Social networks that shape conservation outcomes

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ABSTRACT

This article explores the role of park rangers’ social networks in two national parks in Sub-Saharan Africa and suggests that the way that actors connect shape conservation outcomes. We do this against the backdrop of how conservation worldwide has moved away from state-centric top-down approaches towards management structures that includes a wide range of stakeholders spanning multiple administrative levels and sectors. This trend entails challenges as well as opportunities for conservation management. The theoretical framework of the study is given by social capital theory and the notion that the structure of social networks – more specifically the three network features of bonding, bridging, and linking – relate to the presence of institutional trust and rule compliance. The findings indicate that the structure of social networks, in particular the different forms of social capital in those networks, matters for the way they function. The result indicates that bridging and linking ties positively relate to institutional trust and rule compliance. These social networks form a basis for building institutional trust in areas where trust towards government tends to be low. Managers should think about these structures when they implement conservation policy. We recommend to 1) foster structures where park rangers connect to a wide range of actors and thus resources, information, and knowledge 2) include park rangers in the decision making for a more efficient and sustainable management, and 3) build bridges that reach the local communities to facilitate institutional trust and encourage voluntary compliance.

1. Introduction

This article explores the role of park rangers’ social networks in two national parks in Sub-Saharan Africa and suggests that the way that actors connect shape conservation outcomes. We do this against the backdrop of how conservation worldwide has moved away from state-centric top-down approaches (Brown, 2003) towards management structures that includes a wide range of stakeholders such as non-governmental organizations (NGOs), government departments, the private sector, local communities, and the military, spanning multiple administrative levels and sectors (Bhatasara et al., 2013; Petursson et al., 2011; Duffy, 2016). This trend entails challenges as well as opportunities for conservation management. On the one side more inclusive and cross-boundary management structures have been argued to be more equipped to solve complex environmental problems e.g., due to the access to diversified resources and the ability to build legitimacy (Bodin and Crona, 2009; Sandstrom and Lundmark, 2016). On the other side the multilevel collaborative management trend has been said to lead to situations where the diversity of actors, and what it implies in terms of competing values, knowledge, and preferred management strategies, challenges the problem-solving capacity (Ansell et al., 2020; Newig et al., 2018). There are lessons to be made about the outcomes of collaborative structures and how these can influence outcomes (Reed et al., 2018). Given the ambiguities in the literature, and the need for more knowledge about how to foster adequate collaboration structures, we see that more theoretical and empirical work is needed that studies how different forms of social structures in conservation management relates to conservation outcomes.

This study explores conservation in the Limpopo National Park and the Gonarezhou National Park situated in Mozambique and Zimbabwe (see map 1). We argue that a social network approach (Prell, 2011) can help to explore the social structures at play in the two national parks.

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This article focuses on the social networks of park rangers and how they connect to other actors. Park rangers are key actors in national park management. They operate at the end of the management chain enforcing conservation law, interacting with the other management stakeholders as well as directly with the citizens that live within and around conservation areas (Day, 2020). Although recent attention has been given to park rangers’ roles and working conditions (Singh et al., 2020; Howard, 2013) as well as the militarization of park ranger’s duties (Annecke and Masubelele, 2016; Day, 2020; Masse, 2020; Trogisch, 2021; Barichievy et al., 2017) studies that focus on how the structure of park rangers’ social networks shape conservation outcomes are missing. We will capture these structures by mapping who park rangers turn to for information and advice and with whom they coordinate their actions regarding conservation management. Drawing on the literature on social networks and social capital theory we further assume that the way these social networks are formed influence the way they function (Bodin and Prell, 2011; Bodin and Crona, 2009; Sandstrom and Lundmark, 2016; Robins, 2011).

While more inclusive management structures are promoted worldwide, they are particularly recognized as important and challenging in the rural African context. We focus on two outcomes that are critical to goal fulfilment in conservation management; namely, the ability to enhance compliance with rules and to build trust (Arias et al., 2015). According to Masse (2020) the mandate and practices of park rangers have shifted from an overall responsibility of conservation towards a stronger emphasis on law enforcement or antipoaching (Masse, 2020). The “green militarization”, i.e., the use of partnerships with military and paramilitary personnel, training, technologies, is a response to a poaching syndicate that is getting more sophisticated (Duffy, 2014; Lunstrum, 2014). Coerced compliance through increased policing and high punishments comes with higher transaction costs which is why sustainable management is dependent on voluntary compliance (Arias, 2015) i.e., peoples willingness to follow rules. Voluntary compliance, in turn, is the result of trust building. Trust in institutions, i.e., the approval and acceptance of an authority, is formed through people’s experiences with the institution (Rothstein and Stolle, 2008; Dinesen and Sønderskov, 2015). In the context of this study conservation management takes place in areas of limited statehood i.e., parts of a country in

![Map 1. Limpopo National Park and Gonarezhou National Park Source: Lunstrum (2013).](image)
which government authorities struggles to implement and enforce rules (Risset al., 2018). Rather than the government, traditional authorities are the trusted authorities of citizens (Boege et al., 2008). Traditional authorities are understood as “a form of governance understood and validated through narratives or procedures deemed ‘traditional’ by constituents” (Holzinger et al., 2016), and include traditional leaders, headmen, chiefs, and elders who’s responsibilities often include land management (Baldwin, 2014; Bank and Southall, 1996; Delius, 2019), holding civil courts on cases relating to customary law (Baldwin, 2014), performing rituals and ceremonies (van Rouvery and van Nieuwla, 1996) and, raising taxes (van den Boogaard, 2020). Although traditional authorities tend to be excluded from the formal conservation management (Linell et al., 2019; Sjostedt and Linell, 2021), their presence and influence over people and resources at local level have been suggested to both hinder and enhance the conservation management process (Dah- berg and Soderberg, 2023). Given the above, rule compliance and institutional trust are important outcomes in national park management in the rural African context.

1.1. Aim and contribution

The aim of this article is twofold: to explore the social networks of park rangers and to examine how these patterns of interactions relates to rule-compliance and trust in Limpopo National Park and Gonarezhou National Park. While the two cases are situated in different countries, with some divergences when it comes to community structures, they do share the overall challenges of management in multi-actor and multi-level management structures in the Sub-Saharan Africa context.

The study will contribute to contemporary research and conservation practices by providing novel insights on the social networks of park rangers, a key actor and perspective that has not yet been fully explored in the literature. Moreover, insights on the possible interplay between these social structures and critical outcomes can contribute to our theoretical understanding of how social networks shape conservation outcomes and have practical implications for how to think of, and encourage the development of, institutions for conservation management in the future.

2. Social network structure with influence on trust and rule compliance

The theoretical framework of the study is given by social capital theory and the assumption that the structure of social networks relates to the presence of institutional trust and rule compliance in the two national parks. Social capital can be defined as social relations with expected returns (Lin et al., 2001) and the idea that the pattern of social relations matter for both individual and process-level outcomes is emphasized in the social capital literature (Borgatti et al., 2002). Since relations shape opportunities as well as constrains for action, we can learn about actors’ problem-solving capacity by exploring the social networks in which they are embedded (Lin et al., 2001). The social network literature suggest that three different types of network structures are of particular importance for understanding how a social network functions: bonding social capital, linking social capital, and bridging social capital. Networks that encompass all three features are of particular importance for understanding how a social structure and critical outcomes can contribute to our theoretical understanding of how social networks shape conservation outcomes and have practical implications for how to think of, and encourage the development of, institutions for conservation management in the future.

Bonding social capital promotes the creation of common norms and values among actors within the same institutional setting (Sandstrom, 2011). It is associated with strong relations within a group where the participants have similar backgrounds, levels of resources, information, and attitudes (Claridge, 2018). In the scope of this paper, bonding social capital refers to park rangers’ relations within ‘their own group’ capturing connections to other park rangers as well as to actors working with conservation law enforcement such as the police and the military. Although these actors may have different assignments in conservation management, they are working within the same formal framework of rules and towards the same goal. High levels of bonding social capital presumably enable common views and knowledge and constitute a strong basis for common action and decision-making in conservation management. Such links are important as it builds trust within the own group and thus encourage park rangers to promote the rules and practices that are set up (Grafton, 2005). Linking social capital promotes the access to power within the formal organization. As with bonding social capital, this type of capital is associated with relations within the formal management structure but addresses, in particular, connections to actors at higher levels of the hierarchy (Dressel et al., 2020; Claridge, 2018). More specifically, linking social capital captures park rangers’ relations to their supervisors, leading the work of park rangers in the field, and to park managers who are responsible for the overall structures and decision-making in the national parks. High levels of linking social capital are beneficial for accessing more knowledge but also for taking part in and influence important management decisions (Dressel et al., 2020; Claridge, 2018). Conservation management thus benefit from linking social capital as it creates an effective management that is shared by the park rangers and park management (Grafton, 2005). Bridging social capital provides access to diversified information and knowledge and is associated with relations spanning across diverse social groups and organizations (Williams, 2006; Putnam, 2000). While bonding and linking social capital refer to connections within rather homogeneous group of actors in formal management structures, bridging social capital pertains to the ties that connect actors outside of these structures, i.e., that constitute bridges across diverse, and otherwise largely unconnected, groups of actors. Building on works by Dressel et al. (2020), bridging social capital is here understood as the links between park rangers and the local community level, including traditional authorities. While the government is represented in the public institutions, traditional authorities are represented by traditional leaders, chiefs, headmen and kings (Mamimine and Mandivengerei, 2001). Russell & Dobson (2011: 746) argue that traditional authorities such as chiefs often are recognized as the institutions that “best represents the norms and values” and therefore are relations between the government and traditional institutions “central to ensuring long-term social and ecological sustainability outcomes”. High levels of bridging social capital are thus

<table>
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<tr>
<th>Type of social capital</th>
<th>Contextualized Definition</th>
<th>Consequence for conservation outcomes</th>
<th>Example</th>
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</thead>
<tbody>
<tr>
<td>Bonding social capital</td>
<td>Strong relations at the same level within the same actor category.</td>
<td>Builds trust within the own group and creates a strong basis for common action and decision-making in national park management.</td>
<td>Park rangers’ connections to other park rangers, the police and the military.</td>
</tr>
<tr>
<td>Linking social capital</td>
<td>Strong relations within the same actor category at higher levels.</td>
<td>Gives access to more knowledge and influence over management decisions leading to more-efficient management.</td>
<td>Park rangers’ connections to their supervisors and the park management.</td>
</tr>
<tr>
<td>Bridging social capital</td>
<td>Strong relations to other actor categories at diverse levels.</td>
<td>Builds trust and bridges to the community level which enhance voluntary compliance. May also harmonize formal and traditional rules and systems.</td>
<td>Park rangers’ connections to the community level including the traditional authority.</td>
</tr>
</tbody>
</table>
important as it may enhance voluntary compliance and trust amongst locals by harmonizing the traditional and park rules (Sjöstedt and Linell, 2021; Tegegne et al., 2022). Table 1 summarizes the theoretical discussion and provides examples in the context of national park management.

In multilevel- and multi-actor management systems, such as the national parks in this paper, high levels of all three forms of social capital are assumed to be important for achieving both rule compliance and institutional trust. Knowledge about the social networks of park rangers and whom they turn to for information, advice and coordinate their actions with, will provide insights into the management structures at the local level and identify both the existence and absence of important relationships (Hanneman and Riddle, 2018). The characteristics of park rangers’ social networks, as well as the relation between bonding, bridging, and linking social capital on the one hand and institutional trust and rule-compliance on the other, will be explored in the forthcoming analysis.

3. Method

3.1. The empirical cases

Limpopo National Park in Mozambique covers an area of about 10,000 km² that was established as a national park in 2001 and Gonarezhou National Park in Zimbabwe was established in 1975 and covers an area of 5035 km² (see Map 1). Both Limpopo National Park and Gonarezhou National Park are managed by a combination of government staff and international NGOs in a multi-level management system. Limpopo National Park is managed by the Peace Park Foundation and Gonarezhou National Park by the Frankfurt Zoological Society. Partnerships with military, as well as training of park rangers in the use of military equipment, have increased the last years in both parks (Witter and Satterfield, 2019; Lunstrum, 2014; Sjöstedt and Linell, 2021). The importance of traditional knowledge and the involvement of local communities are protected by law in both countries, this is illustrated in a range of environmental and conservation policies (see e.g., the Mozambique Environmental Policy (1995), the Environmental Law (1997), the Conservation Areas Law, The Mozambique Constitution, and the Parks and Wildlife Act (1982) in Zimbabwe). Both parks are located in areas where the state’s reach traditionally have been low and the level of trust is similar towards traditional authorities and the ruling party of the country (Afrobarometer A, 2014/2015; Afrobarometer B, 2014/2015). Citizens in both countries moreover prefer to turn to the traditional authorities before the local government representatives when they have a problem or when they wish to express their views (Afrobarometer C, 2016/2018) indicating the importance of building social networks with the traditional authority, i.e., bridging ties, in the two contexts. Finally, it should be noted that although the two national parks in this study share several characteristics in their formal management structure, they also differ in certain regards. Importantly, whilst local communities have been relocated from inside both parks, there are still communities living inside the Limpopo National Park. One of the main ongoing programs in the Limpopo National Park is therefore resettlement of these communities. Dahlberg and Söderberg (2023) have illustrated how the relationship between the park staff and communities living inside the park is strained, and that some of the communities have put up roadblocks to keep park rangers out. Witter and Satterfield (2019) who has studied the situation for the local communities still residing inside Limpopo National Park has argued that “As they await relocation, the basic human security of residents has become deeply undermined by decreased access to environmental resources, an erosion of basic services, increased human-wildlife conflict, and the criminalization of their livelihoods.”. This difference will be kept in mind when interpreting the empirical results and possible differences in outcomes between the two national parks. A strong relationship between park rangers and the traditional authorities and communities in the Limpopo National Park can thus be assumed to be both more crucial and difficult for rule compliance and institutional trust.

Despite this difference in community structure the two national parks, are considered as typical cases of multi-actor and multi-level conservation management (Seawright and Gerring, 2008). By focusing on these two national parks, we are interested in studying if and how different forms of patterns relates to conservation outcomes.

3.2. Material and analysis

This paper is part of an on-going research project in the Great Limpopo Transfrontier Park and Conservation Area, in which interview data with local communities, traditional authorities and elite-actors as well as survey data with local communities have been collected. For this specific paper we rely on data gathered in 2017–2018. As there has not been any major changes in demographics and policies we believe that the results presented in this paper provide a good illustration of how social structures affect conservation outcomes in the area.

The two national parks constitute the main analytical units in this paper, and we rely on three forms of data to learn about social networks and outcomes within these parks: social networks with park rangers, interviews with park rangers and a survey with the local communities.

Network questionnaires and individual semi-structured interviews were conducted with 10 park rangers in Gonarezhou National Park (about 6% of the total numbers of park rangers) and 13 park rangers (about 10% of the total numbers of park rangers) in Limpopo National Park during a fieldtrip that took place from February to March in 2018. We interviewed all park rangers that visited the headquarters during this time-period. Thus, we did not have a random sample. However, the park rangers that we interviewed varied in age, years in the profession, work responsibility and park region. Although in-person qualitative interviews are always affected by interview bias, we believe that it would have been practically impossible to obtain detailed and rich data regarding the social networks as well as the management outcomes in the two parks with a full-scale survey. The average length of the interviews was 60 min. Of the 23 individual interviews, two were conducted in English and 21 with local persons acting as interpreters. Having the discussions in the mother tongue of the respondents contributed to a richer discussion and outweighed the risk of information getting lost in translation.

To map the social networks of the park rangers, the researchers asked several questions about who they connect with, and in what sense, in conservation management. The questions were inspired by previous studies of conservation management (Matti and Sandström, 2011, 2013; Lundmark et al., 2018, see also Zafonte and Sabatier, 1998) and the researchers filled out questionnaires together with the respondents. To explore the social networks and measure the tie strength, we ranked relations influenced by models of collaborative governance from Carlsson and Berkes (2005), Arnstein (1969) and Fung (2006), with the first action, whom they turn to for information, regarded as the weakest relation, the second action, whom they turn to for advice, as the second strongest and the third, whom they coordinate their actions with, as the strongest. For a deeper understanding of the relationships, we also asked the respondents to elaborate on their relationships to the actors during the interviews. Thus, we collected information about the presence and strength of ties between park rangers and other actors through interviews.

The network data was imported and analyzed in UCINET6, a software for social network analysis, and illustrated in Netdraw (Borgatti, 2002; Borgatti et al., 2002). First, the data was analyzed to illuminate

1. Total number of park rangers in Gonarezhou National Park in 2017–2018 was about 180.

2. Total number of park rangers in Limpopo National Park in 2017–2018 was about 130.
the presence of different types of relations. The combined networks were then analyzed to determine the strength of interactions between park rangers and other actors in each national park.

To cover the outcome variables, i.e., rule-compliance and institutional trust, we analyzed data from a survey with 1700 respondents (769 from Zimbabwe, 931 from Mozambique) living inside or in the border area to the Limpopo National Park and Gonarezhou National Park between May 2017 and June 2018. The survey was completed through face-to-face interviews by the research team and random sampling was applied to communities with help from local leadership, government officials, and resource persons who assisted in identifying the communities’ jurisdictions. For more information regarding the data collection see previous literature e.g., Ntuli et al. (2019) or Jagers et al. (2021). To capture rule compliance, we included an item asking, “How willing are you to follow the rules of the park?” (Ranging from ‘not at all willing’ (1) to ‘very willing’ (5)). Second, an item was also included to capture trust in institutions asking, ‘to what extent do you think that the following groups or persons can be trusted?’ with a focus on “Park rangers” (respondents can state answers ranging from 1 (not at all) to 4 (to a great extent)).

In addition to the survey data, we also analyzed the perceptions of park rangers. Two questions were asked during the interviews with park rangers: Do you perceive that poaching has increased or decreased the last five years? /Do local communities trust park rangers? Here poaching is understood as any extractive use of wildlife that is considered illegal in the national parks (Duffy, 1999), thus this includes subsistence poaching as well as poaching for illegal wildlife trade. For the first question data is missing on park ranger 8, Gonarezhou National Park and for the second question data is missing on park ranger 1, Gonarezhou National Park. By capturing the involved actors’ perceptions of the two outcome variables we can triangulate the survey results with the local communities in the studied national parks. Although the park remains the main analytical unit, we are also able to zoom in on individual park rangers’ social networks and study how the pattern of a specific actor relates to his or her perceptions of conservation outcomes.

Lastly, some limitations associated with the data needs to be acknowledged. The number of park rangers included in the study is restricted. The sample restricts the possibility to quantify the results but is considered satisfying for the aim to get a deeper understanding of the structure of the social networks of park rangers and how these structures relate to conservation outcomes. The outcome variables in this paper measure conservation outcomes through the perceptions of local communities and park rangers and not by looking at objective data. Although actual poaching data would have been preferred such data has not been able to access. Thus, we cannot say with hard facts that poaching is on a certain level in the two parks. What we can say, by combining survey and interview data, is how the actors who work daily in the park and the actors who are the main subjects of compliance, perceive rule compliance in the two parks. We return to these limitations in the conclusions of the paper.

4. Results

The empirical findings are presented in three parts devoted to the social networks of park rangers, responses on institutional trust and rule-compliance, and the relation between these factors. The empirical

| Table 2 | The connections of Park Rangers in Limpopo National Park and Gonarezhou National Park. |
|----------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Limpopo National Park | Social capital | How many park rangers turn to the following actor for information: | How many park rangers turn to the following actor for advice: | How many park rangers coordinate their actions with the following actor: | Total numbers of park rangers with connections to the specific actor: |
| Bonding social capital | Police | 1 | 5 | 2 | 5 |
| | Park rangers | 2 | 5 | 4 | 7 |
| | Civil servants | 1 | 1 | |
| Linking social capital | Park management | |
| | Local communities | 3 | 2 | 4 |
| | Traditional authorities | 3 | 2 | 4 |

| Gonarezhou National Park | Social capital | How many park rangers turn to the following actor for information: | How many park rangers turn to the following actor for advice: | How many park rangers coordinate their actions with the following actor: | Total numbers of park rangers with connections to the specific actor: |
|----------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Bonding social capital | Police | 1 | 6 | 8 | 5 |
| | Military | 4 | 4 | 4 |
| | Civil servants | 1 | 2 | 2 |
| Linking social capital | Park management | 6 | 6 | |
| | Local communities | 8 | 8 | |
| | Traditional authorities | 2 | 2 | 4 |
results from the two parks are presented separately to enable an analysis of overall patterns and potential differences between the two national parks.

4.1. Social networks of park rangers in the Limpopo National Park and Gonarezhou National Park

The results in Table 2 indicate that park rangers’ networks in Limpopo National Park and Gonarezhou National Park consists mostly of ties to actors within the same category, i.e., other government actors such as the police, the military and other park rangers, illustrating the presence of bonding social capital (see Table 2). The interviews show that these bonding ties are especially important for increasing the manpower needed to carry out the work. Coordination with the police takes place when they, for example, have captured poachers and the police come to pick them up. In Gonarezhou National Park, park rangers furthermore conduct joint operations together with the Zimbabwean National Army, patrolling and catching poachers together. In Limpopo National Park another tie within the same institutional setting judged to be important is that with park rangers (see Table 2). Park rangers provide access to information and knowledge and an opportunity to share ideas.

The interview data informs us that ties to the management-level personnel provides park rangers with knowledge and information through linking social capital. Park rangers turn to their supervisors for advice regarding arrests, in situations where, for example, formal and traditional rules clash or when they find a poacher. Despite the strong ties park rangers have with supervisors and park management; the interview data indicate that these ties do not necessarily lead to more decision-making power for all park rangers. While some respondents in Gonarezhou National Park state that they are involved in decision-making, most respondents in Limpopo National Park say that they are not involved in any decision-making. Several park rangers in Limpopo National Park describe the relationship as autocratic. “No, I’m not involved in decision-making. The rules come from the top and descend to us (Park ranger 11, Limpopo National Park).

The networks of park rangers in Limpopo National Park and Gonarezhou National Park include two actors at the community level: traditional authorities and local community members (see Table 2). While local community members inform park rangers about the geographic location of poachers and animals, traditional authorities advise park rangers regarding traditional rules. The bridging ties with the traditional authority does however provide park rangers with more than diverse information and knowledge, it also gives park rangers access to an alternative management system.

Several park rangers describe how they coordinate their actions in situations when poachers have been captured. The traditional authorities are described as crucial actors for achieving voluntary rule compliance. Traditional authorities act as a tie between the park rangers and local communities, especially in situations in which trust is low, local communities are not following the rules, or when there is conflict between the park administration and the communities. Some park rangers furthermore describe how they combine traditional and formal systems by first taking the poacher to the traditional authorities and thereafter to the police. As exemplified by Park ranger 21 (Limpopo National Park) answering the question on how they get local communities to follow the park rules: “(we) call a meeting with the chief of the village to let them know about the rules, hear about their own rules, and see whether the things can work together”. Park ranger 20 (Limpopo National Park) on the same question: “It’s dependent on the community leaders. If the community leaders give advice, therefor they can obey. But if not, they don’t care”. Another park ranger (16: Limpopo National Park): “Sometimes there are difficulties amongst the rangers and the communities. Although they collaborate, those who are helpful are the community leaders”. There is moreover a significant difference between the structure of bridging social capital between the park rangers in Gonarezhou National Park and Limpopo National Park. Whilst only four of the 13 park rangers have ties to local community members eight of ten park rangers in Gonarezhou National Park have ties to the local community (see Table 2). One contributing explanation to the difference in structure of bridging social capital in Limpopo National Park might be the difference in community structure and the ongoing resettlement of local communities that is causing conflicts, and thereby preventing collaboration, between the park staff and the actors in these communities.

To sum up, the interviews show how park rangers activate their social networks for the purpose of gaining access to various types of information, knowledge and resources needed to carry out their tasks. The ties that are the strongest are the bonding ties which are foremost directed to the police and park rangers. Bonding social capital creates a strong basis for common action by providing park rangers with additional manpower, information on poachers and location of wild animals as well as new knowledge and ideas. Although the level of bonding social capital in the social networks of park rangers in the two national parks are on a similar level the structure differs in other regards. Fig. 1 and Fig. 2 illustrate these differences that are elaborated below.

In Gonarezhou National Park the military is described as an important collaborative partner in the management process. In Limpopo National Park it is the connections to park rangers that is emphasized. The ties to the management level are less strong, than the bonding ties, but still regarded as important for park rangers to access information and

Fig. 1. A social network of a park ranger in Gonarezhou National Park.
advice on how to deal with complicated situations. Only in one of the two contexts, Gonarezhou National Park, are linking ties providing park rangers with more decision-making power. Thus, although the level of linking social capital is similar in the two national parks, the interview data informs us that there is a difference in structure of capital. The data confirms the importance of bridging ties for accessing a more diverse set of knowledge, but also an additional management system. Thus, these ties do more than inform park rangers on traditional knowledge and customs. Some park rangers and traditional authorities create a joint informal governance system. Lastly, there are significant differences between Limpopo National Park and Gonarezhou National Park (illustrated in Figs. 1 and 2). Whilst all park rangers describe networks rich in bonding social capital, social networks of park rangers in Gonarezhou National Park tend to have higher levels of especially bridging social capital as more park rangers there have social networks that reaches local communities.

4.2. Institutional trust and rule-compliance in Limpopo National Park and Gonarezhou National Park

We start by exploring how the variables of interest are distributed and find that a majority of the respondents trust park rangers (see Table 3). A total of 70.31 % in Gonarezhou National Park and 70.8 % in Limpopo National Park trust park rangers to some or to a great extent. The trust towards park rangers is slightly higher in Gonarezhou National Park where 43.23 % trust park rangers to a great extent compared to 39.55 % in Limpopo National Park. This means however, that almost 30 % of the respondents in both parks do not trust park rangers. For compliance we also see a difference between the two parks, 90.37 % in Gonarezhou National Park compared to 87.65 % in LNP are willing or very willing to follow the rules of the park. The data moreover illustrates that more than 10 % of the respondents in Limpopo National Park are reluctant to follow park rules, compared to less than 5 % in Gonarezhou National Park.

In line with the survey data the interview data with park rangers illustrate that institutional trust is lower in Limpopo National Park than in Gonarezhou National Park and rule compliance is higher in Gonarezhou National Park than in Limpopo National Park. For the first question “Do local communities trust park rangers?” the results show that half of the park rangers experience the presence of institutional trust. Five reported that there is no institutional trust and eight that there are those who trust park rangers and others who do not trust them. Although about half of those reporting institutional trust are from Limpopo National Park and half from Gonarezhou National Park, all respondents that reported no trust in the institution are from Limpopo National Park. In the group that reported some institutional trust, five are from Limpopo National Park and three from Gonarezhou National Park. Similar results are found for the second interview question “Do you perceive that poaching has increased or decreased the last five years?” Although 17 out of 22 park rangers perceive that there has been a decrease in poaching in the last five years, 4 of the 5 park rangers that perceive that poaching has increased during the same period work in Limpopo National Park.

To sum up, the data shows that local community members in Gonarezhou National Park are more willing to follow the rules of the park than the communities in LNP. The data moreover shows that local community members in Gonarezhou National Park tend to trust park rangers more than in Limpopo National Park. In the next section we will analyze how the pattern of park rangers social network relate to rule-compliance and institutional trust.

4.3. How bonding, linking and bridging social capital relate to conservation outcomes

We have now concluded that there is a difference between the two national parks studied in this paper, both regarding the structure of the social networks of park rangers as well as the levels of rule compliance.

<table>
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<tr>
<th>Table 3 Survey data.</th>
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<tbody>
<tr>
<td><strong>Institutional trust</strong></td>
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<tr>
<td>To what extent do you think that the following groups or persons can be trusted? (Park rangers)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Not at all</td>
</tr>
<tr>
<td>To a limited extent</td>
</tr>
<tr>
<td>To some extent</td>
</tr>
<tr>
<td>To a great extent</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Rule compliance</strong></th>
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<tbody>
<tr>
<td>How willing are you to follow the rules of the park?</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Not at all willing</td>
</tr>
<tr>
<td>Not willing</td>
</tr>
<tr>
<td>Neither willing nor reluctant</td>
</tr>
<tr>
<td>Willing</td>
</tr>
<tr>
<td>Very willing</td>
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Fig. 2. A social network of a park ranger in Limpopo National Park.
Fig. 3. A social network of a park ranger that perceive that local communities trust park rangers.

Fig. 4. A social network of a park ranger that perceive that local communities do not trust park rangers.

Fig. 5. A social network of a park ranger that perceives that poaching has increased the last 5 years.
and institutional trust. The data illustrates that in Gonarezhou National Park where the networks of the park rangers have higher reach in terms of bridging social capital the levels of rule compliance and institutional trust are also higher. Empirical findings thus indicate that bonding social capital alone does not positively relate to institutional trust and rule compliance. The result stresses the importance of including the actors outside of the formal management structure and the own organization in conservation management, especially at community level. These findings are understood as especially important in areas of limited statehood where traditional authorities are the main local authority. Stronger relationships between park rangers and their superiors may also have positive effects on conservation outcomes, especially if park rangers are involved in the decision-making. Networks that hold strong bridging and linking social capital and thus reach all the way from park management to local communities tend to be the most beneficial for conservation outcomes. These claims are also supported by the interview data.

There are however intra-park differences both regarding social network structure as well as park ranger’s perceptions to conservation outcomes. For a deeper understanding of how different structures of social capital relates to rule compliance and institutional trust we will now analyze individual park rangers’ networks in relation to their perceptions on conservation outcomes.

We start with the eleven park rangers who state that local communities trust them. An analysis of their social networks illustrate that these tend to have linking social capital and particularly high levels of bonding and bridging social capital (see Fig. 3). Park rangers that perceive that local communities trust them tend to interact with many actors from the same institutional setting such as police and military, indicating high bonding social capital. Linking social capital is also evident as many of the park rangers in this group connect with supervisors and park management to share information. These networks also have vertical reach to the local communities and strong ties to traditional authorities. The common denominator is that these park rangers seek advice from many actors at different levels.

Some notable differences are found when the characteristics of the network of park rangers that perceive that local communities trust them compared to the networks of park rangers who perceive that local communities do not trust them (see Fig. 4). An analysis of the social networks of the five park rangers reporting that local communities do not trust park rangers connect to a high degree with other park rangers and civil servants, indicating that their networks have high levels of bonding social capital but lower levels of linking social capital. Although some actors have ties towards supervisors, none of them has a network that reaches to the park management. These park rangers also have fewer ties towards local communities and traditional authorities, indicating that their networks hold relatively low level of bridging social capital. Several park rangers in this group describes the relationship to the communities as problematic: “It’s a little bit complicated with the communities. It’s first of all difficult to get in contact with the communities because in the communities there are poachers, and those poachers are part of the community. (…) the community sometimes places barriers to block the roads. They throw stones towards us, call us names, and say a lot of things. (…) “We are enemies. We don’t trust each other”. (Park ranger 19, Limpopo National Park). Park ranger 14, Limpopo National Park moreover describe how it’s the conflicting views on conservation that cause lack of trust “They trust us a little bit. There are times they look at us like enemies because we prohibit them to do something which they used to do before”.

Considering the relation between social networks and rule compliance, we note that a large majority of park rangers reported that poaching has gone down in the past five years. Seventeen out of 22 Park rangers belong to this group, but it is difficult to see any patterns regarding network structure and a decrease in poaching. The social networks of the 17 park rangers in areas with a perception of reduced poaching differ in terms of both number and diversity of actors, with no general pattern emerging.

In the group of five park rangers that perceived an increase in poaching, however, some pattern could be found (see Fig. 5). Among these park rangers bonding social capital is high as most of them primarily have ties towards other park rangers. Although none of them has direct ties to park management many of them connect with their supervisors, indicating moderate levels of linking social capital. However, the networks of these park rangers tend to have significantly lower levels of bridging social capital. Although two of them have ties towards local communities or traditional authorities these connection concern information sharing rather than advice or coordination and is therefore regarded as weaker.

To conclude, the social networks of the park rangers who perceive that local communities trust them encompass higher levels of linking and, in particular, higher levels of bridging social capital that establish linkages between the formal management and community level. Amongst the park rangers that experience an increase in poaching, bridging, and linking ties are however lacking. By zooming in on individual park rangers’ networks the conclusions regarding the importance of bridging and linking social capital are confirmed. We can see that despite the difference in community structure between the two parks there is a correlation between patterns of interaction and conservation outcomes in both contexts.

5. Conclusions

The overall aim of this paper was to explore the social networks of park rangers and to examine how these patterns of interactions relates to rule-compliance and trust in conservation management in Limpopo National Park and Gonarezhou National Park. Our study shows the advantages of a social network approach for the study of conservation management. The empirical results show that park rangers social networks include a wide range of actors. The concepts of bonding, bridging, and linking social capital were used to describe and analyze social network structures in relation to conservation outcomes. Findings imply, in line with the theoretical assumptions, that the patterns of social interactions influence conservation outcomes and underline the importance of networks including different forms of social capital. Thus, our study suggests that broad assumptions about bonding, bridging, and linking social capital, are valid across contexts.

In both parks the police are the most important actor in the social networks of the park rangers. In Gonarezhou National Park the military is also an important connection for the park rangers. However, we find no relation between this type of bonding social capital and conservation outcomes. Our results indicate that a one-sided focus on increased policing and militarization of conservation management, known as “Green militarization”, is not beneficial for building institutional trust and encourage voluntary compliance. Something that might not come as a surprise as the trend of militarization has been shown to increase human rights violations such as forced relocations of local communities and killings (Masse et al., 2018).

The empirical results indicate that bridging and linking ties positively relate to institutional trust and rule compliance. Social networks with high levels of bridging social capital form a basis for building institutional trust in areas where trust towards government tends to be low. Although traditional authorities play a crucial role in the management that takes place at the local level the result indicates that it is the connection towards the local communities that matters for the conservation outcomes. Our result does not offer any explanation to this, but previous studies on conservation management in Southern Africa have illustrated that there are traditional authorities that act as intermediaries, where all communication between the park staff and the communities goes via the traditional authority (Dahlberg and Söderberg, 2023). There are also studies that show how collaborations between park staff and traditional authorities can lead to the latter securing power and resources for themselves and their kin, rather than facilitating local participation and community benefits (Muyengwa and...
As our result indicates that a social network with high levels of bridging social capital, but which excludes local communities, may not experience the positive effects in the form of increased rule compliance and institutional trust, the importance of traditional authorities facilitating interactions between park rangers and local community members should be emphasized.

Research on network governance emphasizes the importance to consider inter-organizational social networks when designing institutional settings and processes (Klijn, 2005) and the findings of this study can be translated into three key messages. We recommend to 1) foster structures where park rangers connect to a wide range of actors and thus resources, information, and knowledge 2) include park rangers in the decision making for a more efficient and sustainable management 3) build bridges that reach the local communities to facilitate institutional trust and encourage voluntary compliance.

The limited number of actors involved in this study must be considered when interpreting the validity of the findings and conclusions must be regarded as tentative. It is also important to once more note that we do not measure actual compliance but rather a perception on compliance. Furthermore, even though the theory implies a causal relationship between networks and outcomes, as supported by the interviews and survey data, no conclusion regarding causality should be made. Nonetheless, in its focus on social networks and qualitative methods this paper differs from much of the work done on conservation management in Southern Africa as well as studies on the role of park rangers. We believe that this study shows the benefit of in-depth interviews for understanding the patterns of interaction in conservation management. Future studies may benefit from similar approaches, particularly those that analyze complete networks for all actors in management networks rather than just the networks of some actors.

CRediT authorship contribution statement

Moa Dahlberg: Conceptualization, Methodology, Data curation, Investigation, Formal analysis, Validation, Writing - original draft, Writing - review and editing, Visualization. Annica Sandström: Conceptualization, Methodology, Writing - original draft, Writing - review and editing, Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

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References


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