



Research

## Visualizing stakeholders' willingness for collective action in participatory scenario planning

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**ABSTRACT.** Participatory scenario planning is a powerful approach to guide diverse stakeholders in creating and reflecting on visions of plausible and desired futures. However, this process requires tools to guide collective action to implement such visions within management agendas. This study develops, applies, and analyzes a novel visual tool within a virtual participatory scenario planning process about the Sierra de Guadarrama National Park (Madrid, Spain). Building on the identification of stakeholders who might engage in scenario strategies, the visual tool guided them in defining tasks to be developed and envisioning their willingness to collaborate in their implementation. We qualitatively analyzed data from recordings, online field observations, a post-survey from the scenario planning process, and a successive policy workshop. Our findings show that the visual tool fosters dialogue between stakeholders to redistribute tasks for working together on needed strategies in the protected area while promoting reflection on their willingness to collaborate as a group to implement them. The visual tool provided graphic outcomes for nine strategies corresponding to pictures of who may or may not be willing to engage in implementing such strategies. We argue that the visual tool is a robust method that can complement participatory scenario planning processes by providing a useful starting point for creating action networks to incorporate the resulting scenario strategies into management agendas. We deliberate on the nature of the visual tool as a boundary object and discuss its role as a decision-support tool. In particular, we reflect on the potential contributions and limitations of the visual tool to four dimensions of participatory conservation governance during participatory scenario planning processes: inclusivity, integration, adaptation, and pluralism. Our study provides a practical orientation to adapt the tool to other contexts and knowledge co-creation processes.

**Key Words:** *action networks; backcasting; decision-support tool; future scenarios; participatory governance; protected areas*

### INTRODUCTION

It is widely recognized that the active participation of stakeholders in social-ecological governance can support the integration of diverse values and knowledge systems to deal with complex conservation problems and collectively identify solutions (Cornell et al. 2013, Fischer et al. 2015, IPBES 2019). It has also been argued that collective action—understood as the voluntary sum of stakeholder efforts at different scales and sectors that allow for aligning interests, goals, and resources—can promote joint strategic actions that catalyze transformations toward sustainability (Wiek et al. 2012, Olsson et al. 2014). To assist practitioners and managers in addressing these social challenges, the scientific community has been increasingly active over the past decades in providing a wide diversity of participatory and deliberative approaches for involving stakeholders in natural resource decision making (Stirling 1999, Lynam et al. 2007). Examples of such participatory approaches include scenario planning focused on collectively envisioning plausible and ideal futures as part of planning and decision-making processes (Oteros-Rozas et al. 2015), multi-criteria methods to support decisions based on a comparative assessment of alternative

options to identify a preference order for possible action plans (Esmail and Geneletti 2018), cost-benefit analysis of a policy or interventions over ecosystem services (Atkinson and Mourato 2008), and agent-based models aimed at exploring interactions and resulting behaviors for social-ecological governance dynamics (Dupont et al. 2016, Bourceret et al. 2021). The development of such participatory techniques has placed an emphasis on dealing with plural understandings, whereas the focus on collective action has been less considered (Wiek et al. 2012). This fact is especially illustrated in the participatory scenario planning (PSP) field.

PSP is a powerful methodological approach to incorporate multiple perspectives, values, and knowledge in natural resource management and conservation decision making and engage stakeholders in governance strategies through vision building of plausible and desired futures (Wollenberg et al. 2000, Palomo et al. 2011, Oteros-Rozas et al. 2015). The normative intentions of PSP to influence decision making entail a wide range of implications for participatory governance that need to be navigated and addressed during its operationalization. These implications include supporting social inclusion, promoting

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intra- and intersectoral coordination and institutional integration, assisting capacity for systemic change, and recognizing the diversity of values, perspectives, and knowledge systems (Visseren-Hamakers et al. 2021). The PSP field has developed a large variety of techniques to deal with these governance issues that can be framed into quantitative assessments (e.g., “Interactive Cross Impact Simulation” and “Fuzzy Cognitive Map based scenarios” [Amer et al. 2013]), qualitative approaches (e.g., “Rich pictures” [Monk and Howard 1998], “Value-based scenario planning” [Rawluk et al. 2018], and art science [Pereira et al. 2019, Heras et al. 2021]), or into a combination of methods (e.g., “Story and simulation” [Alcamos 2008, March et al. 2012]). The application of such techniques, individually or in concert, has led to PSP being regarded as a productive approach for guiding social-ecological systems governance in the face of uncertainties (Peterson et al. 2003, Ruiz-Mallén et al. 2015) while supporting more inclusive responses to sustainability transformations (Pereira et al. 2019). In doing this, PSP can foster a better understanding of human-nature interactions and guide opinion-forming or policy decisions toward sustainability (e.g., Peterson et al. 2003, MA 2005, Oteros-Rozas et al. 2013, Butler et al. 2014, Beach and Clark 2015, Bennet et al. 2016). As a result, PSP has become a popular participatory approach used to support stakeholders in imagining futures through co-learning and co-creation processes globally (Oteros-Rozas et al. 2015, Nalau and Gobb 2022). The increasing popularity of PSP has been reinforced in the science-policy interface at a global scale from processes such as the Millennium Ecosystem Assessment (MA 2005) and the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES). In particular, IPBES adopted participatory scenarios as one methodological approach to assess biodiversity and ecosystem services to help decision makers identify potential consequences of different policy choices (IPBES 2016).

However, PSP processes lack focus on guiding and supporting stakeholders in establishing action networks that help operationalize outcomes into management and conservation agendas (e.g., Nieto-Romero et al. 2016, Totin et al. 2018). Stakeholders have different degrees of willingness to initiate the reciprocity mechanism and achieve the benefits of collective action (Ostrom 2000). In turn, individuals’ willingness for reciprocity can be modulated by multiple internal and external barriers, which often prevent action toward future visions (Nieto-Romero et al. 2016). Internal barriers may include differences in ideology, culture, or perceived benefits, and lack of organizational capacity, financial resources, or motivation from counterproductive collaborative experiences in the past (Ghişa et al. 2001, Volkery and Ribeiro 2009, Nieto-Romero et al. 2016). External barriers often entail limited governmental support in the translation of PSP outcomes to action and legal constraints that can hinder the influence of local actors in governance (Armitage 2005, Volkery and Ribeiro 2009, Nieto-Romero et al. 2016). As a first step to dealing with these barriers, it is necessary to reflect and make visible the ways stakeholders are willing to act within the governance system (Charli-Joseph et al. 2018). Building upon this assumption and focusing on the PSP field, we intended to create a novel tool that might support stakeholders to move from theory to practice for collectively implementing tangible PSP outcomes.

Our study aims to develop, apply, and analyze a novel visual tool within PSP processes to explore stakeholders’ willingness to implement collectively formulated strategies. We used the case study of Sierra de Guadarrama National Park (SGNP, Spain). Specifically, we conceive a visual tool as a contextualized graphical means to open up a dialogue between stakeholders across different sectors and scales on the redistribution of tasks for working together toward the PSP resulting strategies and, at the same time, envision their willingness to collaborate as a group to implement them. We expected the visual tool could generate conversations around stakeholders’ organization and cooperation for implementing the PSP resulting strategies. We focused our research on the following questions: (1) What role does the visual tool play in the PSP process? (2) What are participants’ perceptions of the visual tool regarding its functionality and usability in the PSP process? (3) How do SGNP’s decision makers perceive the visual tool regarding its potential further applicability for the Park’s participatory governance? We argue that the visual tool might enrich PSP processes by opening dialogue for supporting diverse stakeholders in uncovering synergies and organizing themselves toward precise actions. Given that this ability is often associated with the boundary object concept—a device that facilitates communication between diverse worldviews and knowledge domains to work together (Star and Griesemer 1989)—we also reflect on the potential of the visual tool to be considered as a boundary object. We finally discuss the potentials and limitations of this visual tool for participatory conservation governance in the context of the PSP exercise and argue that it could be easily adapted to social-ecological knowledge co-creation processes and contexts.

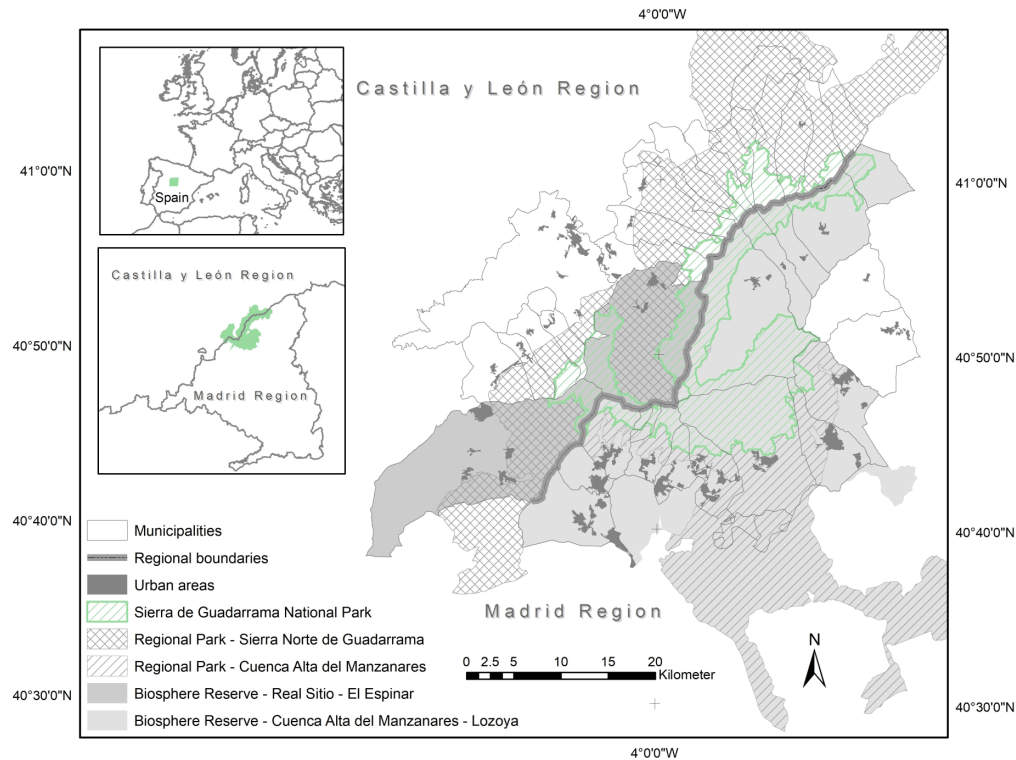
## METHODS

### Case study

SGNP is located in central Spain, between the regions of Madrid and Castilla y León, with two regional parks and two UNESCO Man and Biosphere Reserves acting as buffer zones (Fig. 1). It is renowned for geological features and biological diversity, supporting notable bird and amphibian diversity, forest landscapes, and proximity to major cultural and historical features and monuments.

Two regional state administrations, Madrid and Castilla y León, manage SGNP (BOCM 2010, BOCYL 2010). SGNP’s constellation of stakeholders includes multiple state administrations with governing competencies in the area at different decision-making scales and non-state actors engaged in productive, recreational, educational, research, and conservation activities (López-Rodríguez et al. 2020a; Table 1). SGNP authorities have created a wide variety of formal and informal mechanisms since 2013 to promote stakeholders’ participation and collaboration to achieve conservation goals (BOE 2013, 2014). Examples of participatory mechanisms are the Advisory Board (i.e., *Patronato*; BOCM 2014, BOCYL 2014), a public process used to develop the management plan of SGNP (i.e., PRUG; BOCYL 2019, BOCM 2020), and workgroups for specific management issues. These participatory mechanisms have produced positive outcomes in cooperation between SGNP authorities and other stakeholders (e.g., governance arrangements to conduct dissemination/education activities and programs for voluntary work and reforestation activities). However, promoting collective alliances

**Fig. 1.** Study area: Sierra de Guadarrama National Park (Spain).



**Table 1.** Stakeholder groups of Sierra de Guadarrama National Park (SGNP) governance system (based on López-Rodríguez et al. 2020a).

Stakeholder group	ID	Description
State administrations	SA	State administration at the international level, national level, regional level, supra-municipal level, municipal and state-owned enterprises/ foundations
Education and research centers	ER	Universities, research centers, schools, high schools
Environmental non-profit organizations	EN	NGOs, associations, foundations, and social corporations related to environmental conservation
Local users: primary sector	PS	Organizations (e.g., federations, associations, trade unions, private companies) related to livestock farming, agroecology, water for irrigation and management, hunting, fishing
Local users: tertiary sector	TS	Organizations (e.g., federations, associations, trade unions, private companies) related to outdoor activities, sports, tourism, commercial
Other local stakeholders	OS	Civil associations (cultural and social activities), local action groups, the general public, individuals, private landowners

across different sectors and scales remains a challenge for the National Park (López-Rodríguez et al. 2020a).

### Methodological approach

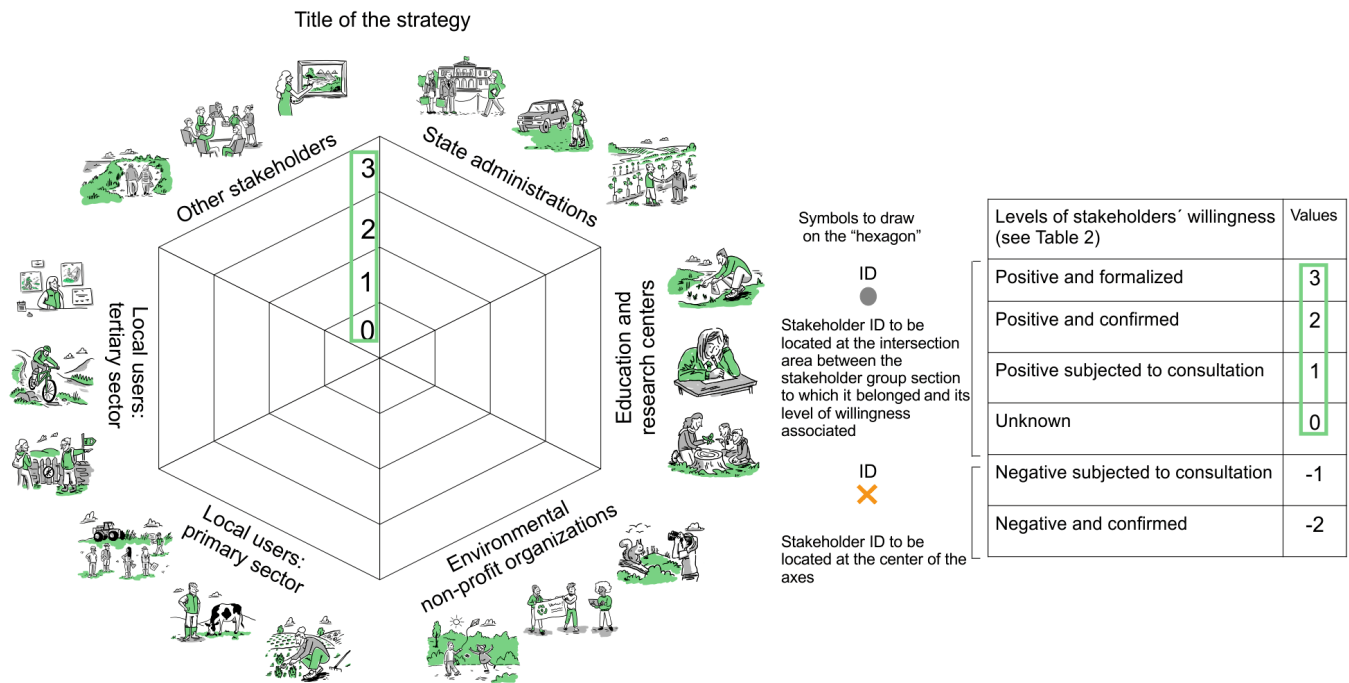
We adopted a social constructivist approach (Moon and Blackman 2014) to acquire knowledge of how stakeholders

perceived a visual tool that was specifically created and applied within a PSP process in SGNP. We denominated it as the visual tool for envisioning stakeholders' willingness to take collective action in implementing PSP outcomes (for practical purposes, hereafter, we refer to it as the visual tool). Methodologically, we followed a sequenced process of design, application, and analysis of the visual tool within an online PSP exercise designed by the authors (Oteros-Rozas et al. 2020). The online adaptation of the PSP process stemmed from the Spanish government lockdown measures during the COVID-19 pandemic (BOE 2020). The PSP process combined traditional scenario methodologies (e.g., Palomo et al. 2011, Oteros-Rozas et al. 2013, Wiek and Iwaniec 2014) with innovative approaches based on artistic methods (Heras et al. 2021) and the use of the visual tool. We hereby describe the methodological development and implementation of the tool.

### Phase 1: Design of the visual tool

We designed the visual tool to be applied after a PSP backcasting exercise (Dreborg 1996). In the backcasting process, participants define management strategies to achieve the desired aspects and avoid the undesired ones of future scenarios and identify stakeholders at different scales and sectors who might be engaged in implementing them. As a complement to the backcasting exercise, we created the visual tool to collectively deliberate and explore (1) the tasks to be developed by the diversity of the identified stakeholders in each resulting PSP strategy and (2) their different levels of willingness to collaborate in their implementation. The conceptual foundations of the visual tool derive from (1) the legal mandate of SGNP's governance system

**Fig. 2.** A sample of the visual tool created to support stakeholders' organization to implement the backcasting strategies within the participatory scenario planning (PSP) process in Sierra de Guadarrama National Park (SGNP). The visual tool is defined according to two analytical dimensions: six stakeholder groups and six levels of stakeholders' willingness to implement a certain PSP strategy according to a standardized scale of values from -2 to 3 (Table 2). Illustrations from Streamline (De Vries and Metzger 2018) adapted to SGNP context by ScienSeed.



to be participatory and socially inclusive (BOE 2013, 2014) and (2) our assumption that stakeholders' motivation to act can be considered an indicator to move from the theory to practice (McKenzie-Mohr et al. 1999).

The design of the visual tool was inspired by the first author's previous experiences with similar approaches to facilitate stakeholders' organization for participatory conservation governance (e.g., López-Rodríguez et al. 2020b). We also relied on previous studies showing the effective power of images in communicating information in comparison with non-visual formats that favor a common understanding between different worldviews while reducing risks of miscommunication (Vervoort et al. 2010, Morsetto 2017). The last was relevant in the lockdown situation because we presumed these risks to be more pronounced in a virtual setting.

Graphically, the visual tool consisted of a hexagon-shaped graphical tool illustrated with cartoons from Streamline<sup>[1]</sup> (De Vries and Metzger 2018) adapted to the SGNP context by ScienSeed (Fig. 2). Each hexagon section corresponds to a stakeholder group of the SGNP governance system (Table 1). These sections were built upon background information on stakeholders' participation and collaboration within SGNP's governance system (López-Rodríguez et al. 2020a). We designed a scale ranging from -2 to 3 to capture the various levels of stakeholders' willingness to implement a given strategy (see Table 2 for level definitions). To visually represent such levels of stakeholders' willingness, we designated the "hexagon" area to

**Table 2.** Description of the visual tool's scale of stakeholders' willingness to implement strategies.

Levels of stakeholders' willingness to implement strategies	Description	Values
Positive and formalized	Positive with already ongoing work (e.g., agreement, project, program) aligned with the strategy.	3
Positive and confirmed	Positive.	2
Positive subjected to consultation	Positive, but the final decision depends on third parties.	1
Unknown	Unknown, uncertain, or non-manifested.	0
Negative subjected to consultation	Negative, but the final decision depends on third parties.	-1
Negative and confirmed	Negative.	-2

draw the levels with values from 0 to 3, and the center of the axes for visualizing those levels with negative values. Levels of stakeholders' willingness were represented with a stakeholders' ID accompanied with different symbols for positive and negative values.

*Phase 2: Application of the visual tool within the PSP process*  
 The online PSP exercise took place on 9 and 10 October 2020 supported by a team of 13 people (including facilitators, note-takers, and digital platforms assistants) and engaged 45



participants. We invited to participate in the PSP process a balanced sample of people ( $n = 134$ ) from different stakeholder groups (Table 1), regions, and genders, with a variable degree of participation in SGNP's decision making (Oteros-Rozas et al., *unpublished manuscript*). Virtual sessions were video and audio-recorded through the Zoom meeting platform with informed consent from each participant.

We used explorative scenarios (van Notten et al. 2003) with the aim of engaging multiple stakeholders in thinking about the future of the SGNP, which also involves supporting decision making in a further stage. Working in heterogeneous groups of 3–5 people, participants co-developed five future scenario narratives for SGNP (up to 2040) by following a two-axes approach that combined different intensities of two drivers of change (van't Klooster and van Asselt 2006) plus the desired scenario (Oteros-Rozas et al. 2020). Using a backcasting approach, each working group first proposed strategies to achieve the desired outcomes and avoid the undesired ones from each designed scenario and then prioritized them based on their feasibility and the degree of cooperation needed. Next, each group facilitator invited participants to identify stakeholders (organizations or individuals) relevant to the implementation of each strategy. Facilitators then led the groups through the visual tool as the last step in the PSP process.

The practical operation of the visual tool within the online PSP workshop took place on the second day. Twenty-three participants were actively engaged in the session in which the visual tool was applied: nine decision makers, four researchers and teachers, five environmental NGO technicians, two local users from the tertiary sector, and three participants related to cultural aspects and media. Seventy-four percent of participants were residents of Madrid and 26% from Castilla y León; 31% were female and 69% male (Appendix 1).

From the identified stakeholders in each PSP strategy during the backcasting, the facilitators first invited participants to define potential tasks associated with each stakeholder to implement the strategy by using a table displayed with Google slides. A code (ID) was assigned to each stakeholder to facilitate their visual identification later in the graphic representation of the visual tool. Using a second template in Google slides, the facilitators presented the visual tool (Fig. 2) with an associated table that included the stakeholders' ID previously defined for each strategy. Then, the facilitators invited those identified stakeholders who were participating in the process to select one of the levels of willingness to implement the PSP strategies contained in the visual tool's scale (Table 2) and explain the reasons for their selection. In case of disagreement on the willingness level between participants working at an institution with the same stakeholders' ID, the facilitators had planned to report all the levels of willingness identified and assigned the higher level to such stakeholders' ID, flagging it with an asterisk as a symbol of the divergence. For those identified stakeholders who did not participate in the workshop session, each facilitator assessed their willingness as unknown according to the visual tool's scale (Table 2) and asked participants for their perception of the potential willingness level of such stakeholders to identify information that might be relevant to implement the PSP resulting strategies. The levels of willingness assigned to each stakeholders' ID were

represented in the mentioned table with its respective values (Table 2). Then, the facilitators drew these results on the visual tool (Fig. 2). For the unknown and positive values of stakeholders' willingness (from 0 to 3, Table 2), each stakeholder's ID was drawn by arbitrarily locating a dot at the intersection area between its stakeholder group and its selected willingness value. The polygon resulting from the linking of all the different dots was colored. Here, it should be noted that we did not intend to build an area to show a precise measurement of stakeholders' willingness. Instead, we aimed to make visible the diversity of stakeholders involved in each strategy and their willingness to implement it. Higher diversity in stakeholders involved and in their willingness may be considered indicative of better conditions for implementing each strategy, and vice versa. For the negative values of stakeholders' willingness (from -2 to -1, Table 2), each stakeholder's ID was combined with a mark located at the center point of the hexagon (Fig. 2). Once the potential willingness of all the identified stakeholders was represented graphically, the workgroups reflected on the final visual representation. This operation was repeated for each strategy.

#### *Phase 3: Analysis of the visual tool*

By relying on the literature on visual information analysis, we defined four variables on which to focus our analysis and understand how the visual tool was perceived by the participants involved in the PSP process: (1) "Interpretability" refers to the spontaneous interpretation of visual representations by participants (Morseletto 2017); (2) "Functionality" relates to what function invokes visual representations and its graphical components when applied (Morseletto 2017); (3) "Usability" is understood as ease of use of visual representations (Luzzardi et al. 2004); and (4) "Applicability" concerning the potential use and application of visual representations as a management tool (McInerney et al. 2014).

We used a combination of methods to collect data for the analysis of the visual tool. We collected online field notes during the visual tool session as part of the PSP process (Walford 2009, Howlett 2022). We used a template for field notes, which included information gathered by the visual tool (i.e., stakeholders involved in the PSP strategies, tasks to be developed by each one, and their willingness to implement them), participants' reflections from the visual representation, observations concerning the use of the visual tool, and general comments on the virtual space (e.g., technological issues, participation patterns, and tensions). After the visual tool session, the facilitators and note-takers of each breakout group held sequenced discussions to complete the data collection template. Qualitative data were matched with the analysis of audiovisual recordings of the visual tool session to extend, clarify, or contrast information and to identify verbatim quotes.

After the online PSP exercise, we conducted an online survey to capture participants' perceptions of the visual tool's functionality and usability (Appendix 2). The survey included seven statements with a four-point Likert scale for agreement and one open-ended question. According to university ethical protocol, the survey was distributed using the Qualtrics platform (Qualtrics, Provo, UT) with anonymous responses. All participants who had actively engaged in the visual tool session responded to the post-PSP workshop survey.

We conducted a second online workshop (1 December 2020) with decision makers and protected area experts to explore the potential applicability of the visual tool as a management tool to support the organization of collective alliances within SGNP (López-Rodríguez et al. 2020c). Three SGNP decision makers who had also been part of the online PSP exercise and one expert on protected areas management (two from Madrid and two from Castilla y León; two female/male) participated in this online policy workshop (Appendix 1). Participants collectively assessed and reflected on the visual tool in terms of management goals that could be addressed, the steps of the management cycle in which the visual tool might be applied, suitability to be used within the SGNP management setting in particular, and the resources required for the visual tool's adoption as a tool for governance practice. The online policy workshop was recorded and summarized with field notes.

We conducted a content analysis of the audiovisual recordings, field notes, and survey responses from the two online workshops and the open-ended survey question (Hsieh and Shannon 2005). We grouped the 12 PSP strategies co-developed in the backcasting according to their similarity, resulting in a total of nine strategies. We also checked the stakeholders' ID gathered through the visual tool to ensure that each identified stakeholder had a unique code of identification as well as the levels of stakeholders' willingness assigned to each stakeholder to confirm that they were consistent with the visual tool's scale (e.g., unknown willingness values assigned to non-participants; see Table 2). We then examined and organized the collected data into the four themes of interest for our analysis: "The visual tool's outputs and interpretability" (i.e., the outputs from applying the visual tool and participants reflections/observations arising from them), "The visual tool's functionality" (i.e., the attributed functions to the visual tool within the PSP process), "The visual tool's usability" (i.e., whether it is easy to use or not), and "The visual tool's applicability for participatory conservation governance" (i.e., able or not to be used as a management tool for participatory conservation governance). To facilitate comprehension of the visual tool outputs, we built the visual representation of each of the nine PSP strategies using a drawing software. We assigned labels to the qualitative data to identify different stakeholder's perceptions of the outcomes and interpretability and the other three themes. We quantitatively analyzed the Likert scale responses from the survey linked to the visual tools' functionality and usability through descriptive statistics.

## RESULTS

### The visual tool's outputs and interpretability

The visual tool effectively illustrated the complexity of potential action networks to implement nine PSP strategies regarding stakeholders' diversity and willingness to take action. Participants named a total of 47 stakeholders and defined a series of tasks for implementing each strategy (Table 3). Of the 47 stakeholders, 17 fell under the category of state administrations, 11 education and research centers, seven local users from the primary sector, four local users from the tertiary sector, six other local stakeholders, and two environmental NGOs (Appendix 3). Fifteen identified stakeholders were present during the visual tool session. Some strategies involved stakeholders of a wide diversity of sectors (S1, S3, S6, S7, and S8; see Table 3), whereas others included only a

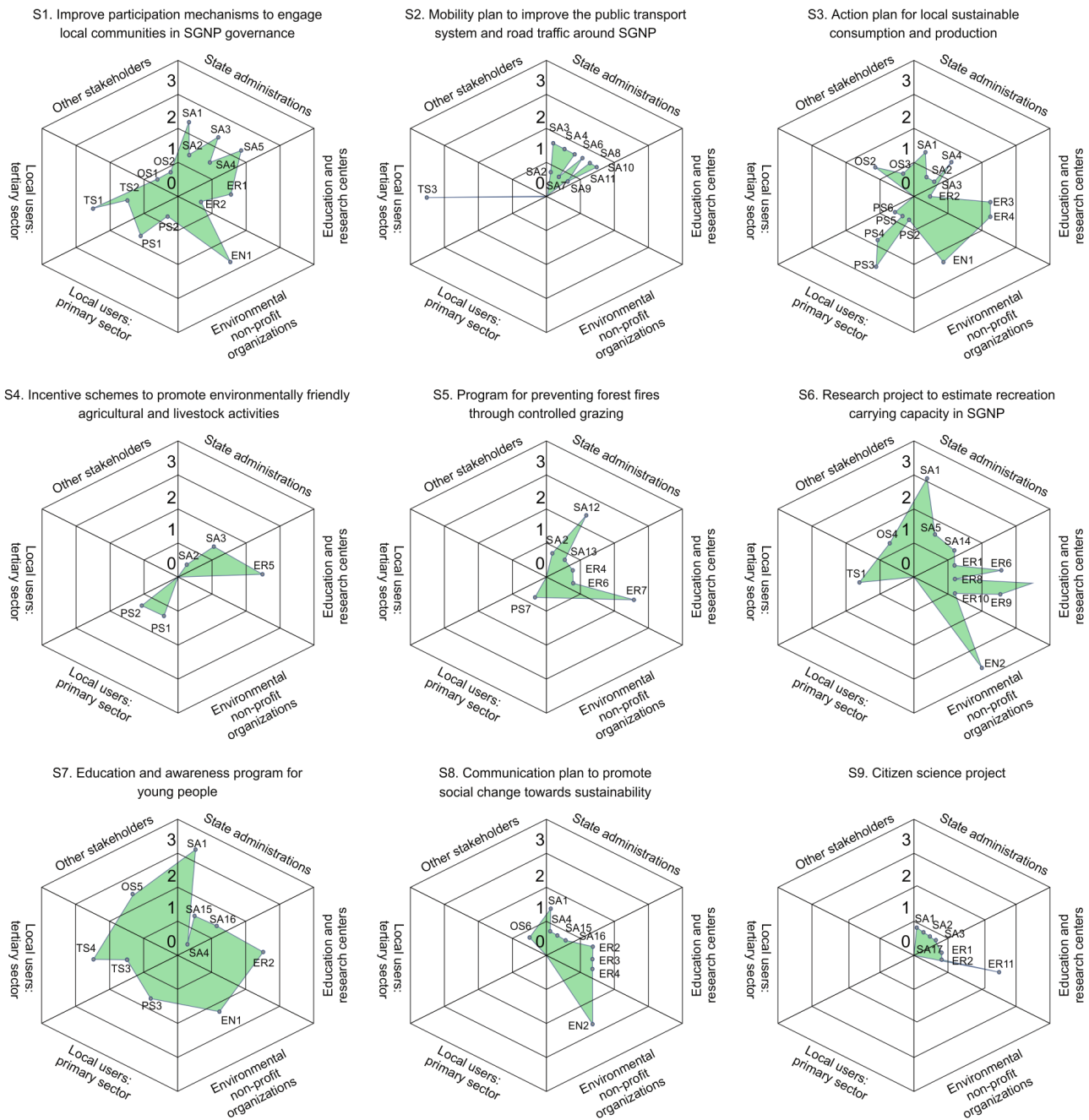
few (S2, S4, S5, and S9). Most strategies were associated with management initiatives implemented by state administrations, with the engagement of other stakeholder groups. This dominant pattern was highlighted by one of the participants: "the decision of implementing the strategy depends on the legal authorities responsible for managing SGNP ..., what we [referred to the other stakeholder groups] can do is request and put pressure to make it a reality." Visually, the tool revealed a variable level of willingness for stakeholders to collaborate to implement strategies (Fig. 3, Appendix 4). We found a total of 57 stakeholders with positive willingness values assigned to the identified stakeholders across the nine strategies ( $n = 33$ , value level 1;  $n = 20$ , value 2; and  $n = 4$ , value 3) versus 31 unknown, uncertain, or non-manifested willingness values (value = 0). Most strategies included at least one stakeholder with unknown willingness. An example included the citizen science project for which just one of the stakeholders could confirm their willingness to implement the strategy as no representatives of the other identified stakeholders participated in the session. The results also revealed seven strategies (S1-S4, S6-S8; Fig. 3) with levels of willingness subjected to consultation (value = 1). For instance, a representative of a sports federation expressed positive willingness to be involved in the research project to estimate recreation carrying capacity in SGNP, but they needed to ask the other members of the federation first. There were eight strategies for which certain stakeholders presented willingness values from 2 to 3 (S1, S3, S4, S5, S6, S7, S8, and S9; Fig. 3). For instance, the representatives of SGNP authorities confirmed their positive willingness (value = 2) to take action in the strategy by improving their mechanisms to engage local communities in SGNP governance. They also expressed an ongoing line of work formalized on the education and awareness program for young people and confirmed their willingness (value = 3) to align it with the defined strategy. Participants did not identify negative willingness values for any of the nine strategies.

Overall, we found that most participants perceived that the visual tool provided a coherent picture of those stakeholders required to take action in each strategy and their willingness to do so (Fig. 3). They understood the green areas highlighted in the hexagons as initial pictures subjected to their knowledge and perceptions, bearing in mind that more efforts and resources would be needed for the effective implementation of the strategies. A participant explained this idea as follows: "the visual tool shows an optimistic image about what we could do in the SGNP, but more participants from other sectors would be needed to know their real willingness to be involved in the strategies." Another participant expressed, "[the visual tool shows that] there is desire and positive intentions to do many things [in SGNP], but there is also a lack of resources, time and mutual support agreements to formalize the strategies."

### The visual tool's functionality

Within the PSP process, our data showed that the visual tool helped to generate a new dialogue space for (1) exchanging ideas about the complex governance network of SGNP (e.g., stakeholders' profiles and activities in SGNP), (2) creating tangible strategies on the ground, (3) identifying potential collaborations across stakeholder groups, (4) clarifying how stakeholders can align efforts, tasks, and resources, and (5) measuring stakeholders' willingness as a starting point to undertake joint action. Survey data revealed that participants

**Fig. 3.** Graphic outcomes of the visual tool corresponding to the different participatory scenario planning strategies. The green areas highlighted in the hexagons describe each strategy according to the diversity of stakeholders involved and their potential level of willingness to implement it.



perceived the visual tool as helpful to support collaborative work to move forward and implement the devised strategies in the PSP process (Fig. 4). The most positive aspects reported by respondents was the visual tool's potential for simultaneously visualizing a diversity of stakeholders needed and their willingness to engage with the strategies. Two respondents specifically wrote that the visual tool approach helped to visualize, "the importance of each social actor for good governance" and "all stakeholders and their level of willingness [to take action]."

### The visual tool's usability

In the survey, 64% of respondents agreed or strongly agreed that the visual tool was easy to use, with 60% expressing the desire to use the visual tool in future participatory processes. A few participants (8%) also identified potential limitations. First, some perceived that grouping stakeholders into pre-established categories might generate confusion and misrepresent certain stakeholders' profiles given the variability within each group. Second, others perceived the visual tool as difficult to use and

**Table 3.** Description of the participatory scenario planning (PSP) backcasting strategies resulting from applying the visual tool approach. Each strategy and its description is shown with tasks to be developed and the stakeholders who might develop each task to its implementation. † Each stakeholder is identified with an ID (Appendix 3) according to stakeholder groups of Sierra de Guadarrama National Park (SGNP): (SA) State administrations, (ER) Education and research centers, (EN) Environmental non-profit organizations, (PS) Users in the primary sector, (TS) Users in the tertiary sectors, and (OS) Other local stakeholders (Table 1).

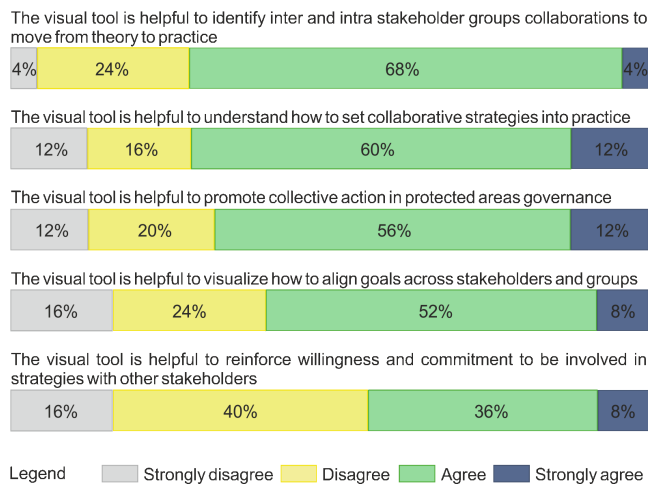
Identified strategy and description	Tasks to be developed by stakeholders	Stakeholders who might develop each task †
S1. Improve participation mechanisms to engage local communities in SGNP governance. This strategy includes a set of complementary actions (e.g., review of the Advisory Board structure and creation and integration of a citizen's assembly within formal governance structure of the SGNP) to engage local communities in conservation decision making.	Coordination and strategy development	SA1
	Review of the Advisory Board	SA1
	Creation of citizen's assembly	SA1
	Monitoring and evaluation of participation	SA1
	Support and approbation of the strategy	SA2; SA3
	Request to set up and develop the strategy	SA4; SA5; EN1; PS1; TS1; OS1
	Funding provision	SA1; SA4
	Development of stakeholders mapping and consultancy	ER1
	Training program on public engagement for SGNP technicians	ER2
	Participation in the citizen's assembly	PS2; TS2; OS2
	S2. Mobility plan to improve the public transport system and road traffic around SGNP. It is a strategic plan to transition toward a resource-efficient and sustainable mobility system designed to visit SGNP.	Coordination of institutional efforts at multiple scales and competencies (e.g., transport, environmental protection, infrastructure) and plan development
Funding provision		SA2; SA3; SA4; SA6; SA7
Social support from the tertiary sector by offering public transport among their services		TS3
S3. Action plan for local sustainable consumption and production. This plan aims to boost local products' value added based on obtaining feed from organic production to promote local development in the area.	Coordination and plan development	SA1
	Articulation of local products brand	SA1; SA4
	Dissemination campaign	SA1; SA2; SA3; SA4; EN1
	Funding provision	SA1; SA2; SA3; SA4
	Educative program in local consumption	ER2
	Consultancy for developing the strategy	ER3; ER4
	Accession to the local products brand	PS2
	Plan to reinforce selling and consumption of proximity local products	PS3
	Menus focused on local products	PS4
	Training program to local producers	PS5
	Consumer networks map	PS6
	Local products consumption	OS2
	Land custody agreements	OS3
S4. Incentive schemes to promote environmentally friendly agricultural and livestock activities. The strategy includes a set of measures to reward farmers for adopting sustainable practices.	Coordination and strategy development	SA2; SA3
	Consultancy for selecting indicators that define sustainable practices	ER5
	Participation and acquisition of incentives	PS1; PS2
S5. Program for preventing forest fires through controlled grazing. This program aims to promote new routes for livestock movement along firewalls based on scientific criteria to prevent ecosystem degradation in Sierra de Guadarrama area.	Coordination and program development	SA2
	Coordination between state administrations and ranchers	SA12
	Silvicultural treatment activities	SA13
	Mountain management plan	ER4
	Research on pastures grazing capacity	ER6
	Organization of exchange of experiences with other similar programs	ER7
	Outreach activities and involvement of ranchers	PS7
S6. Research project to estimate recreation carrying capacity in SGNP. The project aims to estimate the optimum recreation capacity in SGNP that is respectful of its ecological functioning.	Funding provision	SA5; SA14
	Prioritization of research proposals	SA1
	Development of research proposal; study development	ER1; ER6; ER8; ER9
	Data provision to develop the research	ER10; TS1; OS4
	Outreach activities	EN2
S7. Education and awareness program for young people. This program focuses on incorporating protected areas into official educative programs in elementary and secondary schools in the Sierra de Guadarrama area.	Coordination and program development	SA1
	Funding provision	SA4
	Approbation of protected areas in its official educative programs	SA15; SA16
	Incorporation of protected areas as a subject into official educative programs	ER2
	Educative activities with specific groups of young people	EN1
	Informal talks	PS3; TS3
	Logistic support to talks	TS4
	Outreach activities	TS4
	Creation of a social network of young people	OS5
S8. Communication plan to promote social change toward sustainability. The strategy involves a set of actions for sustainability learning at all levels of education (e.g., elementary, secondary, and university levels) in teaching centers of the Sierra de Guadarrama area.	Logistic and material support	SA1
	Development of dissemination campaign	SA1; SA4; SA15; SA16; OS6
	Participation in dissemination activities	ER2
	Consultancy for developing educative material	ER3; ER4
	Coordination with education centers	EN2
	Training program on sustainability for students	EN2

(con'd)



S9. Citizen science project. Focused on actively involving citizens in data monitoring to generate new scientific knowledge in SGNP.	Coordination and project development Funding provision Logistic and material support Consultancy for development de project Data analysis Data collection and monitoring Training program in data monitoring for students	SA1 SA2; SA3 SA17 ER1 ER1 ER2 ER11
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**Fig. 4.** Perceived functions associated with the visual tool in the participatory scenario planning process by survey respondents.



understand for people who are not used to working visually or with similar visual tools.

#### The visual tool's applicability for participatory conservation governance

During the policy workshop, SGNP's decision makers highlighted that the visual tool might be interesting "to visualize on whom we can count when it comes to implementing a certain strategy [in the National Park]" as well as "to provide insights on the establishment of collaborations with other state administrations to address conservation issues beyond our [SGNP's authorities] legal competences." They emphasized the helpfulness of the visual tool in identifying stakeholders who could cooperate in management strategies. SGNP's decision makers stated interest in using the visual tool to support the development of a participation and volunteering subprogram they were planning to implement. The visual tool was perceived as particularly helpful to involve actors that are under-represented in decision making. For instance, during the PSP workshop, a representative of an environmental education cooperative that is not part of the Advisory Board expressed gratitude for the opportunity to have their voice heard and showed a positive willingness to stay engaged in resultant strategies.

SGNP decision makers also reflected on how to enhance the applicability of the visual tool for the protected area management. They suggested (1) an improvement of social science skills and economic resources regarding the park's management to develop participative processes using the visual

tool, (2) the creation of a stakeholder map to identify potential participants to be involved in the participatory processes, (3) the development of a technical protocol with instructions on how to use the visual tool, and (4) the promotion of institutional leadership to embed the visual tool into administrative procedures.

#### Methodological limitations

We assume that these results were dependent on the knowledge and perspectives of the participants' sample in the visual tool workshop session, which included an under-representation of some stakeholder groups (e.g., local users of the primary sector). We designed the PSP process to include a balanced representation of stakeholder groups, but participation was voluntary, and not all groups responded to our invitation. Along similar lines, participation gradually declined over the PSP process, particularly in the last session when we applied the visual tool (Appendix 1). As recent work in SGNP found, multiple factors associated with the online format imposed by the COVID-19 pandemic and confinement policy might have limited the participation of stakeholders (Lo et al. 2022). Nevertheless, it is important to note that our research aimed to explore the visual tool from a methodological perspective for which the participants' sample provided a wide range of valuable contributions for its comprehensive analysis.

#### DISCUSSION

##### The role of the visual tool to support collective action in scenario planning

Our findings reveal the use of the visual tool to support the organization of stakeholders for collective action in conservation governance as part of PSP processes. In particular, the visual tool used herein helped guide and visualize how the diversity of stakeholders could be organized to carry out conservation strategies while enticing them to consider their willingness to be actively involved. We found that the tested visual tool opened up (1) dialogue between SGNP stakeholders from different levels and sectors on how to redistribute tasks and responsibilities to strategically work together for a common goal and (2) reflection on how they were willing to collaborate as a group to implement PSP strategies. As previous studies state (e.g., Olsson et al. 2006, Charli-Joseph et al. 2018), we found that the information exchanges and deliberations helped to identify diverse factors (e.g., individual intentions, motivations, plans, and beliefs) that are key to aligning interests, goals, and resources and promoting joint strategic actions. An example is the PSP strategy to improve participation mechanisms to engage local communities in SGNP governance (S1; Table 3), in which the participants aligned a set of complementary actions to make it a reality. Regardless of the SGNP authorities having the legal responsibility to develop participatory mechanisms (BOE 2013, 2014), the participants identified 13 other stakeholders from different levels and sectors that could support the strategy in multiple ways (e.g., through funding provisions by local

administrations or the development of stakeholders mapping and consultancy on participatory governance by the universities that conduct research in the National Park).

The generated dialogue and reflections facilitated by the visual tool culminated in providing graphic outcomes (i.e., the green areas highlighted in the hexagons in Fig. 3) that correspond to initial pictures of who may or may not be willing to implement the PSP strategies to turn them into reality collectively. These graphic outcomes revealed the visualization of comparatively different collaboration patterns and willingness between stakeholders in proactively implementing the PSP strategies, providing some indications of the threshold for moving from scenario to action. These different patterns can be observed, for instance, by comparing the graphic outcomes associated with the education and awareness program for young people (S7; Fig. 3) and the citizen science project (S9; Fig. 3). In the first strategy, the participants identified that 10 stakeholders would collaborate to implement it, who, in turn, expressed different levels of positive willingness to do it. This may indicate that favorable conditions may exist to establish real agreements between stakeholders for taking joint action and implementing the strategy. However, in the second strategy, it can be observed that only one out of the seven stakeholders identified to implement the strategy showed positive willingness to engage in its implementation. This undetermined support to this strategy may imply it would be more challenging to make it a reality.

On this basis, we argue that the visual tool can be a useful starting point for organizing stakeholders to collaborate and take joint action in implementing the PSP strategies. The graphic outcomes of the visual tool (Fig. 3) can be interpreted as initial pictures that visualize who may be willing to get involved in each PSP strategy. Decision makers and practitioners could use them as the point of beginning to foster the creation of stakeholders' action networks for protected areas. These graphic outcomes could evolve based on the reactions of the identified stakeholders as part of the implementation processes. Therefore, the initial pictures provided by the visual tool should not be interpreted as binding and conclusive because it is contingent on the subjective understanding of participants at a certain moment. The visualization functions as a thread to organize collective action, and it might evolve as stakeholders confirm or deny their involvement, or willingness, in the strategies. In line with previous studies (e.g., Rickards et al. 2014, Nieto-Romero et al. 2016), we are aware that applying the visual tool and making visible stakeholders' willingness might not be a guarantee that stakeholders will then work together to implement PSP strategies. At present, we cannot predict whether the PSP strategies will be finally implemented in SGNP. It is widely recognized that multiple institutional, economic, and social factors (e.g., absence of political will, social skills, and organizational capacity, lack of resources and time availability, limited ability to make decisions of social actors, individuals' tendency to attribute the responsibility of conservation to external bodies) can inhibit collective action (e.g., Ostrom 2000, Volkery and Ribeiro 2009, Nieto-Romero et al. 2016, Bosone et al. 2022). In this sense, it should be noted that our study's focus did not include monitoring and evaluating the implementation of the PSP strategies. We think it would be interesting if future research assessed the potential impact of the visual tool to translate these strategies into action.

Responding to recent calls for the need to guide stakeholders in taking tangible action to implement PSP outcomes (e.g., Nieto-Romero et al. 2016, Totin et al. 2018), we posit that the visual tool can be considered a complementary method to backcasting techniques in the PSP process. Backcasting helps outline potential management strategies to address future scenarios' negative or positive aspects (Dreborg 1996). Over the last few years, backcasting has also been hypothesized to help foster collective action to implement such strategies as outcomes of PSP processes (Butler et al. 2014, 2015). However, an increasing number of studies state that this technique usually fails to empower stakeholders to take collective action (e.g., Oteros-Rozas et al. 2015, Nieto-Romero et al. 2016). We believe that our visual tool approach offers support in this regard because of its role in successfully guiding stakeholders to better visualize and therefore eventually organize action networks (Fig. 4). Beyond PSP processes, we argue that the visual tool has the potential to be easily adapted to other social-ecological knowledge co-creation processes. As a single case study, we are aware that the context-specific design of the visual tool might be considered a constraint for replicability. It is widely recognized as an inherent challenge that certain social science-based approaches and tools can be successful in a specific context and scale, but not in another (Star 2010, Lundgren 2021). To overcome this challenge, we have set out a detailed methodology that provides a practical orientation to be easily adapted to different contexts, processes, and formats (e.g., in-person workshops).

Interestingly, some of the identified abilities of the visual tool (i.e., opening dialogue for promoting collaborative work across sectors) link to the concept of boundary object. Boundary objects are abstract or concrete tools adaptable to different perspectives and knowledge domains to maximize the autonomy of diverse worldviews and facilitate communication to work together (Star and Griesemer 1989). Research has focused on boundary objects that emerge organically through transdisciplinary processes facilitating dialogue and collaboration between different actors under specific conditions. These boundary objects embody concepts such as "ecosystem services" (e.g., Abson et al. 2014, Steger et al. 2018), "resilience" (e.g., Brand and Jax 2007, Baggio et al. 2015), and "stewardship" (e.g., Enqvist et al. 2018). Boundary objects can also encompass a wide range of frameworks (e.g., Partelow 2016), models (e.g., Clark et al. 2011), data (e.g., Venable 2017), and visual devices such as knowledge maps (e.g., Walters et al. 2019) and films (e.g., Schneider et al. 2009). We suggest that the visual tool developed herein might also be considered a boundary object because it has facilitated dialogue between stakeholders across sectorial boundaries and scales in SGNP and created shared reference points to support collaboration between them. Future empirical studies are needed to analyze the visual tool's features from the boundary object theory (e.g., interpretive flexibility, structured aspects; Star and Griesemer 1989, Star 2010) and demonstrate its role as such.

#### **Implications of the visual tool for participatory conservation governance**

From the governance standpoint, our findings show that the visual tool has potential as a decision-support tool for participatory conservation governance. In fact, SGNP's decision makers recognized the visual tool's applicability to guide collaborations between a wide variety of governmental and non-governmental stakeholders. They specifically expressed that the visual tool could

support the ongoing development of the participation and volunteering subprogram of SGNP. This perception is complemented by most workshop participants who, in the post-workshop survey, considered the visual tool as an easy-to-use tool to support collaborative work to move forward and implement the co-defined strategies, and they advocated for its use in future participatory processes. We suggest that the visual tool we designed and tested could become part of the wide range of participatory research tools for supporting management decisions.

Based on the aspirational goals of PSPs to influence decision making (Wollenberg et al. 2000), the question remains as to how the visual tool approach can contribute to actual participatory governance. To address such a question, we refer to the framework proposed by Visseren-Hamakers et al. (2021) that identifies four governance dimensions that need to be combined and operationalized for fostering transformation toward sustainability goals. These four governance dimensions are inclusivity, integration, adaptation, and pluralism. We found that the visual tool shows potential contributions and limitations to reinforce participation in decision making in terms of the four dimensions.

#### *Inclusivity*

Under-representation of certain stakeholders in governance systems is a commonly recognized challenge. Institutional and socioeconomic factors often hinder stakeholders from being represented in participatory processes (Ruiz-Mallén et al. 2013). Our findings show two ways that the visual tool can facilitate inclusive approaches. First, the visual tool allowed the mapping of non-participant stakeholders as potential partners to successfully implement the PSP strategies. For example, a group of food production actors in the SGNP buffer zone did not participate in the PSP process but were considered pivotal by workshop participants (S3; Table 3). Second, the visual tool helped identify action networks between stakeholders formally included in the SGNP governance system (i.e., members of the Advisory Board of SGNP) and those who were not (e.g., educational and cultural sector). Making visible such potential alliances between well- and under-represented stakeholders may dissolve feelings of exclusion expressed by minority or previously excluded groups (López-Rodríguez et al. 2020a), thus, creating better conditions to facilitate their future engagement in the protected area governance (Innes and Booher 2004, López-Bao et al. 2017). Indeed, this happened in the case of a local environmental education cooperative without official representation in the Advisory Board within our own case study area of SGNP.

Our findings, however, reveal two potential limitations of the visual tool concerning inclusivity. One refers to the categorization and delineation of stakeholder groups that could generate feelings of exclusion by specific stakeholders who might feel they are not included in any predefined categories. To avoid stakeholders' potential feelings of exclusion or misunderstanding when applying the visual tool, we suggest clarifying the stakeholder groups at the beginning of the exercise and redefining them if needed. The other is associated with the potential difficulty of understanding the visual tool by non-experienced people working with similar visual approaches. This perception may be in line with many experts in data visualization who warn that radar plots can be poorly perceived and understood by human eyes (e.g., Tufte

2001). We assume that this effect is less pronounced in a social space where facilitators guide the application of the visual tool, and probably, for this reason, the visual tool was well-interpreted and understood by most participants in SGNP. It would be interesting for further research to explore new design choices for the visual tool with a higher potential to be accessible and open to the eye to overcome potential limitations in terms of interpretation for certain people.

#### *Integration*

Integrating governance instruments across different sectors and scales is pivotal in developing coherent policies and actions that support transformative change toward global sustainability goals (Visseren-Hamakers et al. 2021). The visual tool can identify state administrations and social agents to integrate institutional and societal efforts from diverse sectors (e.g., policy, academic, social, and cultural) and scales (e.g., local and regional). In our study, this integration became evident through the PSP strategies that included coordination between multiple state actors from different sectors and decision-making scales while embracing external forms of social engagement. This dominant pattern might be because SGNP is a government-led national park, in which multiple state administrations with legal authority converge to govern. In contrast, civil society groups play a consultative role. An example is the mobility plan to improve the public transport system and road traffic around SGNP (S2; Table 3), for which participants considered that articulation of institutional efforts at multiple scales and competencies (e.g., transport, environmental protection, infrastructure), as well as support from the tertiary sector (e.g., tourism companies and ski stations), would be needed. In addition, the visual tool might also guide grassroots initiatives needing support from and/or coordination with state administrations.

#### *Adaptation*

Visseren-Hamakers et al. (2021) argue that adaptive governance systems need to enable continuous opportunities for iterative learning, adjusting responses to uncertainty, social conflicts, and complexity over time. This type of governance can hardly be created by unilateral action of a sole authority (Chaffin et al. 2014). Instead, interactions between multiple stakeholders are needed to deal with the complexity and uncertainty associated with rapid environmental changes to pursue a desired state of social-ecological systems. Chaffin et al. (2014) argue that adaptive governance can emerge when such different stakeholders reorganize in response to perturbations such as policy windows, funding opportunities, and/or biophysical shocks to the system. Although the visual tool was not purposively designed to address systems' adaptation, we argue that it might have the potential to facilitate adaptive capacity if it were applied in an adaptive governance context. In such an adaptive process, the visual tool can provide a flexible approach to follow the evolution of dynamics in the governance system by identifying stakeholders that could be interested in implementing adaptive responses and monitoring their involvement to make such responses a reality. In our study, this can be illustrated through the case of the sports federations, identified as partners who could estimate recreation carrying capacity in SGNP (S6; Table 3). Their willingness was "positive subjected to consultation," but their confirmation depended on other federation members who would be consulted after the PSP exercise.



### Pluralism

Scholars increasingly advocate for opening up participatory governance processes to consider a range of perspectives encapsulating differing ontological assumptions and epistemological positions (e.g., Anderson et al. 2016, Matulis and Moyer 2017, Rawluk et al. 2020, Skrimizea et al. 2020). According to previous work, such processes offer stakeholders the opportunity to (1) generate dialogue to reflect and learn on social-ecological systems' complexity while dealing with dissonance that usually occurs when engaging a wide diversity of stakeholders (Rawluk et al. 2020); (2) create new actionable understandings about problem-solving in social-ecological systems' governance (West et al. 2019); (3) promote innovative possibilities for transformative action of governance systems (Anderson et al. 2016, Skrimizea et al. 2020), and (4) engage with processes in agreement with stakeholders' terms (Matulis and Moyer 2017). In this regard, the visual tool incorporated two negative levels for "willingness to collaborate" in effort to offer the opportunity for discordant voices to emerge as part of the collective deliberations. Interestingly, our findings show that participants did not assign any of such levels to the identified stakeholders in the PSP strategies (Fig. 3). A potential reason is that the co-learning and knowledge co-production approaches guiding the PSP process could facilitate the gradual generation of consensual outcomes (Oteros-Rozas et al., *unpublished manuscript*). The visual tool session occupied the last step of the PSP process, potentially prompting participants to a high level of agreement concerning the strategies and obscuring dissenting perspectives. Here, complacency bias could play a role in obscuring dissent perspectives. This could also arise because participants were not invited to explore potential trade-offs in the environmental, social, and economic consequences of different strategies (Ayre and Nette 2015). We suggest that future research could analyze factors that limit dissent perspectives from emerging when applying the visual tool and how to deal with them.

### CONCLUSION

Our study presents a context-specific visual tool that is created, applied, and analyzed within a PSP process, as a complement to the backcasting exercise. We refer to it as the visual tool for envisioning stakeholders' willingness to take collective action in implementing PSP outcomes. The aim of the visual tool was to open up a dialogue between stakeholders on the redistribution of tasks for working together toward PSP-resulting strategies while reflecting on their willingness to collaborate as a group to implement them. The generated dialogues and reflections facilitated by the visual tool culminated in providing graphic outcomes for each PSP strategy corresponding to initial pictures of who may or may not be willing to collectively engage to turn various conservation strategies into reality. The insights reveal that the visual tool can complement the backcasting technique by providing graphic outcomes that can be considered a useful starting point for creating action networks to put in motion the identified PSP strategies. Our study also reveals that the visual tool has the potential as a decision-support tool, and it can provide some practical contributions to four dimensions of participatory conservation governance during participatory scenario planning processes: inclusivity, integration, adaptation, and pluralism. We provide a practical orientation to adapt the visual tool to multiple contexts and social-ecological knowledge co-creation processes.

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[1] Streamline is an open-source cartoon visualization tool for envisioning and developing different scenarios for protected areas management (De Vries and Metzger 2018).

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### Data Availability:

*The data that support the findings of this study are available on request from the corresponding author*

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## Appendix 1. Workshop participants

Table A1.1 Number of participants in the PSP workshop and the visual tool session classified by stakeholder groups, regions and gender.

Stakeholder groups (n)	PSP work-shop	Visual tool session	Regions (n)	PSP work-shop	Visual tool session	Gender (n)	PSP work-shop	Visual tool session
State administrations	13	9	Madrid	7	5	Female	5	3
			Castilla y León	6	4	Male	8	6
Education and research centers	7	4	Madrid	6	3	Female	1	3
			Castilla y León	1	1	Male	6	1
Environmental non-profit organizations	11	5	Madrid	11	5	Female	6	2
			Castilla y León	0	0	Male	5	3
Local users: primary sector	4	0	Madrid	3	0	Female	3	0
			Castilla y León	1	0	Male	1	0
Local users: tertiary sector	3	2	Madrid	2	1	Female	0	0
			Castilla y León	1	1	Male	3	2
Other local stakeholders	7	3	Madrid	7	2	Female	2	1
			Castilla y León	0	1	Male	5	2
<b>Total</b>	<b>45</b>	<b>23</b>		<b>45</b>	<b>23</b>		<b>45</b>	<b>23</b>

Table A1.2 Number of participants in the second workshop and the visual tool session classified by management area, regions and gender.

Management area (n)	Policy work-shop	Visual tool session	Regions (n)	Policy work-shop	Visual tool session	Gender (n)	Policy work-shop	Visual tool session
Planning and management of protected areas	4	2	Madrid	2	1	Female	2	1
			Castilla y León	2	1	Male	2	1
Management of public use in protected areas	3	1	Madrid	2	1	Female	2	0
			Castilla y León	1	0	Male	1	1
Environmental education in protected areas	3	1	Madrid	1	0	Female	2	0
			Castilla y León	2	1	Male	1	1
Vigilance and control in protected areas	2	0	Madrid	1	0	Female	0	0
			Castilla y León	1	0	Male	2	0
<b>Total</b>	<b>12</b>	<b>4</b>		<b>12</b>	<b>4</b>		<b>12</b>	<b>4</b>

Appendix 2. Post-workshop survey

Regarding the visual tool used in the PSP workshop (visual tool's picture shown), please check the box to show your level of agreement with the following sentences:

Questions concerning the visual tool	Strongly disagree	Disagree	Agree	Strongly agree
1. The visual tool is helpful to identify inter and intra stakeholder groups collaborations to move from theory to practice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. The visual tool is helpful to understand how to set collaborative strategies into practice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. The visual tool is helpful to promote collective action in conservation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. The visual tool is helpful to visualize how to align goals across stakeholders and groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. The visual tool is helpful to reinforce willingness and commitment to be involved in conservation initiatives with other stakeholders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. The visual tool is an easy-to-use tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. In future participative processes for protected areas governance, I would like to use the visual tool again	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. What has been for you the most outstanding function/s of the visual tool?

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Appendix 3. Stakeholders' codes.

Table A3.1. Codification of the stakeholders made during the application of the visual tool approach.

Stakeholder groups	Name of organizations/social actors	ID
State administrations	SGNP conservation authorities	SA1
	Environmental Regional Ministry of the Autonomous Community Madrid	SA2
	Environmental Regional Ministry of the Autonomous Community Castilla y León	SA3
	Local state administrations that intersect with the SGNP	SA4
	National Parks Autonomous Agency	SA5
	Transport Regional Ministry of the Autonomous Community Madrid	SA6
	Transport Regional Ministry of the Autonomous Community Castilla y León	SA7
	Directorate of drove roads of the Autonomous Community of Madrid	SA8
	Directorate of drove roads of the Autonomous Community of Castilla y León	SA9
	Civilian guard	SA10
	National Ministry for Transport	SA11
	Forest rangers of the Autonomous Community of Madrid	SA12
	Citizen's Protection Regional Ministry of the Autonomous Community of Madrid	SA13
	National Ministry for Research and Innovation	SA14
	Education Regional Ministry of the Autonomous Community Madrid	SA15
	Education Regional Ministry of the Autonomous Community Castilla y León	SA16
Education and research centres	Culture Regional Ministry of the Autonomous Community of Madrid	SA17
	Universities that research in the SGNP	ER1
	Education centres around SGNP	ER2
	University of Valladolid	ER3
	Polytechnic University of Madrid	ER4
	Institute of Research, Rural Development, Food and Agricultural Autonomous University of Madrid	ER5
	Open University of Catalonia	ER6
	National Museum of Natural Sciences (Spanish National Research Council)	ER7
	University Foundation "González Bernáldez"	ER8
	Research Centre for Energy, Environmental and Technological Research of the Ministry of Science	ER9
	Cooperative "Educando Social"	ER10
Environmental non-profit organizations	Environmental associations engaged in the SGNP	EN1
	Environmental NGO "Amigos de la Tierra"	EN2
Local users: primary sector	Agricultural trade unions with a stake in the SGNP	PS1
	Group of local producers around SGNP	PS2
	Primary sector companies around SGNP	PS3
	Restaurants in SGNP buffer zone	PS4
	Shepherd School	PS5
	Group of local consumers around SGNP	PS6
	Agricultural association of Madrid (UGAMA)	PS7
Local users: tertiary sector	Sport federations with a stake in the SGNP	TS1
	Users of tertiary sector	TS2
	Tertiary sector companies	TS3
	Sky resort Valdesquí	TS4
Other local stakeholders	Well-recognized individuals	OS1
	Local population around SGNP	OS2
	Association of Private Landowners	OS3
	Rural development partnership "Sierra de Guadarrama"	OS4

Supra-municipal administration for social services in Rascafría  
Local media

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OS5  
OS6



## Appendix 4. PSP workshop outputs

Table A4.1 Description of the PSP backcasting strategies resulting from applying the visual tool approach. Each strategy and its description is shown with task/s to be developed by the identified stakeholders, and their willingness' values assigned by workshop participants [<sup>a</sup> Each stakeholder is identified according to stakeholders' ID (Appendix 3) / <sup>b</sup> Stakeholders' willingness values based on the predefined visual tool's scale in Table 2 from -2 to 3]

Identified strategy and description	Tasks to be developed by stakeholders	Stakeholders who might develop each task <sup>a</sup> and their willingness' values
<p><i>S1. Improve participation mechanisms to engage local communities in SGNP governance</i> This strategy includes a set of complementary actions (e.g., review of the Advisory Board structure and creation and integration of a Citizen's assembly within formal governance structure of the SGNP) to engage local communities in conservation decision-making.</p>	Coordination and strategy development	SA1 (2)
	Review of the Advisory Board	SA1 (2)
	Creation of Citizen's assembly	SA1 (2)
	Monitoring and evaluation of participation	SA1 (2)
	Support and approbation of the strategy	SA2 (1); SA3 (2)
	Request to set up and develop the strategy	SA4 (1); SA5 (2); EN1 (2); PS1 (1); TS1 (2); OS1 (0)
	Funding provision	SA1 (2); SA4 (1)
	Elaboration of stakeholders mapping and consultancy	ER1 (1)
	Training program on public engagement for SGNP technicians	ER2 (0)
	Participation in the Citizen's assembly	PS2 (0); TS2 (0); OS2 (0)
<p><i>S2. Mobility plan to improve the public transport system and road traffic around SGNP</i> It is a strategic plan to transition towards a resource-efficient and sustainable mobility system designed to visit SGNP.</p>	Coordination of institutional efforts at multiple scales and competencies (e.g., transport, environmental protection, infrastructure) and plan development	SA2 (0); SA3 (1); SA4 (1); SA6 (1); SA7 (0); SA8 (1); SA9 (0); SA10 (1); SA11 (1)
	Funding provision	SA2 (0); SA3 (1); SA4 (1); SA6 (1); SA7 (0)
	Social support from the tertiary sector by offering transport public among their services	TS3 (3)
<p><i>S3. Action plan for local sustainable consumption and production</i> This plan aims to boost local products' value added based on obtaining feed from organic production to promote local development in the area.</p>	Coordination and plan development	SA1 (1)
	Articulation of local products brand	SA1 (1); SA4 (1)
	Dissemination campaign	SA1 (1); SA2 (0); SA3 (0); SA4 (1); EN1 (2)
	Funding provision	SA1 (1); SA2 (0); SA3 (0); SA4 (1)
	Educative program in local consumption	ER2 (0)
	Consultancy for developing the strategy	ER3 (2); ER4 (2)
	Accession to the local products brand	PS2 (0)
	Plan to reinforce selling and consumption of proximity local products	PS3 (2)
	Menus focused on local products	PS4 (1)
	Training program to local producers	PS5 (0)
	Consumer networks map	PS6 (0)
	Local products consumption	OS2 (1)
	Land custody agreements	OS3 (0)

Table A4.1 (Continued)

Identified strategy and description	Tasks to be developed by stakeholders	Stakeholders who might develop each task <sup>a</sup> and their willingness' values
<p><i>S4. Incentive schemes to promote environmentally friendly agricultural and livestock activities</i> The strategy includes a set of measures to reward farmers for adopting sustainable practices.</p>	Coordination and strategy development	SA2 (0); SA3 (1)
	Consultancy for selecting indicators that define sustainable practices	ER5 (2)
	Participation and acquisition of incentives	PS1 (1); PS2 (1)
<p><i>S5. Program for preventing forest fires through controlled grazing</i> This program aims to promote new routes for livestock movement along firewalls based on scientific criteria to prevent ecosystem degradation in Sierra de Guadarrama area.</p>	Coordination and program development	SA2 (0)
	Coordination between state administrations and ranchers	SA12 (2)
	Silvicultural treatment activities	SA13 (0)
	Mountain management plan	ER4 (0)
	Research on pastures grazing capacity	ER6 (0)
	Organization of exchange of experiences with other similar programs	ER7 (2)
	Outreach activities and involvement of ranchers	PS7 (0)
	Funding provision	SA5 (1); SA14 (1)
<p><i>S6. Research project to estimate recreation carrying capacity in SGNP</i> The project aims to estimate the optimum recreation capacity in SGNP that is respectful of its ecological functioning.</p>	Prioritization of research proposals	SA1 (3)
	Elaboration of research proposal; study development	ER1 (1); ER6 (2); ER8 (1); ER9 (2)
	Data provision to develop the research	ER10 (1); TS1 (1); OS4 (1)
	Outreach activities	EN2 (3)
<p><i>S7. Education and awareness program for young people</i> This program focuses on incorporating protected areas into official educative programs in elementary and secondary schools in the Sierra de Guadarrama area.</p>	Coordination and program development	SA1 (3)
	Funding provision	SA4 (1)
	Approbation of protected areas in its official educative programs	SA15 (1); SA16 (1)
	Incorporation of protected areas as a subject into official educative programs	ER2 (2)
	Educative activities with specific groups of young people	EN1 (2)
	Informal talks	PS3 (1); TS3 (1)
	Logistic support to talks	TS4 (2)
	Outreach activities	TS4 (2)
	Creation of a social network of young people	OS5 (2)
	Logistic and material support	SA1 (1)
	Elaboration of dissemination campaign	SA1 (1); SA4 (0); SA15 (0); SA16 (0); OS6 (0)
<p><i>S8. Communication plan to promote social change towards sustainability</i> The strategy involves a set of actions for sustainability learning at all levels of education (e.g., elementary, secondary, and university levels) in teaching centers of the Sierra de Guadarrama area.</p>	Participation in dissemination activities	ER2 (1)
	Consultancy for developing educative material	ER3 (1); ER4 (1)
	Coordination with education centers	EN2 (2)
	Training program on sustainability for students	EN2 (2)

Table A4.1 (Continued)

Identified strategy and description	Tasks to be developed by stakeholders	Stakeholders who might develop each task <sup>a</sup> and their willingness' values
<i>S9. Citizen science project</i> Focused on actively involving citizens in data monitoring to generate new scientific knowledge in SGNP.	Coordination and project development Funding provision Logistic and material support Consultancy for development de project Data analysis Data collection and monitoring Training program in data monitoring for students	SA1 (0) SA2 (0); SA3 (0) SA17 (0) ER1 (0) ER1 (0) ER2 (0) ER11 (2)