; strategic planning; sustainable tourism; professional qualification and administration and Finance. ADERE's activities were focused on the development of projects financed by the European Community and the Portuguese State, with the aim of contributing to the improvement of the living conditions of the resident populations and to the valorisation and conservation of the Natural and Built Heritage. With the implementation of these projects, it was also able to promote and publicize the regions abroad, both among visitors and tourists. At the same time, it developed Vocational Training actions for residents in the PNPG Regions, providing participants with knowledge and skills that improved their professional performance or created new sources of income complementary to agriculture.

The Land Use Plan for the Peneda-Gerês National Park (LUPGNP) was approved in 1995 by Council of Ministers Resolution No. 134/95, of 11 November, to be implemented for 10 years. It was revised in 2011 through the Resolution of the Council of Ministers no. 11-A/2011. At this stage, a management model was adopted based on the positive differentiation of residents in the park. For instance, traditional grazing and traditional practices of beekeeping and circulation and visitation are always allowed to residents, even in

areas of full protection. Secondly, the plan (LUPGNP) established a clear written definition of the areas subject to protection regimes and the areas that, as part of urban perimeters, were not subject to them. Thirdly, the protection regime of areas with the highest proximity to a state of natural evolution and less altered by human intervention was increased, namely through better and more comprehensive zoning of total protection areas (nature preservation). Fourthly, the procedures for authorization and issuing of opinions by the ICNB, I. P., were simplified, in particular, the procedures for prior control of urban planning operations. Finally, the conditions for visiting the area of the PGNP and the conditions for welcoming visitors were improved, namely through the "Doors of the Peneda-Gerês National Park" Project, which developed anchor structures in the management and promotion of visitation in the surrounding territory. The "Doors of the Peneda-Gerês National Park" Project brought equipment prepared for the reception, recreation, and leisure of visitors to the Park. These spaces are framed by an information system and environmental and heritage awareness, which prepares the visitor to explore the surrounding territory. Visitors can collect information on the activities of environmental entertainment and nature sports that can be developed in the territory. Thematic exhibitions and interpreted trails that integrate each of these facilities are also part of the offer.

Despite the participation of the 5 municipalities that made up the park mediated by ADERE, at this stage, the municipal land use plans that did not comply with the LUPGNP provisions had to be subjected to change by adaptation, prevailing the LUPGNP guidelines over these. Thus, at this stage, cooperation between the various municipalities already took place, but their autonomy in terms of park management was still limited (Table 2). The ICNB—Institute for the Conservation and Biodiversity was the one that still had the power on policy formulation and management, while the municipalities only cooperated as secondary stakeholders (with no decision-making power).

Table 2. Governing the Peneda-Gerês National Park (2nd Phase)

2nd PHASE—From Feb. 1993 to March 2021
Place Governance Model
- Cooperation between the 5 municipalities;
- The governance of the PGNP is based on the Land Use Plan for the Peneda-Gerês National Park (POPNPG) mediated by ADERE (association to the development of the park's regions) that was created in Feb. 1993. The 5 municipalities' autonomy is still limited.

Cooperation Areas
- Strategic planning; Valuing natural resources and nature preservation/conservation; Educational, tourist and scientific issues; Promotion; Training; Projects on heritage promotion; Sustainable tourism

Penalties
- Income investment from the 5 municipalities (ADERE financing costs)
- Reduction in tourists
- Less local and regional development and negative impacts on the economy

Stakeholders	Interests and Benefits
A—Major stakeholder (decision-making power): - ICNB—Institute for the Conservation and Biodiversity	Policy formulation and Management Preservation/Conservation
B—Secondary stakeholders (no decision-making power): - 5 Municipalities (Arcos de Valdevez Region, Ponte da Barca Region, Melgaço Region, Montalegre Region, Terras de Bouro Region); - ADERE (that represents the 5 municipalities); - Northern Regional Coordination and Development Commission; - Hunting and Fishing Clubs; - Department of Nature and Forest Conservation; - Humanitarian Associations; - Porto and North of Portugal Tourism Entity; - Sports Recreational and cultural associations; - Local Commercial and Industrial Associations - Local Community and local management associations of land - Tourists	Security Controlled Management External promotion Territory occupation Cultural heritage Use of the land Access to protected areas Residence license External promotion Infrastructure

3.4. Governing the PGNP: 3rd Phase (2021-present)

Finally, a third phase was introduced in March 2021. This ushered in a new co-management model to shape the relationship of the 5 municipalities. These stakeholders now participate more actively in the governance of the PGNP, together with the ICNF (institute for conservation of nature and forests). This institute (ICNF) maintains all its responsibilities in terms of licensing, with the municipalities being responsible for acting more in the field of valuing territories. The ICNF has 50 members of the National Corps of Forestry Agents (hired as civil servants), organized into 10 teams of five members each, distributed throughout the Park for surveillance, prevention, and first intervention in case of fire. The main goal of this new place governance model is to create a dynamic of proximity management, in which different stakeholders put at the service of the protected area the best they have to offer within the framework of their competencies and attributions, putting into practice participative, collaborative, and articulated management. The main areas of cooperation are connected to social, economic, ecological, territorial, and cultural development, promotion, awareness, and communication (visibility) and increase in the number of visitors.

The non-decision-making role of the municipalities in previous phases was very criticized because they were the most interested party concerning park governance. Due to this, a new model was developed: the co-management place governance model. This is a model of greater proximity management of protected areas, established by Decree-Law n ° 116/2019 on 21 august. It links higher education and non-governmental organizations to the environment, in addition to other relevant interlocutors who, in close articulation with the ICNF I.P. (Institute for the Conservation of Nature and Forests), are committed to collaborating for the sustainable promotion and enhancement of the territory, its heritage, and its communities. Now, the national authority for the conservation of nature and biodiversity, the municipalities present in the territory of the protected area, and those who, through experience and technical-scientific knowledge, contribute to the conservation, valorisation, and competitiveness policies of the territory are the group of entities that, in a collaborative and articulated way, embody the Co-management Committee of the protected area as an administration and management body, which is primarily responsible to the community for the performance of its management.

The co-management of the PNPG is implemented through the Co-management Plan that is prepared and executed by the co-management committee of this protected area. It determines the strategy to be implemented to value and promote the territory in question, raise awareness among local populations, and improve communication with all its interlocutors and users. The co-management model of protected areas aims to: a) Create a shared dynamics of valorisation of the protected area based on its sustainability in the political, social, economic, ecological, territorial, and cultural dimensions and focusing specifically on the areas of promotion, awareness, and communication; b) Establish concerted procedures aimed at improving performance in safeguarding natural values and in responding to society's requests, through greater articulation and efficiency of interactions between ICNF, I.P., municipalities and other competent public entities; c) Generate a closer relationship with citizens and relevant entities for the promotion of sustainable development in the protected area.

The five municipalities represent the relevant stakeholders (actors) because they have competencies like the management of protected areas at a local level. They can also establish, instruct and decide on administrative infraction procedures and apply penalties and additional sanctions.

The Peneda-Gerês National Park place governance by the five municipalities (ICNF, 2021) seeks to foster values like the respect and safeguard of territorial resources, to contribute to the development of local activities, to incorporate innovation and creativity, to enable

environmental, economic and social promotion, awareness and communication actions, to stimulate the participation and initiative of civil society, namely through awareness-raising actions and educational projects, as well as partnerships with promoters, companies, research centers, training institutions and municipalities aimed at planning and carrying out actions for the sustainable development of the territory, in particular, actions associated with agriculture, hunting, fishing, culture and nature tourism, to promote debate on activities and actions that take place in the protected area and encourage good management practices for its sustainable use and exploitation, to provide the necessary information to ensure coherence and complementarity among the various bodies and entities, with a view to the sustainable and integrated development of the protected area, to communicate by disclosing the main attributes existing in the protected area, to elaborate and approve the management instruments, after the opinion of the strategic board, to identify the instruments and financing lines to support the execution of the protected area's co-management plan and support potential beneficiaries to access these same lines, and to elaborate and approve the internal regulations necessary for its good performance (See Table 3).

Table 3. Governing the Peneda-Gerês National Park (3rd Phase)

3rd PHASE—After March 2021
Place Governance Model
- Cooperation between the 5 municipalities; The governance of the PGNP is based on the co-management model with the active participation of the 5 municipalities that integrate the PGNP within a dynamic of proximity management; Participative, collaborative and articulated management
Cooperation Areas
- Financial Cooperation; Human resources cooperation; Social and economic cooperation; Ecological cooperation; Territorial cooperation; Cultural development; Promotion, awareness and communication (visibility); Increase in the number of visitors; Strategic planning
Penalties
- Fines; Sanctions (cuts or difficulties in accessing financing); Loss of visitors; Loss of notoriety; Less local and regional development and negative impacts on the economy

Stakeholders	Interests and Benefits
A—Major stakeholder (decision-making power): - 5 municipalities that integrate the PGNP (Melgaço, Arcos de Valdevez, Ponte da Barca, Terras de Bouro and Montalegre); - ICNF—Institute for the Conservation of Nature and Forest	Policy Management Preservation/Conservation Law enforcement External promotion Territory occupation Cultural heritage Infrastruture
B—Secondary stakeholders (no decision-making power): - ADERE (representing the 5 municipalities); - Porto and North of Portugal Tourism Entity; - Representatives of scientific institutions and specialists - Representatives of the central administration services - Parish councils - Environmental non-governmental organizations - Representatives of the associative and business entities - Representative of other entities relevant for the sustainable development of territories - Local Communities and local land management associations - Tourists	Security Controlled Management External promotion Territory occupation Cultural heritage Use of the land Access to protected areas Residence license

Table 4 was developed to better understand and summarize the different phases.

Table 4. Synthesis/Comparison of the three Phases of the Peneda-Gerês National Park Governing

Phase	Governance Model	Benefits/Advantages	Penalties
Phase 1	- No specific cooperation; The governance of the PGNP is based on a technical advisory committee chaired by the director of the park and a scientific committee	- Long-term scientific planning; Valuing natural resources; Nature preservation/ Conservation; Educational, tourist and scientific issues	- No penalties are defined
Phase 2	- Cooperation between the 5 municipalities; - The governance of the PGNP is based on the Land Use Plan for the Peneda-Gerês National Park (POPNPG) mediated by ADERE (association to the development of the park's regions) that was created in Feb. 1993. The 5 municipalities' autonomy is still limited.	- Definition of cooperation areas - Strategic planning; Valuing natural resources and nature preservation/ conservation; Educational, tourist and scientific issues; Promotion; Training; Projects on heritage promotion; Sustainable tourism	- Income investment from the 5 municipalities (ADERE financing costs) - Reduction in tourists - Less local and regional development and negative impacts on the economy
Phase 3	- Cooperation between the 5 municipalities; The governance of the PGNP is based on the co-management model with the active participation of the 5 municipalities that integrate the PGNP within a dynamic of proximity management; Participative, collaborative and articulated management	- Financial Cooperation; Human resources cooperation; Social and economic cooperation; Ecological cooperation; Territorial cooperation; Cultural development; Promotion, awareness and communication (visibility); Increase in the number of visitors; Strategic planning	- Fines; Sanctions (cuts or difficulties in accessing financing); Loss of visitors; Loss of notoriety; Less local and regional development and negative impacts on the economy

4. Game theoryand stakeholders' strategic decisions

To analyse the expected outcomes of different governance and management systems on the PGNP, we adopt a game-theoretical approach. Game theory studies decision-making and strategic behaviour. A game is the formal description of a strategic scenario. It is constituted by the players, referring to the agents, their information set, inclusive of the possible actions available to them, as well as their preferences or payoffs. Game theory is particularly useful for studying strategic interdependence. The latter exists when the payoff of a player is influenced by the actions of the other players. For instance, the benefits a municipality derives from cleaning its area of the park depend on whether the other municipalities clean theirs. Game theory also usually presupposes that those agents behave rationally and in a self-regarding way, i.e., in accordance with their preferences and making full, reasonable use of all the information available.

Game theory was extensively developed in the second half of the XXth century. Among others, a crucial contribution was that of John Nash, Jr. (1951), defining his eponymous equilibrium concept and proving the conditions for its existence. In non-cooperative static games, there is always at least one Nash equilibrium when players have perfect and complete information. A Nash equilibrium is a solution concept that requires that no player can benefit by unilaterally changing his strategy so long as the strategies of the others remain unchanged. Some of the most famous

static games are the battle of sexes (with multiple Nash equilibria), the prisoner's dilemma (with an equilibrium that is not Pareto optimal), or the stag hunt game (which describes a conflict between safety and social cooperation). In recent decades, several Nobel Memorial Prizes in Economics have been awarded to researchers using game theory as a methodology. The future of game theory applications thus seems auspicious.

Game theory has been applied to various fields, not only in economics but also in political science, psychology, sociology, and others (Kreps, 1990). Among these is tourism. An example is the contribution of Zhao et al. (2019), focusing on regional tourism cooperation. These authors used an asymmetric evolutionary game to study intrinsic motivation for cooperation in regional tourist markets. They highlight the need for policy to focus on cooperation maintenance and illustrate how game theory can suggest strategies to tourism stakeholders in competitive environments. Another contribution is that of Sheng (2011), who uses a game theoretical framework to study the context of strategic interactions between competitive and complementary destinations, taking regional competition and sustainable development into consideration. This author shows that sustainable development in a destination requires decision-makers to choose moderate, as opposed to aggressive, strategies. As for Chen et al. (2021), these authors apply game theory to study green supply chains by hotels and conclude that most hotels have an incentive for green growth that is connected to profits. Finally, Tavares and Tran (2019) also use game theory to model competition and cooperation between two tourist destinations—Canada and the USA. These authors seek to better understand the short and long-term impacts of tourism receipts.

Each phase in the history of the governance and management of the PGNP created a specific set of incentives for its governing bodies. In this article, we seek to answer two main research questions:

RQ1: what are the potential behavioural consequences of the evolving incentive schemes confronting stakeholders?

RQ2: how do those consequences potentially impact cooperation and welfare?

To answer them, we model each phase with a different non-cooperative game. Since any model must simplify reality, we work with two-player, one-shot games. However, when feasible or relevant, we generalize our discussion to the n-person, repeated equivalents.

In all our games, the players are the municipalities, who have to decide whether to cooperate or not in the management of the park. The payoffs are intended to capture each municipality's benefit, net of any costs sustained, from the conjunction of its strategies with those of the other municipality. The payoffs are purely ordinal: the most preferred outcome is ranked 4, and the least preferred is ranked 1.

4.1. 4.1. 1st Phase: No cooperation

In the 1st phase, municipalities had no decision-making powers. Each was merely one among many secondary stakeholders. This dilution of relevance tended to foster a self-regarding stance. The relation among the municipalities was indirect. There were thus no obvious means for sustaining cooperation. A municipality that chose to invest in the Park would benefit the others, but had no means of forcing them to share costs. The municipality making an investment would finance the whole cost while the others also reaped the benefit. There was thus an incentive to do nothing and free-ride on the investment of the others. The municipalities found themselves in a Prisoner's Dilemma. Table 5 shows the payoff matrix in normal form for this scenario, with the ordinal ranking of each possible outcome.

For municipality A, the preferred outcome (ranking 4) occurs if it does not contribute when Municipality B makes an investment. In this situation, it would be able to enjoy the benefits of the

Table 5. 1st Phase: Municipalities in a Prisoner's Dilemma

		Municipality B	
		Not Cooperate	Cooperate
Municipality A	Not Cooperate	2,2	4,1
	Cooperate	1,4	3,3

investment without any costs. The symmetrical situation occurs in terms of payoffs when roles are reversed in terms of decisions, as can be seen in the Table 5. If both players decide to keep only their interests in mind, neither makes an investment. This is worse for both, since they would benefit from cost-sharing this investment. Indeed, if both cooperated, their payoffs would be lower than in the scenarios in which they free-ride on the investment of the other but higher than in the no-cooperation scenario. Given this incentive structure, the Nash equilibrium is that both municipalities do *not* cooperate since this is the only set of strategies that ensures that none can increase its payoff by unilaterally changing its strategy.

Two questions may be raised at this juncture. First, whether these results are robust when there are more than two players. Recall that in our case-study, there are five municipalities. Second, whether the results are robust if the players interacted more than once. During the 1st Phase, municipalities interacted repeatedly, across time, without any clear end in sight.

The Prisoner's Dilemma is not trivially generalized to n-players (Hamburger, 1973). Still, much work has been done to identify what other equilibria are likely to be observed if interactions are repeated. As is well-known, when repetitions are finite, the same equilibrium is to be expected in each iteration. However, when there is no end in sight to interaction, as in our case-study, other equilibria may be possible. For instance, a municipality may choose to make an investment to signal to the others that in future years it is open to cooperating. This, of course, hinges on how much the municipality discounts the future: the cost is present, but the benefit is only forthcoming. As Berg and Kitti (2013) demonstrate, however, if agents in a prisoner's dilemma discount the future too much, even with interactions without an end in sight, the only Nash equilibrium is the one of the one-shot game we identified above. This is a likely scenario given that municipal leadership is elected for merely four-year mandates.

In this initial stage, and keeping in mind the two research questions, the equilibrium result shows that the municipalities will opt not to cooperate, which has a negative impact on the welfare of the PGNP. This outcome is driven by the underlying conflict of interests, driven by the lack of dialogue and consensus (as referred by Pulhin et al., 2021). The resulting equilibrium is not beneficial to the National Park. This underlines the need to analyse scenarios with governance policies in place that reduce conflicts, as mentioned by Stanila (2017), and that bolster the cooperation that is necessary for the promotion and protection of the PGND.

4.2. 2nd Phase: Mediating agent (ADERE)

This phase is characterized by the existence of a mediating agent, ADERE, responsible for facilitating cooperation among the municipalities, helping them coordinate to reach the best outcome for the entire PGND. The role of municipalities is, therefore less diluted among other stakeholders, and their relationship is fostered. The centrality of municipalities also indicates that non-cooperation could lead to significant reputational costs. The municipalities, therefore, faced an extra cost if they chose to free-ride on the investment of others. The municipalities found themselves in a Stag Hunt. Table 6 shows the altered rankings for each of the municipalities for this scenario.

Table 6. 2nd Phase: Municipalities in a Stag Hunt

		Municipality B	
		Not Cooperate	Cooperate
Municipality A	Not Cooperate	2,2	3,1
	Cooperate	1,3	4,4

In this setting, there is a mediating agent (ADERE) which interacts with the different Municipalities, driving them to exploit synergies and therefore maximize their payoffs when both cooperate (4,4). If a municipality opts not to cooperate, it can explore the beneficial returns obtained from the investments undertaken by the other municipality, saving the investment cost, but it incurs an even greater reputational cost. This outcome is thus ranked 3. The one who bears the brunt of the investment is even worse-off. Finally, when neither municipality invests, they will tend to have lower rankings (2,2) given the benefits they were unable to reap and possible reputational costs with their constituencies. Therefore, in this scenario, there are two Nash equilibria, in which both municipalities choose their best responses, and none can unilaterally increase its payoff: one where both municipalities do not cooperate and another where both municipalities cooperate.

Games with multiple equilibria indicate that the strategic aspects modelled do not determine a final outcome. Other factors need to be brought in, like the influence of culture or other aspects that may render one of the outcomes focal to the players. The n-player version is a trivial generalization. As for the repeated game without an end in sight, a similar conclusion applies to that of the 1st Phase: when the future is highly discounted, the same equilibria are expected in this case.

In this second phase, no cooperation remains a potential equilibrium, meaning that the negative impact on the park's conservation and development is still a possibility. As a result, the outcome may not be socially optimal. Moreover, this phase indicates that costs play a role in the decision-making process, as Chen et al. (2021) pointed out. This raises the need to investigate the impact of other costs (like penalties) on the outcome. These are included in the 3rd phase.

4.3. 3rd Phase: Co-management system

The third stage is characterized by the existence of a co-management system. In this scenario, all municipalities have a direct say and work as a team. The underlying logic is that the players act as a unit, aiming to maximize the outcomes from a global stance and not an individual one. Failure to cooperate is now associated with not only reputational losses but also hefty penalties for breach of behaviour. The municipalities found themselves in an Anti-Harmony game (Berg & Kitti, 2013). Table 7 shows the altered rankings for each of the municipalities for this scenario.

In this scenario, the municipalities' best option is to cooperate. If one does not, the penalty is significant. As a result, both players are worst off when both opt not to cooperate (ranking 1,1—the lowest outcome for both in all cases). In the case where one player opts not to cooperate when the other upholds the commitment to cooperate, the latter is unable to reap the full benefits of the co-management system and therefore attains the ranking of 3 (and not 4, as when all players

Table 7. 3rd Phase: Municipalities in an Anti-Harmony Game

		Municipality B	
		Not Cooperate	Cooperate
Municipality A	Not Cooperate	1,1	2,3
	Cooperate	3,2	4,4

cooperate). In this case, the Municipality which does not cooperate, although it bears the costs of non-cooperation (as explained above), given that the other opts to cooperate, is nevertheless able to take advantage of the investment. There is only one Nash equilibrium, in which both municipalities cooperate since this is the only set of strategies such that neither municipality has an incentive to change its strategy. This equilibrium is also an equilibrium of the game with interactions without an end in sight.

In this third phase, the result attained is socially optimal, as the municipalities cooperate, working as a team, fostering the well-being of PGNP, and enabling its preservation, protection, and development. This governance mechanism enables the alignment of the different municipalities, which have their agendas and whose interactions tend to be conflicting (Haukeland, 2010). The municipalities will be more engaged and jointly contribute to value creation (Bridou et al., 2022) in the PGNP.

In summary, our findings show that the Nash equilibrium depends on the alignment and co-management systems the municipalities (local government) face. Our model indicates that ensuring higher alignment leads to higher cooperation among the municipalities. Additionally, the greater and more effective the mechanisms/sanctions put in place to discourage deviation, the more stable that outcome seems.In other words, if the municipalities have a high level of alignment and strong incentives to stick to the agreed-upon strategies, they are more likely to achieve a stable outcome that benefits the National Park and, therefore, all involved.

5. Conclusion

This study focused on the governance history of the PGNP. It used game theory to model three different stages in that history: municipalities not aligned, municipalities aligned with ADERE, and, finally, a co-management system. When the stakeholders are not aligned, we argued that they were in a Prisoner's Dilemma, and we anticipated that the equilibrium to be observed is one with no cooperation. When a mediating agent (ADERE) was introduced, we found that two Nash equilibria were plausible: one without cooperation and another with cooperation. The third, present phase, that of the co-management system, thus seems more promising, as we anticipate only one Nash equilibrium in which both municipalities cooperate. Therefore, we anticipate that this recent governance model should foster better outcomes for the municipalities and the communities. Our research questions could be answered, then, by noticing that incentive schemes fostering alignment among stakeholders lead to more cooperative behaviours and, consequently, improved welfare.

Our findings make a practical contribution to the management and governance of the PGNP. By throwing light on the role incentives play and especially on the different expected outcomes as they change through time, our contribution can give credence to the current, more promising, co-management model. It also indicates that deepening alignment and cooperation is essential, as the Park inevitably faces new challenges and opportunities. Furthermore, our findings are also useful to those concerned with the management and governance of infrastructures similar to the PGNP.

Our findings illustrate what Lalicic and Weber-Sabil (2020) argue: that in the implementation of protected area management plans, it is essential that the main stakeholders with diverse interests in the protected area are involved and that they do so in cooperation. On the other hand, the absence of cooperation brings lower net gains and potentially a tragedy of the commons, i.e., severe damages to the protected resources, compromising local development and the communities' welfare (as stated by Pulhin et al., 2021). Further investigation is needed, however, to elucidate the negative impacts of non-cooperative strategies, like lower local development, social and economic impacts to the community, or negative impacts on environmental protection.

Another limitation of our study comes from the lack of data concerning the interactions of stakeholders throughout the Park's history. If it were available, we could offer more than broad-

stroke conclusions about cooperation. We might consider a more detailed set of incentives and explain the outcome of fine-grained interactions. Furthermore, our study focuses on a single case. Further research is necessary to clarify not only the usefulness but also the robustness of game-theoretical analyses in the study of protected areas.

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Notes

1. Ju et al. (2022) state that poverty alleviation and ecological resources management should be regarded as a multi-dimensional and complex interactive process. Ecological compensation as a global environmental management policy instrument has contributed to poverty alleviation. Using a dynamic replicator of equations, the authors find the stated strategies for each kind of stakeholder and their results show that the government regulator's strategic choices depend on the expected benefits and costs.
2. A related literature that offers potential insight is that on wine tourism which is, evidently, closely connected to wine-producing territories. Giacosa et al. (2019) focus on the impact of wine tourism not only on wineries (as local stakeholders), but above all on the entire wine-producing territories. The authors study the Italian Piedmont area, a well-known wine tourism destination. They develop a theoretical and empirical framework that highlights how the business model of this wine tourism destination system is sustainable. Similarly, to Festa el al (2020b), the authors emphasize the role of different common goods in the creation of a successful wine tourism destination system that requires different types of stakeholders, including both private and public operators. This said, not all public and private operators are equally engaged in collaborations (Alonso, 2011; Alonso & Bressan, 2017; Brunori & Rossi, 2007; Carson et al., 2014; Rodríguez et al., 2014). Giuseppe Festa et al. (2019) also model collaborations among different stakeholders involved with wine tourism.

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