ENVISION

A SOCIAL NETWORK ASSESSMENT OF THE SIERRA DE GUADARRAMA NATIONAL PARK'S GOVERNANCE

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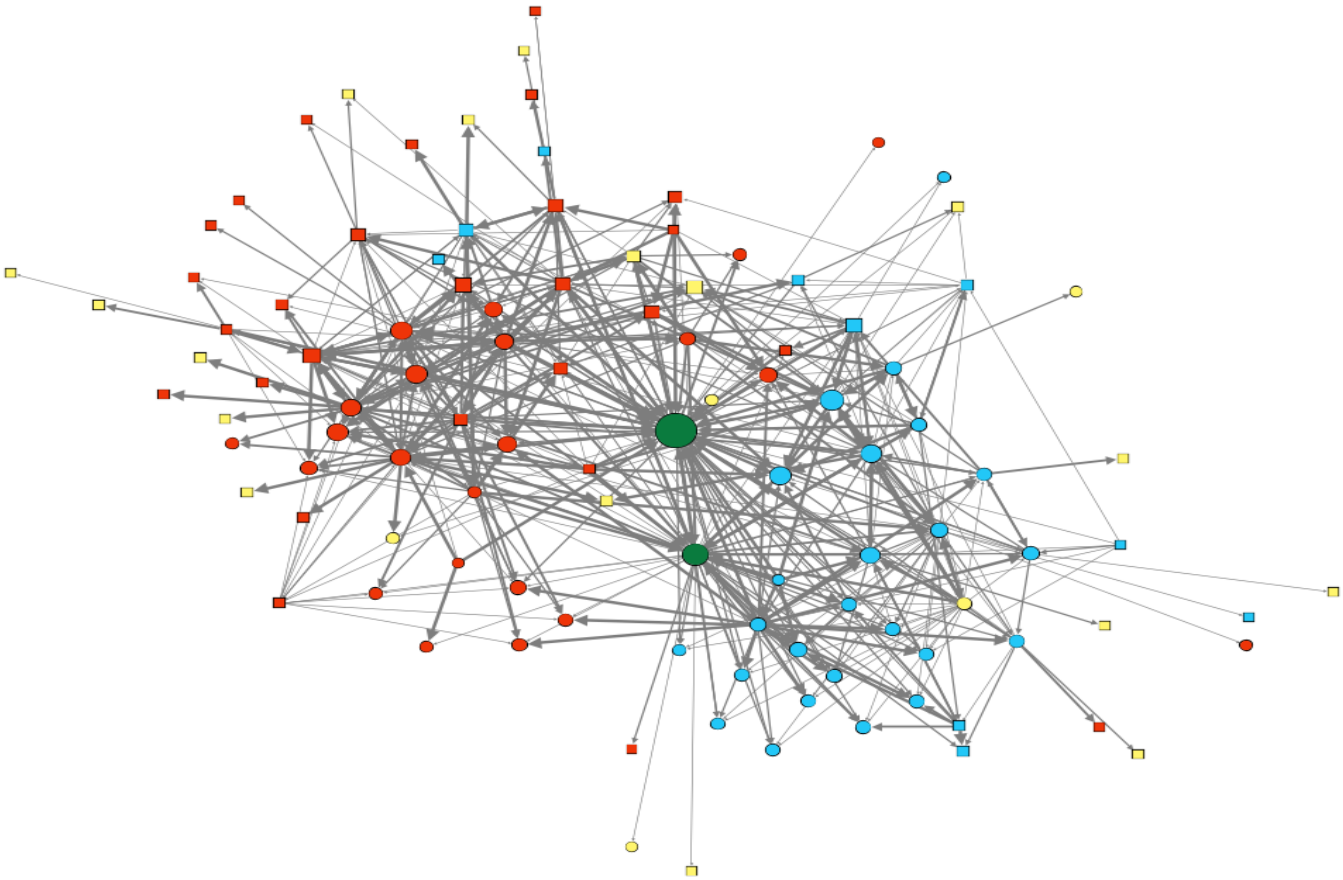

ENVISION is a 3-year research project that develops an inclusive approach to the management of protected areas with the aim of improving biodiversity and human well-being. We engage diverse groups of stakeholders of a protected area, such as recreational users, local residents, local businesses, land owners, agriculture, researchers or local governments and protected area managers.

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1. Abstract

Inclusiveness and participation in protected area management is not only recognised as a challenge, particularly in National Parks, but it is also critical for the achievement of long term biodiversity conservation and respectful human-nature interactions, as has even been recognised in the development of the Post-2020 Global Biodiversity Framework. However, this implies dealing with contrasting views and power relations that create conflict. To unravel the structure and characteristics of relationships between different stakeholders, also in conservation governance, Social Network Analysis has proven to be a useful tool. How do the structures of protected area networks influence landscape management governance processes? Which stakeholders play significant roles in the networks of interaction, information sharing, economic flows, and conflicts? How do different stakeholders group together in terms of their patterns of interactions? What are the differences between state administration and other actors in the roles they play within the networks? We address these questions in the context of the Sierra de Guadarrama National Park, a seemingly recent protected area nearby the largest city in Spain. Through the review of policy document, stakeholder mapping and interviews, we carry out a social network analysis. The results show a centralized structure in the interactions network of the Sierra de Guadarrama, dominated by state administrations and in combination of a decentralized and cohesive network of other actors, different from governmental bodies, that are distributed regionally in Madrid and Segovia. This last finding suggests that such a network has excellent potential for future collective initiatives because of the existing informal alliances between different actors and their regional distribution. Other actors in the SGNP, which are well connected and therefore hold the potential to act as bridges between different stakeholders are an environmental education centre and a tertiary sector association. On the other hand, our results reveal that the network of conflicts cannot be underestimated, so inclusive conservation in protected areas should include social mediation and mitigation measures.

2. Introduction

Protected areas are conceived as the primary strategy for biodiversity conservation and ecosystem services maintenance at global level, but their effectiveness is often being questioned (Coad et al., 2015). Inclusive participation in decision-making has been pointed by many scholars as the cornerstone of effective governance and management (Berkes, 2010; Lele et al., 2010; Porter-Bolland et al., 2012; Reyes-García et al., 2021), an idea strongly supported by recent global biodiversity policies such as the Post-2020 Global Biodiversity Framework (First Draft) (Convention on Biological Diversity, 2021). Local communities' involvement in management facilitates the integration of local ecological knowledge in conservation initiatives, a key determinant for the success of conservation projects (Brooks et al., 2012).

However, some authors highlight the tension between biodiversity protection, natural resource usage, and centralization in decision-making processes across different protected areas (Borrini-Feyerabend & Hill, 2015). This issue is pivotal in the case of National Parks, historically dominated by top-down governance models (i.e., 'fences and fines') and even harder to address in the case of transboundary protected areas that are managed by more than one government body. According to the International Union for Conservation of Nature (IUCN) (Dudley 2008), National Parks' main priority is the protection of natural biodiversity along with its underlying ecological structure supporting environmental processes while promoting educational and recreational activities. Although participatory approaches are widely accepted among National Parks' decision-makers and managers, these are too frequently conceived just as means to inform or consult stakeholders. Consequently, such an approach means that a government body has the full legitimacy, responsibility and accountability for managing the National Park. Widening this approach to embrace the inclusive conservation goals of the Post-2020 Global Biodiversity Framework implies dealing with tensions, such as acknowledging that power relations play a fundamental role in conservation (Raymond et al. 2022).

In this vein, previous approaches to power relations analysis in natural resource management and conservation include the identification of relevant stakeholders, the characterization of their discourses, their relative power, influence, and legitimacy, and their networks of interactions (West et al., 2006; Nchanji et al., 2021). Moreover, power relations can be approached throughout the Foucauldian notion of "constitutive power," understood as the pressures emerging through network dynamics and multiplicities of interactions (Svarstad et al., 2018). In particular, the patterns of relationships and the structural characteristics of such networks, even beyond the absence or presence of relationships between single stakeholders, might be relevant to foster (or hinder) effective governance processes and positive environmental outcomes (Bodin et al., 2006; Bodin & Crona, 2009). For instance, the power and influence held by an organization over natural resource management can be associated with its position and influence within a social network (Ernston et al., 2008; Ernstson, 2011; Borgatti et al., 2009).

Social network analysis (SNA), a set of concepts and methods to systematically measure, describe, analyse and interpret patterns of relationships between actors (Mills et al., 2014), has been suggested as a potentially helpful tool in conservation governance and planning. SNA enables the identification of relevant stakeholders and understanding of their roles (Vance-Borland and Holley, 2011; Prell et al., 2009) to disentangle social structures at place (Bodin and Crona, 2009; Prell et al., 2011[1]), conservation opportunities and constraints (Knight et al., 2010), guiding communication, trust, collective learning and engagement efforts to maximize efficiency (Prell et al., 2009), and/or to target specific stakeholders (Crona and Bodin, 2009). In addition, SNA might inform decision making efficiently, allowing coordinating multiple scales of action (Guerrero et al., 2013), facilitating strategic networking to strengthen linkages between conservation initiatives at different scales and prioritizing conservation actions when combining social and ecological data (Mills et al., 2014). This relational approach also supports transformative change for social-ecological systems' maintenance and adaptation when applied to protected areas' management (Calvet-Mir et al. 2015). However, suggestions for further research on participatory governance in protected areas have pointed out the need to describe in depth the practical mechanisms associated with efficient interventions, the question of which network structures promote local participation or what would be the optimal ratio of bonding and bridging ties, among other issues (Bodin and Crona, 2008; Crona and Hubaeck, 2010; Barabási, 2009; Newman, 2003; Calvet-Mir et al., 2015).

Most frequently, social networks emerge from collaborative relationships (e.g., information or resource exchange) between government and non-government stakeholders willing to achieve common objectives in conservation initiatives. As we mentioned above, the strength of ties, such as power relations, information sharing, and consensus building, may affect social processes in resource management (Prell et al., 2009). Empirical studies suggest that collaborative arrangements, which involve a diverse pool of actors, are more likely to establish adaptive processes than other systems (e.g. Ostrom, 1990). Also, these cases provide arenas for learning and problem-solving, eventually benefiting conflict resolution (Carlsson and Berkes, 2005).

In sum, research supports the claim that stakeholders' network structure affects protected areas' governance processes and outcomes (e.g., the density of relations, degree of cohesiveness, subgroup interconnectivity, and degree of network centralization), but it does not necessarily positively impact the conservation of natural resources. For example, if only a few ties exist among actors, joint action is hard to achieve. However, too many relationships can foster homogenization and reduce the capacity for effective collective action to deal with changing conditions (Crona and Bodin, 2009). In addition, the phase of the governance process (e.g., initiation, reorganization, consolidation) might influence which structural characteristics are most likely to be beneficial (Crona and Bodin, 2009).

The literature on SNA and protected areas management is increasingly accumulating pieces of evidence, but also reports the need to further expand research, for instance when analysing participation within National Parks, e.g.: to incorporate conflictive relationships among stakeholders in the analysis (López-Rodríguez et al., 2020), and to assess the efficiency of the governance system, for instance through external indicators of performance like stakeholder satisfaction measures, or indexes of local development.

To address these gaps in the literature, we developed a research for four years in the Sierra de Guadarrama National Park (SGNP, Spain) and posed the following questions: How do the structures of the SGNP networks look like and do they influence landscape management governance processes? Which stakeholders play significant roles in the networks of interaction, information sharing, economic flows, and conflicts? How do different stakeholders group together in terms of their patterns of interactions? What are the differences between state administration and other actors in the roles they play within the networks?

The paper is organized as follows: the next section describes the Methods, including the data collection and analysis strategies, followed by a description of the SGNP case study. We then report the main Results of our research, which are later discussed in the Discussion and conclusions section, where final remarks and potential further steps in this line of inquiry are provided.

3. Methods

3.1 Case Study

The SGNP (34,000 hectares) is located in the Central Mountain System of the Iberian Peninsula across the regions of Madrid (64% of the territory) and Castilla y León, in the province of Segovia (Fig.1). It was legally established in 2013 (BOE, 2013; BOCYL, 2010; BOCM, 2010), becoming Spain's newest national park. The SGNP protects formations and reliefs of mountains and high mountains (Peñalara is the highest at 2.428 masl), glacial cirques, unique granite rock formations, alpine lakes, grasslands, and pastures, and pine forests that serve as a refuge for autochthonous and diverse biodiversity. The National Park is surrounded by two UNESCO Man and Biosphere Reserves and two regional parks.

The SGNP is managed by two regional state administrations (Madrid and Castilla y Léon), which share the legal authority in conservation decisions and coordinate through a formal decision-making board, the Management Board. In addition, there is: a Coordination Board in charge of coordinating with other state administrations holding the authority de jure in the SGNP; and an Advisory Board, a consultative body to promote the involvement of society in conservation governance (BOE, 2013; BOCYL, 2014). In addition to these decision-making entities, the National Park counts on a variety of formal and informal mechanisms through which stakeholders can participate in the SGNP's governance. Examples of such mechanisms include the participatory process to develop the strategic document that sets a long-term vision for achieving conservation goals of the SGNP (i.e., the Guiding Plan for Use and Management of the National Park, PRUG, according to the Spanish title) (BOCM, 2020; BOCYL, 2019), and informal meetings and workgroups to deal with specific management issues (López-Rodríguez et al., 2020). In the SGNP, a wide diversity of stakeholders are interested in multiple and competing uses such as recreation and sport activities, extensive livestock farming, environmental conservation, education, and research. Climate change constitutes a further critical challenge, due to its impact on water and snow availability as well as species ranges. These features have led to a complex constellation of stakeholders interested and involved in governing the SGNP.

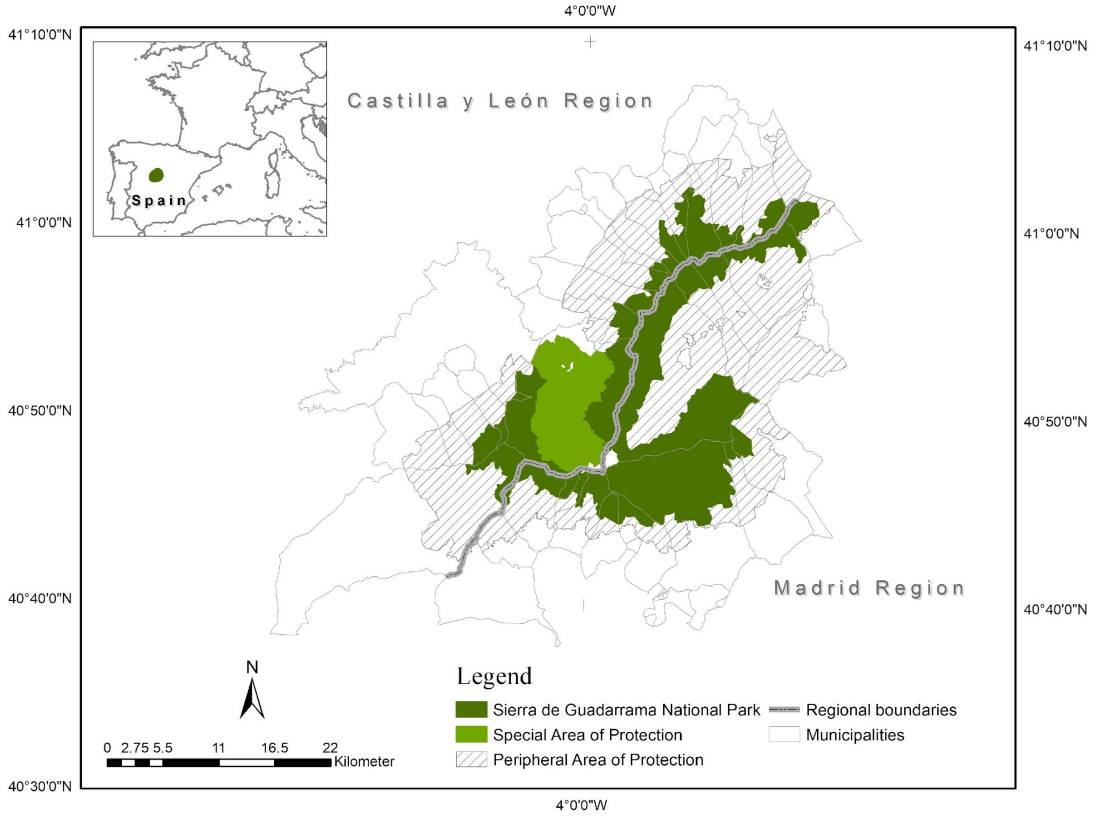

Fig. 1. Map of the SGNP region including the main protected areas and the municipality borders (From López-Rodríguez et al., 2020).

3.2 Data Collection

We conducted nine semi-structured interviews (Ritchie and Lewis, 2004) with key informants (April-May 2019) to achieve a preliminary understanding of the SGNP governance system (as described in López-Rodríguez et al., 2020). The review of policy documents complemented this fieldwork (e.g., participatory processes and formal-based decision-making boards), together with a newspaper library search. To build the stakeholders' universe for the social network analysis, we defined as a criterion the inclusion of all the representatives of institutions, collectives, and individuals with a stake in SGNP management because they affect or are affected by decisions (Reed, 2009). This included representatives of 1) state administrations with legal competencies within and around the SGNP, 2) entities with governance arrangements in the National Park, 3) the Advisory Board of the SGNP, and 4) organizations involved (at least twice) in the participatory process for the elaboration of the Guiding Plan for Use and Management of the National Park. According to these criteria, we identified an initial list of 75 stakeholders to be interviewed.

Next, we designed an interview guide to understand stakeholders' relationships in terms of four types of networks (I) interactions at large, (II) communication, (III) conflicts, and (IV) economic dependency (see Appendix A). The interview guide included a table with the initial list of stakeholders. We coded them according to six predefined stakeholder groups of the

SGNP governance system established previously by López-Rodríguez et al. (under review) (Fig.2). We identified each stakeholder with the code of its corresponding stakeholder group and consecutive numbering. We used the table with the stakeholders coded as support material during interviews to guide the interviewees in undertaking the social network analysis. By using this table during the interview, interviewees were asked to identify stakeholders with relationships for each of the four networks defined in our study. This list was open for incorporating other stakeholders identified by the interviewees who were also coded following the mentioned criteria. We tested the interview guide prior to its use (n=4).

Fig. 2. Stakeholder groups of the SGNP governance system established by López-Rodríguez et al. (under review). Each group includes a code and description.

We conducted 44 interviews (July, September, and October 2019, response rate of 46,32%) with the identified stakeholders (55% from Madrid and 45% from Castilla y León regions; 55% of them state administrations actors and 45% other actors). Before each interview, we informed interviewees that all the responses would be anonymized and used for research purposes, and they gave their previous consent. We applied during the interviews a snowball sampling strategy (Bernard, 2005) to identify potential stakeholders that could complement the stakeholders' universe for the social network analysis. We established that those stakeholders mentioned at least three times by the interviewees would be included as part of our stakeholders' universe. This allowed us to increase the initial list of stakeholders (n=95). We invited all the identified stakeholders from different regions, groups, and gender by email and phone.

We audio-recorded all the interviews and took field notes (Walford, 2009). Subsequently, we developed summaries and applied a mixed-method approach based on qualitative and quantitative analysis to analyse the collected data. For analysing qualitative data, we conducted a content analysis (Hsieh and Shannon, 2005) of the summaries and field notes, consulting audio

files for clarifications when needed. We inductively analysed each qualitative variable (Table 1) by using labels and not predefined codes (Newing, 2011). This way, the variables were classified and grouped into different categories according to their similarity in content: "motivation to interact", 12 categories based on the motivation goals; "forms of collaboration", two categories according to formal and informal mechanisms; "type of information", seven categories regarding the features of the data shared; "conflict description", ten categories built upon the causes of the conflict; and "description of funding", three categories related to the type of funding. For quantitative data, we built matrices for each variable with the data collected classified by stakeholders for the social network analysis. Table 1 summarizes the name generators used in this study.

Table 1. Name generators used for eliciting each type of network (interaction, information, economic, and conflict).

Network	**Type of relation /Question**	**Relation subtype**
Interaction	*With whom do you interact?*	Coordination
		Funding requests
		Administrative procedures
		Research
		Dissemination and education activities
		Volunteering
		Socioeconomic and rural development
		Management/Restoration of natural resources
		Activities for public and recreational use
		Advice on management and regulations
		Surveillance activities and complaints
		Media pressure agreements

Information	*To whom did you provide information?*	Management/administrative /technical/ regulatory
		Uses of the SGNP (public, recreational, etc.)
	From whom did you receive information?	Use of natural resources (firewood, grass, water, mushrooms, etc.)
		Research and scientific activity
		Educational/courses, awareness
		Volunteering
		Local development
Economic	*From whom did you receive economic resources?*	Material resources
		Financial resources
		Human resources
		Miscellaneous
Conflict	*With whom do you have a conflictive relationship?*	Restriction of public/recreational uses
		Restriction of extractive uses (hunting, fishing, pasture, etc.)
		Private land limitations
		Limits/State administration of the PNSG
		Urban expansion/management
		Clash of visions/management criteria/uses of the PNSG
		Non-compliance with SGNP regulations
		Coordination/Disagreement between governmental organizations
		Wildlife population control/management
		Pressure in the media and social media

3.3 Data Analysis

A social network comprises actors (nodes, grouped in the Fig.2 categories) linked by meaningful relations (ties, Table 1). SNA is suited to identify structural patterns among these actors by analysing the relations. The emphasis on relationships and their patterns requires

analytical concepts and methods different from those used in conventional statistics (Wasserman and Faust, 1994). Data analysis includes measurements of the whole network and individual actor levels.

The node attributes included the characteristics of actors like the province (i.e. Madrid and Segovia), municipality, and stakeholder type (e.g. state administrations or other). The networks contained directed data weighting the ties according to the frequency or intensity of for all four networks (see Table 1). We analysed the four matrices with the aid of Gephi software (Bastian et al., 2009) and Ucinet (Borgatti et al., 2002).

At the whole network level, we used the following measures:

- Density: provides a measure of the overall 'connections' between the participants (de Laat et al., 2007). Network density is defined as the number of links observed in a network divided by the maximum number of possible links (Carrington and Scott, 2011).
- Core/periphery: informs whether the network has a core or cohesive subgraph where actors are tied to each while the rest of nodes are loosely connected (Borgatti & Everett, 1999). In this case we tested this measure with the interaction network, which we took as the baseline because it contains the largest number of differentiated relations and includes the majority of the actors involved. Also, its composition is similar to the information network.
- Degree centralization: The extent to which ties are distributed among the actors of a network. This score shows the level of "centralization" or "hierarchy" of a network.

At the node level we used the following measures (Carrington and Scott, 2011:4):

- Degree centrality: is a simple measure of centrality that tells us how many direct connections a node has. Since we are working with directed data it is necessary to distinguish between indegree centrality (the number of nodes adjacent to a given actor measured typically by the number of nominations received) and outdegree centrality (the number of nodes adjacent from a given actor measured by the number of nominations given).
- Betweenness centrality: the extent to which a given actor lies in the path connecting two other actors from the network, i.e., its "mediation" or "bridging" capacity (Zhang and Luo, 2017).

For each network, a data matrix was created considering that all existing ties are directed and filtering out isolated nodes.
In addition, the centrality measures exposed for each node are considered and, in each case, they were analyzed according to the particularities of each type of tie: the indegree for the interaction frequency network, the betweenness for the communication flow networks and conflict network, and outdegree and indegree for economic networks. In Conflict networks we also used "weighted indegree" to ponder the weight of each tie for a better visualization of coexistence of conflicts.

4. Results

The full network including all relations contained 127 nodes or actors, either interviewed directly or mentioned by the interviewees, being the Interaction network the largest one and the Conflict one, the smallest, both in terms of nodes and ties (Table 2). The Interaction network showed the largest density, and the Economic network the smallest. Instead the Economic network was the most centralised one, indicating remarkable levels of economic cooperation, and the Conflict network was the most decentralised. Only the Interaction network showed a clear core-periphery structure.

Table 2. Summary of the network measures for each of the four networks studied in the SGNP.

Networks	N actors	N ties	Density	Degree centralization	Core-periphery structure
Interaction (I)	108	576	0,05	0.444	Yes
Information (II)	106	491	0,044	0.440	-
Economic (III)	73	111	0,021	0.507	-
Conflict (IV)	52	74	0,045	0.399	-

Results reveal that the three types of connections, i.e. interaction, information and economic, are interrelated, while conflict occurs more frequently among nodes in Madrid (Fig.3)

For network analysis and visualization, we use, in all the graphics, the node shape to represent the two types of actors:

- Circle for state administration stakeholders,
- Square for the other stakeholders that are different from state administrations.

The node colour indicates the province:

- Red for Madrid,
- Blue for Segovia,
- Yellow for multi-located stakeholders,
- Green for specific and relevant SGNP stakeholders.

The size of the nodes depends on specific measures of centrality according with the analysis and the network.

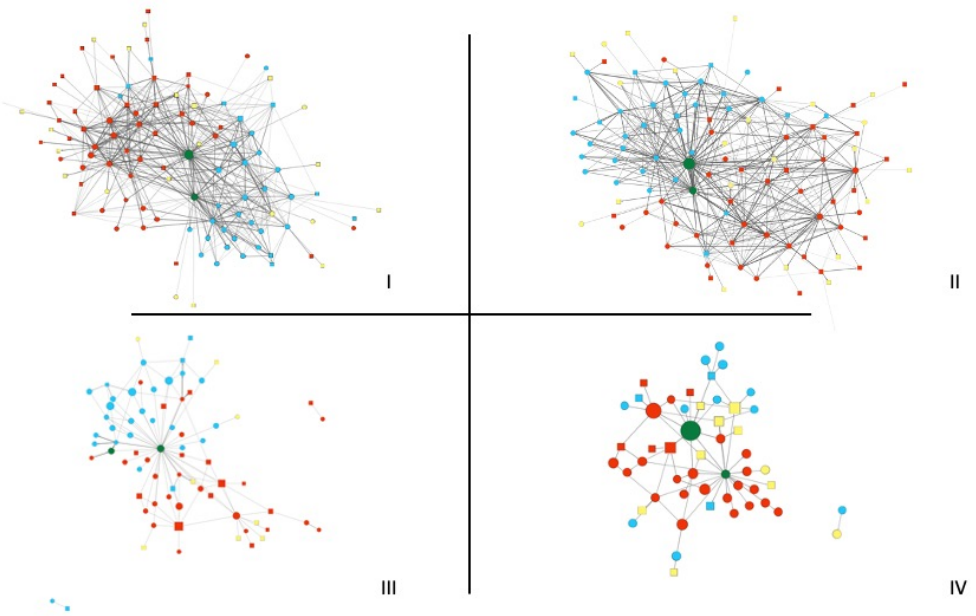

Fig. 3. Plots of the four studied networks: I Interaction, II Information, III Economic, IV Conflict. Size node: Indegree.

4.1 Interaction network

The Interaction network shows, not only the largest number of actors, but also a variety of types of interactions between them. We find that the "administrative procedures" are the most frequently consulted topics (43.6 %), followed by "advice on management and regulations" (mentioned by 32% stakeholders) and "management/restoration of natural resources" (31%).

When focusing on the two main categories of actors separately (state administrations and the rest of actors, see Table 3 and Fig.4), the divide between the two realities clearly appears: state administrations actors' network is less dense, more hierarchical or centralised (with some actors having more ties) and with a core-periphery structure. In such a structure, core actors, like the SGNP Management Board in this case, have considerable power to control other actors' access to multiple sources of information and resources (Wasserman and Faust, 1994). Conversely, other actors conform to a more dense, decentralized network of relationships, eventually an indicator of strong potential for collective action.

Table 3. Network measures for state administrations and other actors' Interaction networks separated.

Level of analysis	**State administrations**	**Other**
N. Actors	71	35
N. Ties	138	81

Network-level measures		
Density	0.095	0.68
Degree centralization	0.685	0.365
Core- periphery	Yes	No

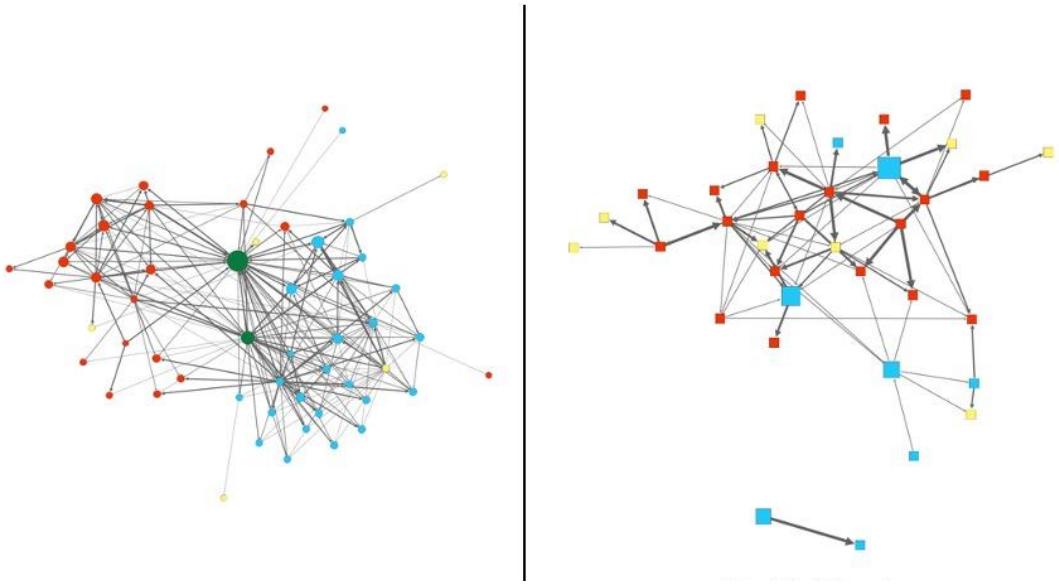

Fig. 4. State administrations stakeholders (left) and other holders (right) interaction networks. Size node: Indegree

Given the coincidence of the pattern found in Fig.4.I with the geographical adscription of the nodes, we decided to analyse the geographically segregated Interaction networks and we indeed found that they were both more dense than the full network (Table 4, Fig.5). However, the degree and indegree of the most prominent state administrations and other actors in the separated networks were smaller than in the full Interaction network (Table 4). The Management Board of the SGNP was equally the most cited (and citing, degree) state administrations-actor in Madrid and Segovia, which is consistent with its central role in the SGNP management setting. Among other actors, it is remarkable to notice that even though the development association of Madrid has a larger degree than that of the national centre for environmental education, they both have similar indegree. These stakeholders might play a relevant role as brokers between state administrations and other actors, for instance when trying to influence both institutional decision-making, and on-ground action by other stakeholders. The environmental education centre is a special actor that can be considered a "scale-crossing broker", i.e. an organization that spends time and resources engaging stakeholders across spatial scales and different stakeholders (Ernstson et al., 2010). By organizing or hosting events and supporting participatory processes, they create and nurture

social arenas to deliberate the (often differing and contested) priorities of different groups for shared resources. However, previous studies have suggested that bridging different levels of organizations and knowledge systems can need multiple facilitators and coordinators, because these scale-crossing brokers often deal with roles beyond brokering knowledge, including resolving conflicts and building trust (Berkes, 2009; Hahn et al., 2006).

Regarding the betweenness, the Management Board of the SGNP shows clearly the largest mediation or bridging capacity as a state administration, not only in general, but also in Madrid and Segovia sub-networks. Instead, regarding the other actors, three different stakeholders emerge with the highest betweenness: two very active conservation NGOs with hands-on local ecological restoration initiatives in Madrid and Segovia sides respectively, and a very long-standing tertiary sector association.

Table 4. Interaction network measures for the networks resulting from the segregation of the two areas included in the SGNP.

Level of analysis	**Madrid**	**Segovia**	**SGNP**
		Network-level measures	
Density	0,07	0,096	0,05
Degree centrality	4,46	4,7	5,333
		Actor-level measures	
Degree	*State administration Actor:* SGNP Management Board (SA_04) Degree: 49 *Other Actor:* Development association (OS_01) Degree: 31	*State administration Actor:* SGNP Management Board (SA_04) Degree: 51 *Other Actor:* Environmental education centre (ER_02) Degree: 16	*State administration Actor:* SGNP Management Board (SA_04) Degree: 92 *Other Actor:* Development association (OS_01) Degree: 35
Indegree	*State administration Actor:* SGNP Management	*State administration Actor:* SGNP Management	*State administration Actor:* SGNP Management

	Board (SA_04) Indegree: 22 *Other Actor:* Development association (OS_01) Indegree: 9	Board (SA_04) Indegree: 21 *Other Actor:* Environmental education centre (ER_02) Indegree: 9	Board (SA_04) Indegree: 40 *Other actor:* Environmental education centre (ER_02) Indegree: 14
Betweenness	*State administration Actor:* SGNP Management Board (SA_04) Betweenness: 4443.1 *Other Actor:* Environmental organization in Madrid side (NGO_03) Betweenness: 84.29	*State administration Actor:* SGNP Management Board (SA_04) Betweenness: 424,20 *Other Actor*: Environmental organization in Segovia side (NGO_04) Betweenness: 22.21	*State administration actor:* SGNP Management Board (SA_04) Betweenness: 180.73 *Other Actor*: Tertiary sector association (TS_06) Betweenness: 142.96

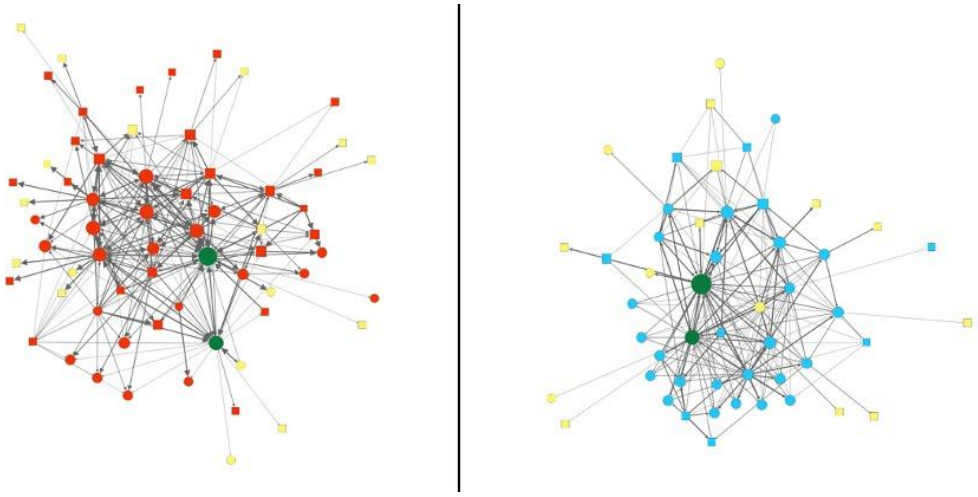

Fig. 5. Regional Interaction networks of Madrid (left) and Segovia (right). The prominent nodes (SA_04 and SA_33) are green. Node size: Indegree

4.2 Information network

To characterise the Information exchange network, we have worked on three different sub-networks after the following name generators: 1) to whom have the different actors provided information (Provide, 105 nodes, 480 ties), 2) from whom have the different actors received information (Receive, 104 nodes, 467 ties), and 3) all information connections without distinguishing whether the information is provided or received (Condensed, 125 nodes, 491 ties) (Fig.6). We observe a similar density (0,03) in the three networks.

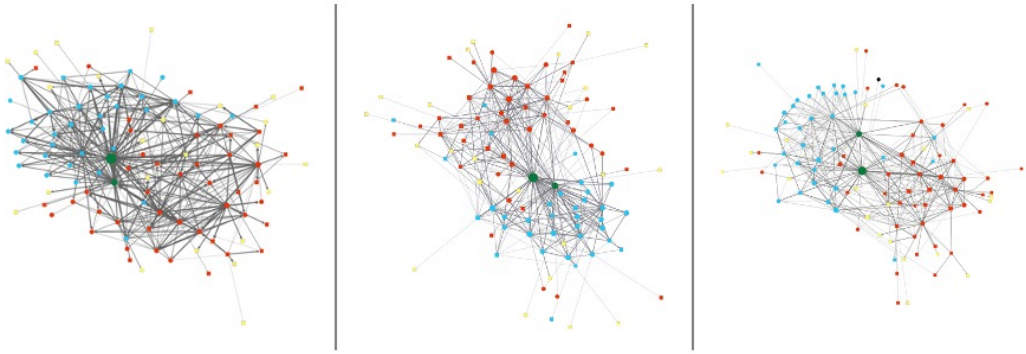

Fig. 6. Information networks: Condensed Information (left), Provide Information (centre), Receive Information (right). Node size: Betweenness.

Concerning communication flows, it is critical to consider the measure of betweenness of the actors (Fig.7): those who have a high index usually act as information transmitters -or potential transmitters- of information (Table 5). In this case the Management Board of the SGNP shows a prominent role in all networks, followed by the Forest Guarding Authority, and three different municipalities in each of the three networks. The previously mentioned environmental education centre appears as a highly requested actor.

Table 5. Measures of the three Information networks in the SGNP.

Information Networks	Betweenness (Nodes)	Indegree (nodes)
Complete	SGNP Management Board (1969.44) Forest Guarding Authority (724.38) City council (SA_24) (343.44)	SGNP Management Board (38) Forest Guarding Authority (15) Environmental education centre (13)
Provide	SGNP Management Board (1921.9) Forest Guarding Authority (694.94) City council (SA_25) (261.18)	SGNP Management Board (37) Forest Guarding Authority (14) City Council (SA_29) (13)
Receipt	SGNP Management Board (2082.48) Forest Guarding Authority (562.43) City council (SA_24) (302.10)	SGNP Management Board (38) Forest Guarding Authority (15) Environmental education centre (13)

We then select the actors who have actively participated both in the reception and provision of information (33) and that, therefore, generate a fluid communication network among its members. This network concentrates 285 ties of mutual exchange information. By using the Gephi filter 'Mutual Edge', we only keep edges that are mutually or reciprocally connected.

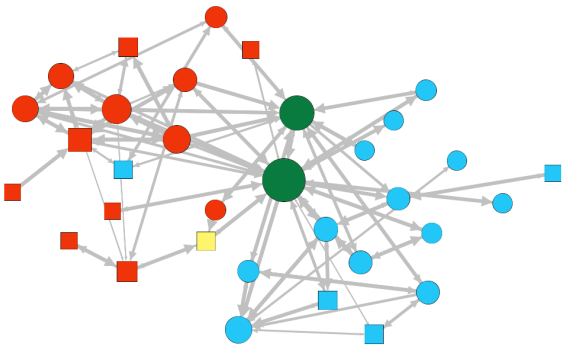

Fig. 7. Network of mutual exchange of Information. Size node: Betweenness. The weight of the edges is thick (more interactions) or thin (less interactions) according to the number of mutual interactions between the nodes.

The other stakeholders present in the mutual network, which has a low density (0.94), are more frequent in Segovia than in Madrid (Fig.8). In fact, with the highest betweenness, three actors stand out: the above-mentioned tertiary sector actor (206.24), the development association (169.84) and one of the local environmental associations (84.040). Most probably the information they exchange is about landscape or natural resource management.

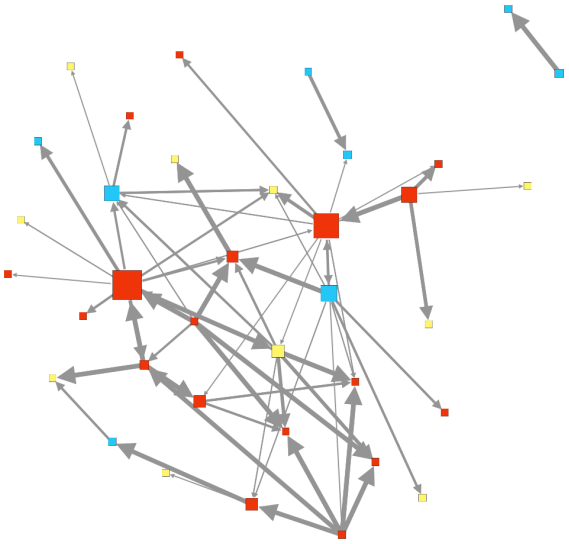

Fig. 8. Information network of other actors (excluding state administrations). Node size: Betweenness centrality.

4.3 Economic network

The Economic resources support network includes the following four types of relations (Fig.9): 1) financial resources (subsidies, membership fees, budget allocations between different levels of government; 67,6% frequency); 2) material resources (transfer of facilities, material, and equipment; 18%), 3) human resources (training, staff support; 3,6%), 4) miscellaneous (management assignments and agreements; 10,8%). This network consists of 73 nodes and 111 edges, and its density is low (0,021).

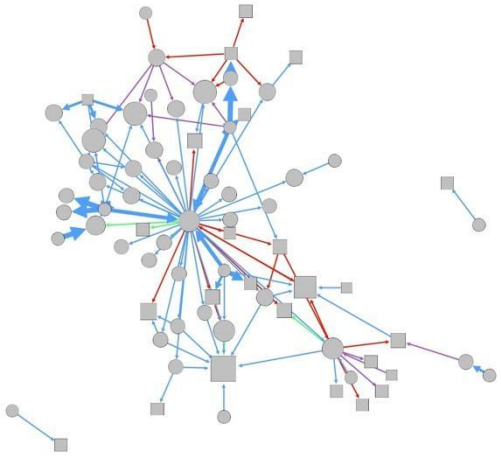

Fig. 9. Network of Economic relations according to their types: blue edges represent financial resources, red edges represent material resources, purple edges represent human resources and green edges represent miscellaneous resources. Node size: Indegree.

The two stakeholders with the highest indegree are not state administration, but rather the development association and the above mentioned tertiary sector association (Fig.10). As expected, the nodes with the highest outdegree are instead state administrations (the Management Board of the SGNP and a municipality). It is remarkable that in this case the, Management Board of the SGPN does not occupy a very central position and, instead, the development association, being in charge of the distribution of Pillar 2 CAP subsidies in the region, shows a more relevant position in the network.

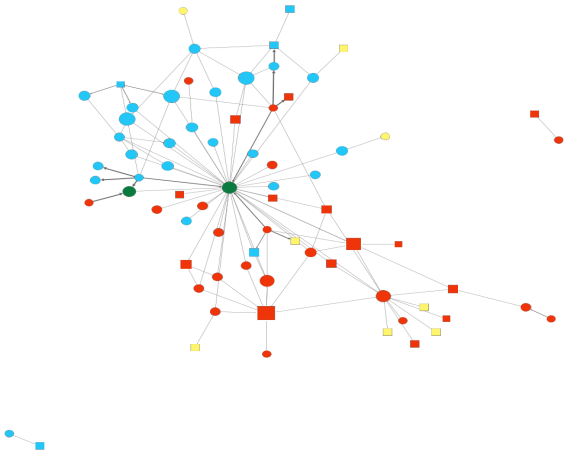

Fig. 10. Economic network. The directed edges indicate the relationship that goes from the stakeholder that gives economic support to the stakeholder that receives it. Node size: Indegree.

The economic relations are geographically segregated (Madrid and Segovia, Fig.11A and Fig.11B) with more dense regional sub-networks than the general network, although with few structural variations. The lack of links between other actors that are not part of the state administration is striking (Fig.11C): we found only one dyad and one triad. Taken together, the three networks help us to understand the key role of state administrations in the flows of resources.

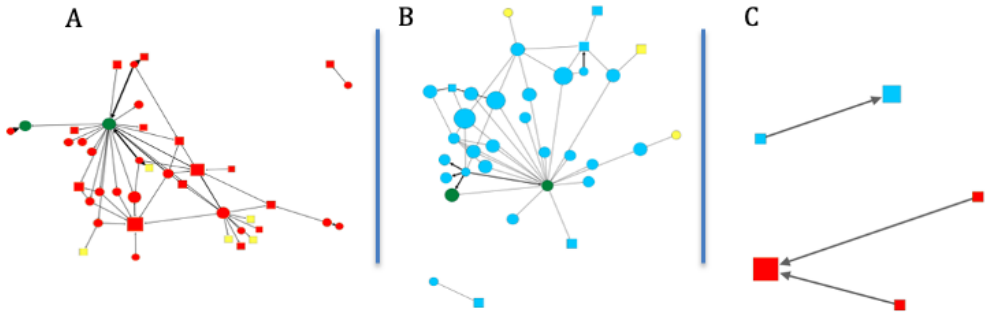

Fig. 11. Economic Network. A) Madrid, 40 nodes, 55 edges; B) Segovia, 34 nodes, 48 edges; C) No-state Stakeholders, 5 nodes, 3 edges. Node sizes: Indegree.

4.4 Conflict network

Conflicts are an inherent part of relationships among people or organizations and this is also the case in SGNP. In our case the conflicts found between stakeholders are of various kinds (see Table 1), but they are grouped in Conflict network composed of 52 nodes and 74 ties, with a low density of 0,03 (Fig.12).

To measure the co-occurrence of conflicts, all types were added in the edge weight (Fig. 12). The thickness of the edges therefore helps to visualize the coexistence of different conflicts and to measure the weighted indegree nodes. The stakeholders with highest weighted indegree are: the Management Board of the SGNP (21.0), an association for mountain sports (13.0), an environmental organisation in Madrid (8.0), and the hunters associations (8.0). The actors with highest weighted outdegree are: the Forestry Guarding entity (due to its responsibility over surveillance, 35.0), the Management Board of the SGNP, a municipality and an environmental organisation in Segovia.

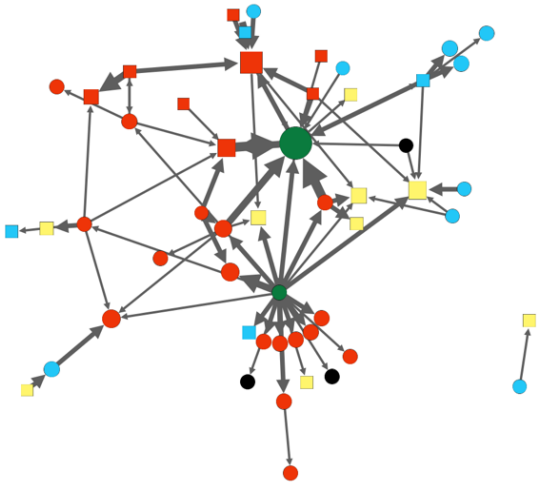

Fig. 12. Conflict Network. Node size: Weighted indegree.

Gephi filter 'Mutual Edge' was applied to the Conflict network, keeping only edges that are mutually or reciprocally connected. The tie strengthening process requires reciprocal interaction between the actors. There were only 7 actors involved in such relations (Fig.13), with the Management Board, the Forestry Guarding, the mountain sports association and the environmental organization, being most central. In this case it is interesting to note that most of them are not state administrations. The nature of these actors, together with the frequency of the types of conflict mentioned, reveals that those between conservation and recreation, and between different views around conservation are the most typical, therefore suggesting the need to consider participation and diversity of views in conservation.

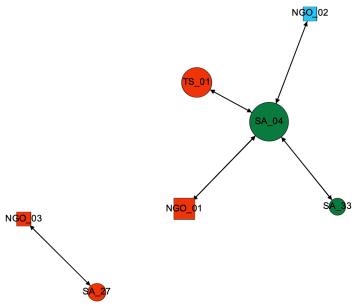

Fig. 13. Mutual ties. Stakeholders involved in mutual conflict relations. Node size: Indegree.

5. Discussion and conclusions

The social network analysis of the SGNP offers a privileged overview of the exchange dynamics between stakeholders in this protected area and provides insights about potential interventions to foster a more inclusive conservation approach. First, our analysis clearly shows that the SGNP is a centralized structure dominated by state administration actors, as it could be expected given it is a National Park. However, interestingly, our results also show that this structure holds a remarkable decentralized and cohesive network of other actors different from governmental bodies that are distributed regionally (i.e., not only in the Madrid region). This last finding suggests that such a network has excellent potential for future collective initiatives because of the existing informal alliances between different actors and their regional distribution. In addition, the network of economic cooperation shows a fluid exchange of resources among all types of actors (and non-solely from top central state administrations actors to the other ones), which constitutes a new indicator of the high potential for further participatory development. The ties of the Interaction network, which are initially used only for specific exchange, e.g. knowledge about resources availability, can evolve into deeper social relationships which in turn can facilitate the development of common norms and values that support cohesion (Crona and Bodin, 2009).

However, as we saw above, relationships are not always positive and productive, and actors are not always effective or collaborative. For instance, depending on the motivations and actions of an organization or person with high betweenness, this strategic position could be utilized to either facilitate or hinder the actions of others or the network as a whole (Grootaert and van Bastelaer, 2002; Mills et al., 2014). This might be the case of stakeholders as the mountain sports association and the environmental association identified. Our results suggest that other actors in the SGNP are well connected, such as the environmental education centre and the tertiary sector association, and therefore hold the potential to deal with the Management Board of the SGNP. However, this potential is not fully realized due to a lack of trust by certain stakeholders in the effectiveness of participatory bodies, such as the Advisory Board, as well as a lack of resources by the SGNP management bodies to create and sustain participation processes. Calvet-Mir et al. (2015) reported a similar situation in another protected area in Spain.

Actually, the network structure with the Management Board of the SGNP displaying such a central role, could be one supporting more inclusive conservation if power would work in synergy with trust, and interactions would be mutual, so that information, support and cooperation could be shared (Graham 2014).

For the case of the SGNP, the network of Conflicts cannot be underestimated, because it allows the identification of barriers and challenges for building consensual solutions between actors, opening venues for further research about the mitigation measures that could be put in place. It is clear that the are dissenting voices in the SGNP, like those of environmental associations with restrictive views on conservation, and those of sports associations with requests for access to organise activities like mountain raids. Making visible and letting them emerge in participatory spaces is necessary but not sufficient to improve inclusive governance. Management approaches for more inclusive conservation in protected areas should include social mediation and new ways to deal with conflicts, which allow balancing the voice of those who are usually marginalised in decision-making and the achievement of conservation goals (Matulis, 2017; Raymond et al., 2022).

Furthermore, our analysis suggests that the SGNP holds the elements for effective governance connecting the more central actors and the other actors into the core of the network of state administrations, reducing the conflicts working separately with the different groups of interest, and promoting the circulation of information in all directions. This integration of the two networks, the institutional highly centralized and the non-governmental one, which is highly cohesive and decentralized, will dismiss the "costs of synchronization" that take place in the two levels, enabling the creation of new values (Lazega, 2020).

To conclude, this network assessment of a National Park provides a blueprint for comparative analysis with other protected areas. In this regard, it would be interesting for future research to have indicators of environmental quality, stakeholders' satisfaction, and local development, among others, to identify which network topologies and dynamics are associated with better outcomes.

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Appendix A.

Description of the variables analyzed for each social network and included in the interview guide.

Network	Variable	Type of variable	Categories	Values
1. *Interaction*	1.1. Frequency of interaction	Quantitative	Very frequent	4
			Frequent	3
			Irregular	2
			Occasional	1
	1.2. Motivation to interact	Qualitative	Content analysis	-
	1.3. Forms of collaboration	Qualitative	Content analysis	-
	1.4. Existence of collaboration	Qualitative	Content analysis	-
			Yes	1
			No	0
2. *Information*	2.1. Information provision	Quantitative	Very frequent	4
			Frequent	3
			Irregular	2
			Occasional	1
	2.2. Information receipt	Quantitative	Very frequent	4
			Frequent	3
			Irregular	2
			Occasional	1
	2.3. Type of information	Qualitative	Content analysis	-

3. *Conflicts*	3.1. Conflict description	Qualitative	Content analysis	-
	3.2. Relationship of the conflict with the management of the National Park	Quantitative	Very related	4
			Related	3
			Indirectly related	2
			Not related	1
	3.3. Existence of conflicts	Quantitative	Yes	1
			No	0
4. *Economic*	4.1. Proportion of funding receptions	Quantitative	>90%	4
			90%-50%	3
			50-10%	2
			<10%	1
	4.2 Description of funding	Qualitative	Content analysis	-