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A Collaborative Approach for Scoping Ecosystem Services with Stakeholders: The Case of Arrábida Natural Park

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Abstract This paper presents an innovative approach for conducting collaborative scoping processes aiming to elicit multiple values of ecosystem services. The proposed methodology rests on three steps combining different participatory tools that promote a comprehensive examination of the perceptions hold by relevant stakeholder groups. The first step consists of an institutional and stakeholder analysis developed in the study area. The second includes a participatory workshop, where a sequence of scoping exercises is conducted with the active collaboration of the invited stakeholders. The final step aims to validate scoping results and develop dependency networks between organizations and the identified ecosystem services. The approach was tested in the Arrábida Natural Park, a marine and coastal protected area in Portugal. Invited participants were able to identify an extensive list of ecosystem services in the natural area, establish linkages between those services and human wellbeing, identify drivers of change and perform a preliminary screening of the associated ecological, social, and economic values. The case study evaluation provided positive feedback on the usefulness of the approach, which advances the existing set of methods for participatory identification of ecosystem services and sets the scene for involvement of stakeholder groups in assessment and management processes.

Keywords Collaborative scoping · Identification of ecosystem services · Stakeholder participation · Management of protected areas

Introduction

The concept of ecosystem services (ES) has been increasingly adopted by researchers and policy-makers in debates concerning biodiversity conservation and management of natural resources (Gómez-Baggethun et al. 2010). One of the key supporting arguments lies in the importance of this concept in relating the value of natural systems with human wellbeing. Under this premise, several initiatives have taken place at global (e.g., MEA 2005; TEEB 2010) and national scales (e.g., UK-NEA 2014), greatly contributing to the dissemination of ES approaches. Notwithstanding, some concerns have been associated with the use of this concept (Martínez-Alier 2002; Spash 2008), namely pointing out to the risks of ignoring multivalue dimensions of ES (de Groot et al. 2002) and differences in values attached by natural resources managers, affected local communities and broad stakeholder groups (Zagarola et al. 2014). Hence, the development of assessment and management frameworks capable of capturing and integrating different ES value dimensions (e.g., ecological, social or economic) are needed to provide a wider information base to support decisions affecting natural and social systems (Lopes and Videira 2013; Martín-López et al. 2014).

Despite the increasing attention given to development of ES assessment methods and tools (Bremer et al. 2015), participatory approaches for eliciting relevant ES at a scoping stage are still less examined. Since adaptive and integrated management processes usually start with a

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scoping process, where a preliminary problem definition is developed, such stage is important to broaden problem views and contextualize the issues at stake. Scoping often entails tasks such as stakeholder analyses and integrated system analyses (Weaver and Rotmans 2006), bringing together different perspectives and sustainability dimensions in a given social–ecological system (Jäger et al. 2008). At a scoping phase, the identification of goods and services provided by ecosystems is thus a first critical step where it is important to understand not only the purpose of the assessment and the type of values to be elicited (Kallis et al. 2013), but also to create a shared understanding of the relevant ES in a given study area. Furthermore, if ES are defined in broad terms as the benefits people obtain from ecosystems (Costanza et al. 1997; de Groot et al. 2002; MEA 2005), it seems all more important to deploy a participatory approach to integrate the perspectives of those parties that affect or are affected by changes in ES provision, from the early stages of a decision-making process (Lopes and Videira 2013; Kenter et al. 2015; Zagarola et al. 2014).

Notwithstanding the generalized agreement on the importance of conducting participatory ES assessments, a literature review on this topic reveals that there is still an incipient inclusion of stakeholders in these processes, particularly at a scoping stage (Menzel and Teng 2010; Seppelt et al. 2011; Iniesta-Arandia et al. 2014). Most scoping studies thus far engage social actors in the identification of ES through survey-based (e.g. Casado-Arzuaga et al. 2013) and individual semi-structured interview approaches (e.g., Quinn et al. 2015). In the deployment of these methods, individual respondents are often presented with a list of services, for a given study area, which is prepared in advance by experts (García-Nieto et al. 2013; Cárcamo et al. 2014). In a case developed in Canada, Darvill and Lindo (2015) conducted individual interviews to identify ES hotspots for provisioning and cultural services using GIS methods. Examples of participatory approaches for ES identification where stakeholder groups are jointly engaged in scoping tasks are still scarce, with exceptions found in a few ES spatial mapping applications. For example, in the study reported by García-Nieto et al. (2015), collaborative workshops were conducted to collect stakeholders' perceptions regarding spatial distribution of a set of ES in a protected area in Spain. Moreno et al. (2014) have also conducted participatory workshops to create mental model maps facilitating a collective analysis of relationships between ecosystems and society. Their study was focused on exploring two specific ES selected by the research team. These cases show that in most participatory ES assessment studies, stakeholder involvement has been focusing on the use of spatial mapping techniques and individual interviews.

Within this context, and drawing on the participatory framework developed by Lopes and Videira (2013), this paper aims to present a collaborative scoping methodology to be applied at inception stages of ES assessment and management processes. Such approach recognizes that using stakeholders' perceptions to capture social values (e.g., Howarth and Wilson 2006; Kumar and Kumar 2008; Kenter et al. 2015) is an important way to foster multidimensional assessments of ES, sharing knowledge and creating awareness on the importance of ES from the very beginning of a decision-making process. Particularly since intangible values of ES are sometimes ignored (Chan et al. 2012), a multi-method approach is presented to promote triangulation of results and provide different opportunities to integrate and articulate perceptions of multiple stakeholder groups.

The proposed methodological approach was implemented in a natural park as an illustration of how "bottom-up" ES identification processes may be promoted by natural resource managers with engagement of broad stakeholder groups. According to Potts et al. (2014), identifying and valuing ES in protected areas are the promising approaches to foster attention to the services provided by the area. A shared recognition of the existence of ES may inform the discussion on their links to human wellbeing (Potts et al. 2014), facilitate dialogues between nature conservation managers and stakeholders, and consequently gather support for management actions. This argument seems particularly promising in protected areas such as natural parks and protected landscapes, where the interaction of people and nature over time plays a vital role and gives rise to distinctive spaces with significant ecological, biological, scenic and cultural values (Dudley 2008; Riper and Kyle 2014). As argued also by Palomo et al. (2014), the current "socio-ecological perspective" advocated for management of protected areas requires an interdisciplinary approach connecting biophysical processes with human activities at different scales, thus showing the importance of capturing and integrating stakeholders' perspectives to support management of protected areas. We aim to demonstrate how such stakeholder involvement may be initiated through a process of collaborative scoping of ES, which prepares and informs subsequent stages of participatory assessment and management processes (Lopes and Videira 2013).

The paper will proceed as follows. The next section describes the case study area selected for the implementation of the proposed approach, as well as the methods deployed at each stage of the ES collaborative scoping process. The third section presents and discusses the results achieved with the empirical application of the framework, while the final section highlights the main lessons learned and avenues for future research.

Collaborative Scoping Approach and Methods

Study Area

The selected site for testing the ES collaborative scoping approach was the Arrábida Natural Park (ANP), a coastal and marine protected area in Portugal, created in 1976 (Fig. 1). ANP is also a Natura 2000 site that has numerous biological, geological, floristic and archaeologies features of high and unique importance (Batista et al. 2011; Cunha et al. 2014). The coastal protected area was enlarged with a contiguous marine protected zone (Marine Park *Professor Luíz Saldanha*), designated in 1998, which harbors more than 1000 species of marine fauna and flora and is considered a hotspot for European marine biodiversity (Cunha et al. 2014).

The case study area was selected for the implementation of the collaborative ES scoping framework due to the richness of the site in terms of natural values (Novais et al. 2004; Cunha et al. 2014), and also because of the challenges placed on nature conservation arising from the intense human presence on the territory. Overlapping the limits of the ANP, there are three main urban centers—Setúbal, Palmela and Sesimbra—with a population of about 235,000 residents (INE 2011). Long-term conflicts have been observed in the area, such as the controversy arising from the existence of a limestone quarry inside the limits of this protected site (Clemente et al. 2004). However, despite several pressures, there is still a significant wild marine and terrestrial area, which is actively managed by nature conservation authorities (ICN 2003).

Collaborative Scoping Approach

The proposed approach for conducting a collaborative scoping of ES emerges from a broader framework to assess and value ES through a structured participatory process (Lopes and Videira 2013). This framework is based on three stages, (1) set the scene; (2) deepen understanding; (3) articulate values. Thus, on this paper we focus on the first stage, where "setting the scene" is achieved through a collaborative scoping process. Figure 2 illustrates the framework, detailing the tasks performed at the scoping stage. We envisioned a level of participatory impact usually designated as "active involvement" (Videira et al. 2006), which means that stakeholders' own understandings and mental models regarding ES will be explicitly accounted for throughout the different steps of the scoping process.

Step 1: Framing the Institutional Context and Stakeholder Analysis

The institutional context plays an important role in decision-making processes. Institutions are hereby understood as the rules governing a decision (Vatn 2005). Hence, during a 2-month inception state, we identified institutions in ANP by collecting and reviewing relevant documents at national and regional levels (e.g., conventions, laws, management instruments). This process was developed in collaboration with managers of the protected area, throughout interviews and several meetings. The aim was to elaborate an interpretative list with the most important institutions that have some influence on the protected area,

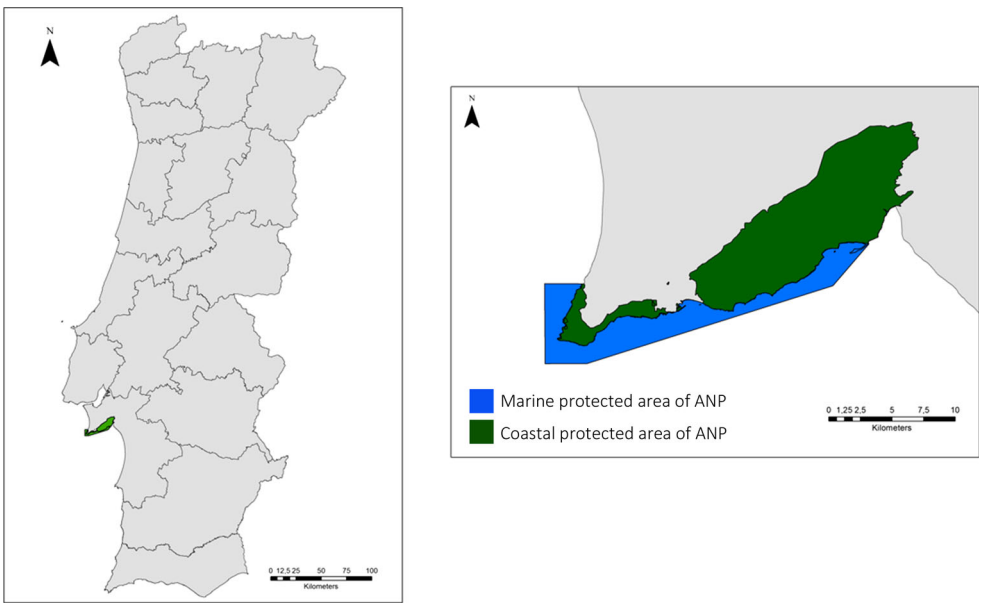


Fig. 1 Arrábida Natural Park map (Portugal). *Source*: Adapted from ICNF (2015)

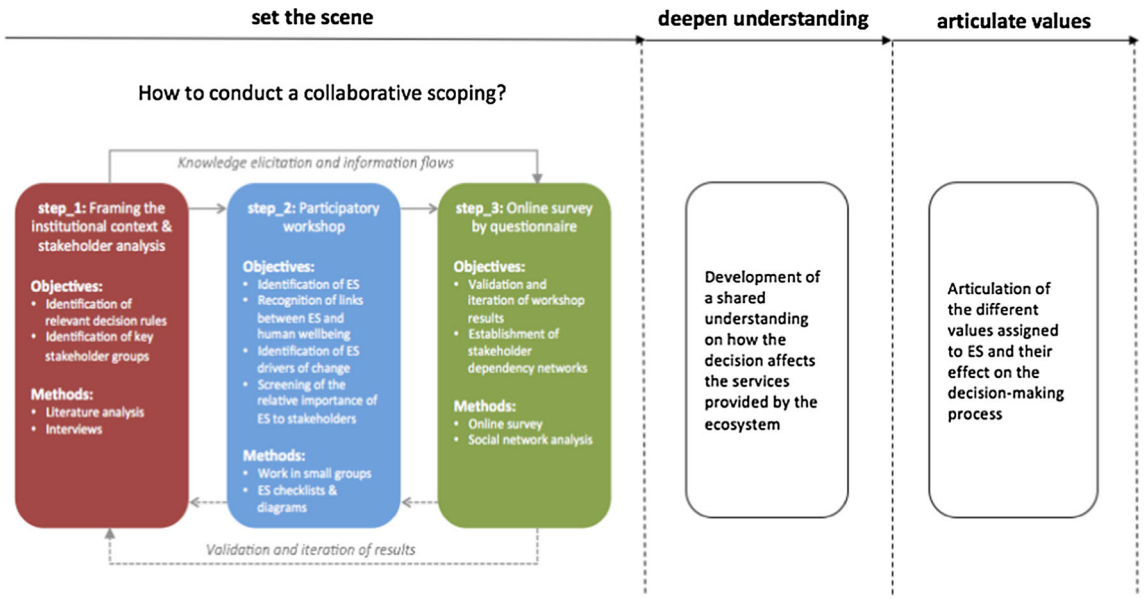


Fig. 2 Ecosystem services collaborative scoping approach (based on the framework developed by Lopes and Videira 2013)

and at the same time, understand to which extent the ES concept was reflected in the management instruments of the park. Stakeholders' identification was also developed in collaboration with ANP managers, combined with a snowballing procedure where invited stakeholders could provide suggestions of other participants to be invited.

Step 2: Participatory ES Scoping Workshop

After the identification of the main institutions and the key stakeholders to invite to the scoping process, we conducted a workshop in Setúbal, where the headquarters of the ANP are located. The workshop aimed to address four broad scoping objectives: (1) identifying ES provided by the protected area, (2) eliciting the linkages between ES and human well-being, (3) identifying ES drivers of change, and (4) assessing the importance attached by stakeholders to different ES values. These scoping objectives were defined to reflect the core elements of the conceptual frameworks advanced by the MEA—Millennium Ecosystem Assessment (MEA 2005) and TEEB—The Economics of Ecosystems and Biodiversity (TEEB 2010). According to these frameworks, adopting an ES approach entails the identification and classification of ES according to different categories of services (e.g., provisioning, regulating, cultural and supporting), linking ES with constituents of well-being, identifying direct and indirect drivers of change and eliciting values (e.g., economic, socio-cultural, biophysical) to support governance and decision-making.

Hence, in the implementation of the scoping approach to the ANP case study, a sequence of small group exercises was organized to deliberate on the following questions: *Which are the ecosystem services that ANP provides? Which are the links between those ecosystem services and human wellbeing? Which are the main threats to ecosystem services in ANP? Which services are perceived as having a higher ecological, economic and social importance?* A script was developed to support the activities conducted during the workshop, including a detailed description of the different tasks and expected outcomes (Table 1).

Step 3: Online Survey by Questionnaire

The workshop outcomes were validated and enhanced by an ex-post online survey by questionnaire. This survey, which was prepared using the Google Docs tool, was distributed to all stakeholders through e-mail. The questionnaire was composed by three sets of questions. The first set aimed to consolidate the list of ES identified during the workshop; the second was meant to validate results regarding the screening of ES importance and the third, to capture the dependencies between stakeholder organizations and the identified ES.

Social network analysis methods (Scott and Carrington 2011) are based on a conceptual network representation of social interactions and are relevant for ES scoping activities since they facilitate the understanding of complex social relationships (Fliervoet et al. 2016; Scott and Carrington 2011) and provide useful information for subsequent stages of participatory assessments. This was shown by Cárcamo et al. (2014) who developed a network graph to observe dependency relationships and possible trade-offs among different ES, biodiversity features, and uses. Kreakie et al. (2015) also recognized the usefulness of these

Table 1 Script for the ecosystem services scoping workshop at the Arrábida Natural Park

Task 1—Background presentations (60 min)	*Purpose*: Familiarize participants with the concept of ES, the management objectives and main features of the protected area and the participatory process to be conducted
	Role of research team: researchers provide an overview of methods and the workshop process; ANP park managers provide an overview of the main features and objectives of the protected area
Task 2—Organization of working groups (15 min)	*Purpose*: Organize four working groups, each of them dealing with a category of ES (i.e., provisioning, regulation, support and cultural)
	Role of research team: Assist participants in the configuration of the groups. With 4 to 6 participants expected per group, several post-it cards with the name of each category of ES are distributed on a wall for participants to select. In each small group, the inclusion of participants with different backgrounds is incentivized
	Role of participants: Participants select, on a first-come first-served basis, the thematic working group that they would like to join
Task 3—Work in small groups: identification of ES (70 min)	*Purpose*: Answer the question: which are the ES provided by ANP?
	Role of research team: Team members support each group's rapporteur in moderating the discussions and clarifying any questions regarding the filling of the worksheets
	Role of participants: Identifying ES in the study area, giving specific examples
Subtask 3.1 Providing examples of each ES category (45 min)	*Purpose*: Development of a list of ES provided by the study area
	Role of research team: A paper worksheet (size A1) is delivered and placed at the center of each small group's working table. Each sheet includes a generic list of ecosystem services for each main category, defined according to MEA (2005) and TEEB (2010):
	Provisioning services: "food", "water", "raw materials", "genetic resources", "medicinal resources" and "ornamental resources"; Regulation services: "air quality regulation", climate regulation", "water regulation", "erosion regulation", "pollination", "human disease and pest regulation"; Support services; "primary production", "O_2 production", "soil formation", "nutrient cycling" and also "habitat formation" and "maintenance of genetic diversity"; Cultural services: "aesthetic values", "recreation and ecotourism", "cultural diversity", "spiritual and religious values", "knowledge and educational systems" and "sense of place"
	Role of participants: Participants of each small group mark up the checklist, with the types of ES that are present in the ANP, and add concrete examples of ES in the ANP
Subtask 3.2 Participants exchange groups	*Purpose*: Extend and validate the list of ES identified in each small group
Group change (5 min)	*Role of research team*: Prompts participants of each small group to exchange seats with colleagues except for the four rapporteurs who stay in the original groups (e.g., participants from the *provisioning group* exchanged with participants from the *support group*, and the *cultural group* members switched with the r*egulation* ones)
Validation (20 min)	*Role of participants*: Rapporteur stays in the original group and explains key results from the first round of discussions (Videira et al. 2012). Participants deliberate and suggest changes to the initial list of examples, using a different color pen to mark the changes made
Task 4—Work in small groups: identifying links between ES and human wellbeing (30 min)	*Purpose*: Answer the question: which are the links between ES and human wellbeing?
	Role of research team: Adding a new sheet, guide participants through the identification of links between different components of human wellbeing and the previously identified ES. The Millennium Ecosystem Assessment (MEA 2005) defines five components of human wellbeing, which include security (e.g. personal safety, secure resource access); basic material for good life (e.g. shelter, access to goods); health (e.g. feeling well, access to clean water and air); good social relations (e.g. social cohesion, mutual respect) and freedom of choice and action (opportunity to be able to achieve what an individual values doing and being)
	These components help participants to think in terms of wellbeing provided by ES allowing the recognition of these linkages
	Role of participants: Participants identify the links between human wellbeing and the ES identified in task 3

Table 1 continued

Task 5—Work in small groups: identifying threats to ES (30 min)	*Purpose*: Answer the question: *Which are the main threats to ES?*
	Role of research team: Adding a new worksheet on each table, guide participants in each small group through the process of identification of threats to the provision of ES identified in task 3
	Role of participants: Develop a list of threats, that should be organized according to different drivers of change (demographic; economic; socio-political; cultural and religious; scientific and technological; climate variability and change; nutrient application to agricultural systems; land conversion; biological invasions and diseases [following the classification proposed by MEA (2005) and Nelson et al. (2006)]
Task 6—Work in small groups: screening the importance of ES (20 min)	*Purpose*: Answer the question: *Which are the most important services at ecological, economic and social level?*
	Role of research team: Distribution of nine dots to each participant (3 red dots for economic importance, 3 blue dots for social importance and 3 green dots for ecological importance), and prompting participants to screen the ES that they perceive as more important in the ANP
	Role of participants: Participants are able to circulate around all the tables for voting (i.e., placing dots) in different categories of services. Participants vote for the services perceived as more important for ecological, social and economic reasons
Task 7—Workshop evaluation by participants (5 min)	*Purpose*: Collect feedback regarding the workshop and collaborative scoping approach, to evaluate outcomes of the process at different levels:
	Organization
	Participants
	Discussions
	Results
	Role of research team: Distribution of the evaluation survey
	Role of participants: Answer an evaluation survey about the workshop

methods for conservation professionals. In our study, we propose adapting the social network analysis approach to build stakeholder dependency networks from the ES identified during the collaborative scoping process. The networks for each category of ES were developed using the Cytoscape tool (Shannon et al. 2003).

Results and Discussion

Institutional and Stakeholder Analysis

The institutional analysis revealed the most relevant rules for action in the ANP. Due to its classification as a "Natural Park," a combination of different socioeconomic activities and a strong human presence on the territory is allowed. Thus, several formal institutions are important for the management of the area, such as ANP's management plan, Natura 2000 rules and several development and conservation programs. A review of these formal instruments showed that despite the reference to examples of services provided by ANP's ecosystems, the concept of ES is not yet explicitly recognized.

The stakeholder analysis performed with the collaboration of ANP's managers, allowed to identify 67 representatives in 38 organizations, classified according to four categories of stakeholder groups (Table 2).

Table 2 shows that a mix of representatives from the four stakeholder categories was achieved both in the workshop and online survey. Governmental organizations included representatives from local authorities (i.e., municipalities), public agencies and protected area managers. Research institutions were represented by universities and research centers. Civil society organizations included local community associations and interest groups. National associations, as well as regional and local organizations, represented business stakeholders.

In the evaluation questionnaire distributed at the end of the workshop, participants were asked to comment on the composition of the stakeholder group. They agreed that a diverse group of relevant interested parties were involved in the scoping process (most frequent answer: 5 meaning strongly agree), although some stakeholders have been absent from the workshop, mostly business representatives (e.g. from tourism, agriculture, fisheries, and forest sectors). Notwithstanding the agreement that they functioned well as a group, the majority of participants commented that time available for developing the exercises in the workshop was limited. In further applications of the approach, the extension of the length of the participatory

Table 2 Invited and participating stakeholder groups in the collaborative ecosystem services scoping process

Organization category (based on Marega and Urataric 2011)	Stakeholder analysis		Workshop participants		Online survey participants	
	Number of organizations	Number of participants	Number of organizations	Number of participants	Number of organizations	Number of participants
Government/Authorities (GA)	16	35	7	12	6	11
Research Institutions (RI)	3	5	1	1	3	4
Civil Society (CS)	12	16	3	5	3	5
Business (B)	7	11	3	3	6	6
Total	38	67	14	21	18	26

workshop could be tested. Nevertheless, this raises the question on the possible trade-off between the duration of events and the attendance rate in such type of voluntary participatory processes (Videira et al. 2012). The fact that an ex-post online survey was deployed provided an additional opportunity and expanded the time available for participants' engagement. This seemed to have worked well in the ANP case, where 39 % of invited participants responded to the online survey, while an attendance rate of 31 % was achieved in the ES scoping workshop.

Identification of Ecosystem Services in the Arrábida Natural Park

In this key task we aimed to engage stakeholders in the elaboration of a comprehensive list of specific ES provided by the protected area. Table 3 shows that workshop participants were able to deliberate, from the ground up, on the ES provided by the protected area, achieving a list with a total of 53 specific examples of ES across all of the four main categories.

Participants' first recognized the presence of all 'generic services' identified in a preliminary checklist distributed at the beginning of the workshop. Subsequently, we asked them to debate on concrete examples for the case study area. This promoted a more in-depth discussion, translating general perceptions on ES types into specific examples that participants could more easily relate with for providing suggestions based on their empirical knowledge. On the other hand, the results we had obtained in the institutional analysis step showed that the concept of ES, as well as some types of ES (e.g., ES.2.5, ES.2.6, ES.3.3, ES.3.4), were not reflected in current institutions for the protected area (e.g., such as those established in the ANP management plan). The rules approved by ANP's nature conservation regulations do not fully adopt an ES approach yet. This was evident from the analysis of legal instruments establishing the institutional context for management of the protected area, wherein the concept of ES was not explicitly mentioned in any of the reviewed documents.

Table 3 also indicates that examples elicited for provisioning and cultural services were more extensive than those collected for regulation and support services. This confirms the tendency referred by several authors who have pointed that the latter ES are usually less 'visible' to people (Iniesta-Arandia et al. 2014). Nonetheless, the scoping approach deployed in the workshop gave positive indications that a deliberative process of ES identification is able to address this limitation by broadening individual perceptions. This happened not only during the debates taking place in the original small groups (subtask 3.1, Table 1), but also by allowing participants to sit in different groups and add suggestions to extend the scope of ES identified by fellow participants in the first round of discussions (subtask 3.2, Table 1).

The degree of familiarity of workshop participants with the ES concept was relatively high. 60 % of participants declared that they knew well the ES concept, 33 % knew it to some extent, while only 7 % declared that they knew the concept but did not fully understand it at the beginning of the workshop. To verify whether the ES list identified by workshop participants was comprehensive, the ex-post questionnaire, made available online after the workshop to all stakeholders, was used to validate results. We asked participants to classify their degree of agreement with the set of ES identified in the workshop, using a Likert scale, from 1—"totally disagree" to 5—"totally agree." The results are presented in the box-plots included in Table 3. With most answers concentrated between "3" and "5" in all four major categories, it may be concluded that a mid to very high level of agreement with workshop results was achieved. In the online survey, a few additional comments were collected—as shown in the last column of Table 3—mostly related with examples that did not illustrate ES in the ANP (ES 1.1.5, ES 2.6.1, ES 4.5.3), ES examples missing from the original list (ES 1.1, ES 1.4, ES 3.5, ES 4.6), and suggestions for management of some of the identified services (ES 1.6.1, ES 2.1.1, ES 4.2.2). A revised list of services obtained at the end of the collaborative scoping process may then be subsequently used to inform future ES assessments in the ANP.

Table 3 Ecosystem services identified by stakeholders in the Arrábida Natural Park

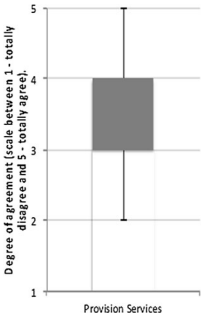
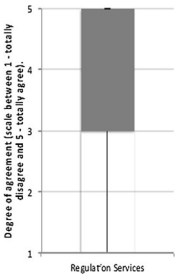
Main ES category	Generic examples of ecosystem services in each main category (adapted from MEA 2005; TEEB 2010)	Step 1—Institutional analysis	Step 2—Participatory workshop		Step 3—Ex-post online survey	
		Are generic examples of ecosystem services referred to in the protected area management plan?	Were generic ecosystem services recognized by workshop participants (Task 3—see Table 1)?	Specific examples of ecosystem services in the protected area, identified by workshop participants (Task 3—see Table 1)	Degree of agreement of survey respondents with the list of ecosystem services identified by workshop participants (scale ranges between 1: totally disagree, and 5: totally agree	Comments added by survey respondents and suggested changes to the list of specific examples of ES elicited in the workshop
ES.1. Provisioning services	ES.1.1. Food	✔	✔	ES.1.1.1. Fish ES.1.1.2. Dairy products ES.1.1.3. Wine ES.1.1.4. Herbs ES.1.1.4. Vegetables ES.1.1.5. Other endemic varieties		"Specific examples of "food" is missing"—build up examples on ES.1.1 "There is no endemic species that could be considered food"—delete ES.1.1.5 "Honey should be an example of food"—add honey to ES.1.1
	ES.1.2. Water	✔	✔	ES.1.2.1. Water provisioning ("although this service is not very relevant in the area")		"For me water is relevant"—maintain ES.1.2.1
	ES.1.3. Raw materials	✔	✔	ES.1.3.1. Limestone		"More examples of biodiversity in genetic resources"—build up examples in ES.1.4
	ES.1.4. Genetic resources	✔	✔	ES.1.4.1. Algae ES.1.4.2. Endemic orchid		"I disagree with fossils (…) they should not be explored"—suggestion for management of ES.1.6.1
	ES.1.5. Medicinal resources	✔	✔	ES.1.5.1. Medicinal herbs ES.1.5.2. Carob		
	ES.1.6. Ornamental resources	✔	✔	ES.1.6.1. Handicraft (scales, shells, fossils)		
ES. 2. Regulation services	ES.2.1. Air quality regulation	X	✔	ES.2.1.1. Pollution from quarries controlled by vegetation		"The vegetation is not enough to control the pollution from the quarry industry"—suggestion for management of ES.2.1.1
	ES.2.2. Climate regulation	X	✔	ES.2.2.1. Rain increase ES.2.2.2. Carbon sequestration with potential increase of biomass close to the soil		"Humidity increase is more correct than rain increase"—rename ES.2.2.1
	ES.2.3. Water regulation	✔	✔	ES.2.3.1. Karst aquifer recharge		"Coastal zone is also protected by dunes and beaches"—complete description of ES.2.4.1
	ES.2.4. Erosion regulation	✔	✔	ES.2.4.1. Coastal zone protection by vegetation		"The hospital is not an ecosystem service"—delete example ES.2.6.1
	ES.2.5. Pollination	X	✔	ES.2.5.1. Growth of agriculture and biodiversity compared to areas outside the limits of the ANP		
	ES.2.6. Human disease and pest regulation	X	✔	ES.2.6.1. Outão Hospital		

Table 3 continued

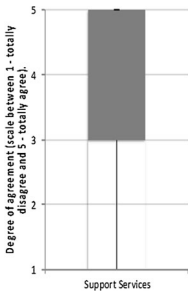
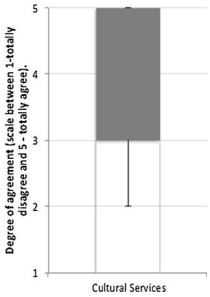
Main ES category	Generic examples of ecosystem services in each main category (adapted from MEA 2005; TEEB 2010)	Step 1—Institutional analysis Are generic examples of ecosystem services referred to in the protected area management plan?	Step 2—Participatory workshop		Step 3—Ex-post online survey	
			Were generic ecosystem services recognized by workshop participants (Task 3—see Table 1)?	Specific examples of ecosystem services in the protected area, identified by workshop participants (Task 3—see Table 1)	Degree of agreement of survey respondents with the list of ecosystem services identified by workshop participants (scale ranges between 1: totally disagree, and 5: totally agree	Comments added by survey respondents and suggested changes to the list of specific examples of ES elicited in the workshop
ES.3. Support services	ES.3.1. Primary production	✔	✔	ES.3.1.1. Primary production ("The ANP presents all the features needed for primary production")		"I do not agree that the ANP presents all the features needed for primary production"—rewrite description of ES.3.1.1
	ES.3.2. O_2 production	✔	✔	ES.3.2.1. O_2 production by forests, prairies, and pastures		"It is important to mention the shredders habitat, which is the refugee for migratory birds"—add this specific example to ES.3.5
	ES.3.3. Soil formation	X	✔	ES.3.3.1. Pockets of land in karst areas that allow attachment of vegetation in mountain areas and water retention		"Instead of Park Luís Saldanha it should be mentioned marine natural park"—rename ES.3.5.1
	ES.3.4. Nutrient cycling	X	✔	ES.3.4.1. Nitrogen cycle—existence of pulses that enable the fixation of atmospheric nitrogen that enters in the cycle		
				ES.3.4.2. Cycles of other nutrients (e.g. P, K, Mg) fixed in organic matter and vegetation		
	ES.3.5. Habitat provision	✔	✔	ES.3.5.1. Park Luíz Saldanha's habitats are important for species fixation		
				ES.3.5.2. Natural forest as habitat for birds		
	ES.3.6. Maintenance of genetic diversity	✔	✔	ES.3.6.1. Different varieties of oak		
				ES.3.6.2. Several types of orchids		
				ES.3.6.3. Atlantic marine biodiversity		

Table 3 continued

Main ES category	Generic examples of ecosystem services in each main category (adapted from MEA 2005; TEEB 2010)	Step 1—Institutional analysis	Step 2—Participatory workshop		Step 3—Ex-post online survey	
		Are generic examples of ecosystem services referred to in the protected area management plan?	Were generic ecosystem services recognized by workshop participants (Task 3—see Table 1)?	Specific examples of ecosystem services in the protected area, identified by workshop participants (Task 3—see Table 1)	Degree of agreement of survey respondents with the list of ecosystem services identified by workshop participants (scale ranges between 1: totally disagree, and 5: totally agree	Comments added by survey respondents and suggested changes to the list of specific examples of ES elicited in the workshop
ES.4. Cultural services	ES.4.1. Aesthetic values	✔	✔	ES.4.1.1. Landscape ES.4.1.2. Area with low population density ES.4.1.3. Artistic inspiration ES.4.1.4. Mountain–sea contrast		"Education for citizenship; the environment has ethnical and scientific content in the context of sport and leisure"—add ethnical and scientific content to ES.4.5 "The migration was more important to the canning, salt and oysters industry"—specify in ES.4.3.3 "Fishing is also a cultural service"—add this example to ES.4.2. and ES.4.6 "Add several national and international classifications as an example of cultural services"—specify in ES.4.1.1 "Application for world heritage"—eliminate ES.4.5.3 "It is missing the recognition of the place by humans and the integration of ecology in culture"—to include in ES.4.6. and in ES.4.5 "The sense of place in ANP and surrounding area leads to a natural predisposition to nature conservation"—add nature conservation to ES.4.6
	ES.4.2. Recreation and eco-tourism	✔	✔	ES.4.2.1. Beaches ES.4.2.2. Nature sports ES.4.2.3. Gastronomy ES.4.2.4. Closeness to river and sea		
	ES.4.3. Cultural diversity	✔	✔	ES.4.3.1. Several people ("There was always human presence in the territory") ES.4.3.2. Invasion territory ES.4.3.3. Migration processes from Lisbon		
	ES.4.4. Spiritual and religious values	✔	✔	ES.4.4.1. Mysticism ES.4.4.2. Isolated areas ES.4.4.3. Arrábida convent ES.4.4.4. Finisterra territory ES.4.4.5. Cape Espichel ES.4.4.6. Tapers ES.4.4.7. Arrábida legends		
	ES.4.5. Knowledge systems and educational values	✔	✔	ES.4.5.1. Biophysical and geological features ES.4.5.2. Limited access to the local ES.4.5.3. Arrábida's candidacy for UN World Heritage site		
	ES.4.6. Sense of place	✔	✔	ES.4.6.1. Mountain–sea connection ES.4.6.2. Remote place to discover ES.4.6.3. Closeness to marine environment		

Linking Ecosystem Services and Human Wellbeing

Recognizing the linkages between the services provided by ecosystems and human wellbeing is part and parcel of an ES approach (MEA 2005; Willemen et al. 2013). Notwithstanding, it is often unclear whether stakeholders realize those linkages and the mechanisms through which they are established. For example, in a study focusing on the role of marine protected areas in delivering flows of ES to support human welfare, Potts et al. (2014) argued that capturing these links was essential to inform debates on how to manage those ecosystems. The MEA (2005) defends that wellbeing components are related with all ES categories, although there are differences in the intensity and in the potential for mediation by socioeconomic factors. In the Ecosystem Services and Poverty Alleviation framework, Fisher et al. (2014) highlighted the possibility of establishing how a specific ES contributes for wellbeing, thus supporting understanding of stakeholder priorities.

For this workshop exercise (see Task 4, Table 1), we aimed to raise awareness on the linkages between ES and human well-being and assess how stakeholders perceived these interrelationships. First, participants were asked to identify the contribution of ES to the wellbeing components advanced by the MEA (2005), by checking the ES categories that they perceived as relevant to each benefit (wellbeing component; Table 4).

Interestingly, a few wellbeing components were considered independent of some ES categories. For example, regarding "good social relations" and "freedom of choice," the small group working on regulation services argued that these two benefits do not result from ES.2. In the study developed by Fisher et al. (2014), these two components appear linked with all the ES categories, although they are more strongly related with cultural services (ES.4.). During the workshop, participants have also identified direct linkages between support services and all wellbeing components, which again showed the importance that the group attached to this ES category. On the other hand, the wellbeing component "security" was not linked to provisioning services (ES.1.). According to Fisher et al. (2014) this wellbeing component is more dependent from the regulation services (ES.2.), which seems to be aligned with workshop results.

Subsequently, we asked each group of participants to detail which components of wellbeing were affected by the specific ES examples they had identified for the ANP. Table 5 provides an example of results achieved by the group working on the cultural ES category.

Table 5 shows that workshop participants considered that all cultural services (ES.4.) are associated with "freedom of choice and action," which underlines the importance of these services, many times considered "invisible" to people and associated with "intangible values." The wellbeing components less linked with the cultural services (ES.4.) were "security" and "basic material for good life," which is also aligned with the results from Fisher et al. (2014). The results emphasize how cultural services are important in the ANP context. According to Karrasch et al. (2014), stakeholders typically express their perceptions and needs in collective rather than individual terms, which is very similar to what happened in the discussion of this scoping objective in the ANP. Identifying these slight differences could help understand different contributions of ES to wellbeing components in the context of a specific protected area.

Identifying Drivers of Change of Ecosystem Services

Anthropogenic drivers of ecosystems change are described as any human-induced factor that directly or indirectly causes a change in ecosystems (MEA 2005). In Task 5 (see Table 1), workshop participants deliberated on the main drivers affecting each of the ES identified in the previous tasks. The examples provided by participants were subsequently assigned to the categories of drivers defined by the MEA (2005) and Nelson et al. (2006). Table 6 presents the results from this task, showing the number of drivers of change identified by participants across the different categories of ES. It should be noted that this procedure did not aim to measure the degree of change induced by each driver on each ecosystem service. It rather meant to collect

Table 4 Summary of the linkages between wellbeing components and the main categories of ecosystem services recognized by workshop participants

Wellbeing components (MEA 2005)	Main ecosystem services categories			
	ES.1. Provisioning	ES.2. Regulation	ES.3. Support	ES.4. Cultural
Security	X	✔	✔	✔
Basic material for good life	✔	✔	✔	✔
Health	✔	✔	✔	✔
Good social relations	✔	X	✔	✔
Freedom of choice and action	✔	X	✔	✔

participants' perceptions regarding the diversity of drivers affecting ES in the ANP and scope the range of interconnected effects observed across the different categories of ES.

Indirect drivers of change were the ones most identified, especially demographic and economic drivers with link to thirteen and twelve ES, respectively. According to the MEA (2005), the distribution of population and living arrangements affects consumption patterns and consequently impacts on ecosystems. The economic, socio-political, and cultural drivers affect in terms of availability of resources, and how individuals choose to allocate them. Science and technology drivers are the ones allowing transformation of raw materials provided by ecosystems into services of value to humans. We allocated "over-exploitation" threats within the demographic and economic drivers of change category, based on the MEA (2005). According to workshop participants, by addressing over-exploitation, it will be possible to reduce a significant source of impacts on different ES. In the context of a protected area, it is understandable that drivers of change such as "cultural and religious" or "science and technology" are less perceived as having impacts on ES. However, it can be pointed as an unexpected result the fact that "nutrient application to agricultural systems" was not mentioned, although agriculture is present in ANP. Additionally, there were few links with "land conversion," despite that according to Rodríguez-Loinaz et al. (2015), this is one of the main drivers of change of ES provision.

Considering each ecosystem service individually, "food" (ES.1.1) is the one showing a higher number of different threats (four in total), followed by "ES.1.2. Water," "ES.1.3. Raw materials," "ES.1.4. Genetic resources," "ES.1.5. Medicinal resources," "ES.2.1. Air quality regulation," "ES.2.3. Water regulation," and "ES.4.3. Cultural diversity," all with three different drivers of change. Four ES did not have any driver of change linked to them (ES.1.6; ES.4.4; ES.4.5; ES.4.6).

In terms of categories of ES, provision services were the ones where more drivers of change have been identified, followed by regulation, support and cultural services. According to participants' perceptions, the majority of the threats to provisioning services are demographic, economic and socio-political drivers, whereas regarding regulation services land conversion was the driver most linked with this category (ES.2.2; ES.2.4; ES.2.5).

Screening the Relative Importance of Ecosystem Services to Stakeholders

The final workshop exercise (Task 6, Table 1) aimed to develop a preliminary assessment of the relative importance of ES to stakeholders. Each participant had sticky dots for voting on ANP's ES they perceived as more important from an ecological, economic and social perspective. As highlighted by several authors (de Groot et al. 2002; Lopes and Videira 2013; Martín-López et al. 2014), one of the main challenges in ES research is to implement approaches capable of integrating biophysical, socio-cultural and monetary value domains to inform decision-making processes. Martín-López et al. (2014) found that depending on the value-domain according to which ES are valued, different outcomes and trade-offs emerge, which underscores the importance of integrating different value dimensions from the onset of assessment and valuation processes. Hence, this scoping exercise intended to test the process of articulating multiple values at a scoping stage, by promoting the screening of the ES importance on different value dimensions (Fig. 3).

Cultural services gathered the overall higher number of votes per ES category, mainly driven by the social importance attached to these services. On the other hand,

Table 5 Perceptions of workshop participants regarding the links between human wellbeing components and cultural ecosystem services

ES.4. Cultural services	Human wellbeing components				
	Security	Basic material for good life	Health	Good social relations	Freedom of choice and action
ES.4.1. Aesthetic values	X	✔	✔	✔	✔
ES.4.2. Recreation and eco-tourism	✔	✔	✔	✔	✔
ES.4.3. Cultural diversity	✔	X	✔	✔	✔
ES.4.4. Spiritual and religious values	✔	X	X	✔	✔
ES.4.5. Knowledge systems and educational values	X	✔	✔	✔	✔
ES.4.6. Sense of place	✔	✔	✔	X	✔

Table 6 Drivers of change of ecosystem services in the Arrábida Natural Park

Drivers of change	ES.1. Provision Services								ES.2. Regulation Services								ES.3. Support Services								ES.4. Cultural Services								Total per driver of change				
	ES.1.1.	ES.1.2.	ES.1.3.	ES.1.4.	ES.1.5.	ES. 1.6.	ES.2.1.	ES.2.2.	ES.2.3.	ES.2.4.	ES.2.5.	ES.2.6.	ES.3.1.	ES.3.2.	ES.3.3.	ES.3.4.	ES.3.5.	ES.3.6.	ES.4.1.	ES.4.2.	ES.4.3.	ES.4.4.	ES.4.5.	ES.4.6.	ES.1.	ES.2.	ES.3.	ES.4.	
	Food	Water	Raw materials	Genetic resources	Medicinal resources	Ornamental resources	Air quality regulation	Climate regulation	Water regulation	Erosion regulation	Pollination	Human disease and pest regulation	Primary production	O2 production	Soil formation	Nutrient cycling	Habitat provision	Maintenance of genetic diversity	Aesthetic values	Recreation and eco-tourism	Cultural diversity	Spiritual and religious values	Knowledge systems and educational values	Sense of place	Provision Services	Regulation Services	Support Services	Cultural Services	Four categories of ES
Demographic																									5	2	3	3	13
Economic																									5	2	2	3	12
Sociopolitical																									4	2	1	0	7
Cultural and religious																									0	0	0	1	1
Science and technology																									0	0	0	0	0
Climate variability and change																									1	1	0	0	2
Nutrient application to agricultural systems																									0	0	0	0	0
Land conversion																									0	3	2	0	5
Biological invasion and diseases																									1	2	3	0	6
Total per service	4	3	3	3	3	0	3	1	3	1	2	2	2	1	2	2	1	2	2	2	3	0	0	0					

provisioning ES received the higher votes in terms of economic importance, but in total this category had fewer votes than supporting services. This was a somewhat unexpected result since the literature points to the fact that usually provisioning services are the most understandable and easily identified category by stakeholders (Iniesta-Arandia et al. 2014). It is interesting to note that this result is largely justified by the highest ecological importance that participants attached to supporting services.

From Fig. 3, it is also evident that stakeholders assigned economic, ecological and social importance to all categories of ES, with the exception of supporting services, which did not receive any vote in terms of social importance. This does not mean that participants did not recognize a social value resulting from support services, particularly since they were able to provide specific examples and establish links between this category of ES and human wellbeing in previous workshop exercises. It rather points out that when asked to screen among a relatively large list of ES, participants directed the available three "social importance" votes to other categories, mostly cultural ES.

Looking at the results for each ES type, the service that gathered more votes was "ES.4.2. Recreation and ecotourism," included in the cultural ES category (Fig. 4). This may be justified by the fact that the ANP is a well-known touristic area comprising wild beaches surrounded by vegetation, and is recognized as a national and international tourist destination (ICN 2003).

"ES.1.1. Food" appears as the second most voted service. This was a surprising result for the ANP management team, which did not expect such level of importance attributed to food ES. However, this result was considered relevant to use in future public communications on the benefits provided by the protected area. The third most voted services included "ES.4.5. Knowledge systems and educational values" and "ES.3.6. Maintenance of genetic diversity," both with nine votes. It is interesting to note the importance attributed to the maintenance of genetic diversity, revealing an alignment with the biodiversity and nature conservation classification of the area. Finally, it is observed in Fig. 4 that two services, "ES.3.4. Nutrient cycling" and "ES.1.6. Ornamental resources," did not gather any vote, which may be justified by the lower awareness or relative importance attributed to these services by participants who concentrated their choices on more prominent ES.

Figure 5 highlights the number of votes received by the different types of ES according to each value dimension. Social importance was mainly attributed to cultural ES, and ecological importance was more recognized in relation to support and regulating services. The distribution of the economic importance votes shows a more scattered distribution along the four main categories of ES.

The three most voted ES in each dimension were "ES.1.1. Food" for economic importance, "ES.3.6. Maintenance of genetic diversity" for ecological importance and "ES.4.3. Cultural diversity" for social importance. Interestingly, none of these services received votes in more than one value dimension. This result shows that is critical to consider different values-domains when performing participatory ES assessments, since there is a risk to ignore important ES when single-dimensional analyses are performed. As value articulating institutions, and consequently not neutral, assessment and valuation methods need to account for the plurality of values possibly assigned to ES (Vatn 2005; Gasparatos 2010; Gómez-Baggethun and Ruiz-Pérez 2011; Martín-López et al. 2014; Hattam et al. 2015). While it is argued that the concept of ES implicitly embodies the ecological importance of ES, the explicit consideration of the three dimensions in this screening exercise allowed to create awareness among workshop participants regarding the multidimensional values of ES in the protected area.

Respondents of the ex-post online survey were also asked to reveal their degree of agreement with the outcomes of the voting procedure conducted in the workshop. Using a Likert scale ranging from 1 ("totally disagree") to 5 ("totally agree"), 4 ("agree") was the most frequent answer obtained from the 26 responses, which denotes an alignment of respondents' perceptions with those of workshop participants. In cases where the level of agreement was low, we asked for additional comments. These justifications largely fell into two different groups of arguments:

(a) Incomparability of ES values and interdependencies among ES (e.g., "I do not agree (…) to vote on ES that are complementary and dependent on each other; there can be no one more important than the other"; "I think that without the functions of regulation and support it is not possible to have provision and cultural services");
(b) Invisibility of some categories of ES (e.g., "I believe that it has only been taken into account the direct benefits of tourist activity. However, without proper preservation and conservation of support, regulation and provision services, cultural services will not have much future (…) the importance of these services is very high, however just because it is not properly accounted for, it was not taken into account.")

These comments emphasized the need for considering interdependencies between ES and promoting an integrated analysis of the different value-dimensions.

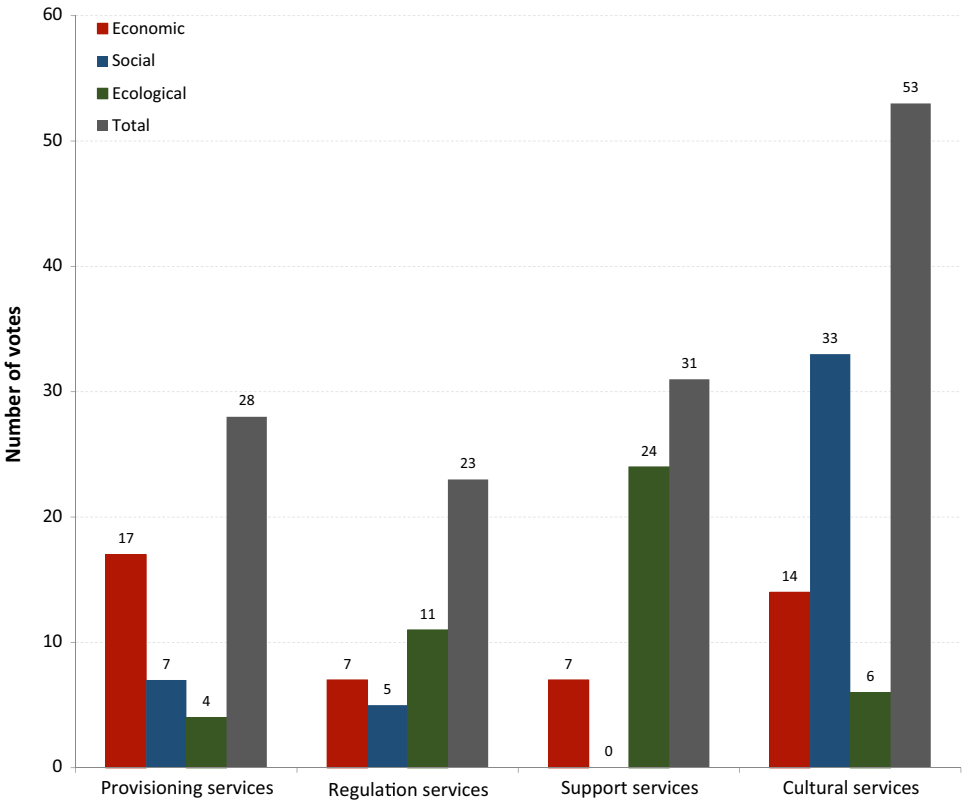


Fig. 3 Sum of votes per ecosystem service category, by type of value (economic, social, ecological and total)

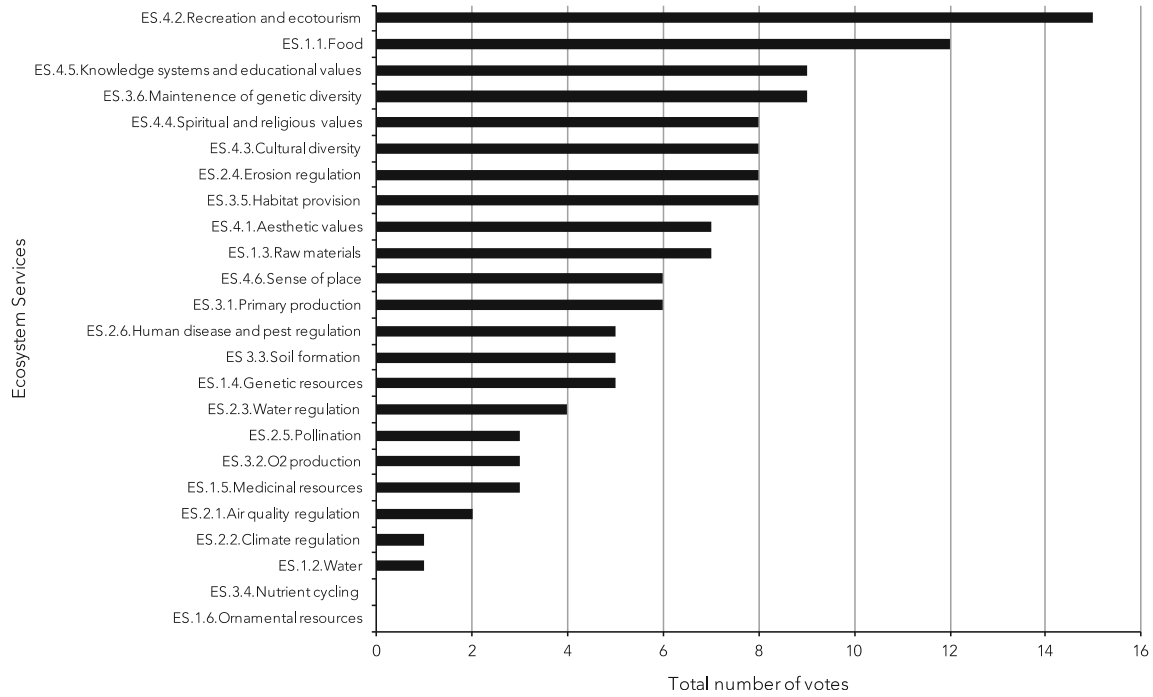


Fig. 4 Ranking of importance attached by participants to the Arrábida Natural Park's ecosystem services

Combining Stakeholder Perceptions of Ecosystem Services Importance and Threats

We investigated the connection of outcomes from the previous workshop exercise with the results obtained in the drivers of change task. It was observed that the most important category of services (i.e., cultural services) is also the one with less number of identified drivers of change, mainly demographic and economic. It should be underlined that the identification of the type and diversity of threats is not a measure of their intensity. Notwithstanding, according to the UK-NEA (2014), a high number of drivers of change acting on ES supply could increase the threats posed by drivers of change, since the combined impact of multiple drivers on an ecosystem service increases the unpredictability of changes in ES. Figure 6 displays the most important ES for workshop participants against the number of different drivers of change associated with each service.

The majority of ES are positioned in the upper left quadrant, which corresponds to the "less important" and the "more threatened" cluster (assuming that a higher number of different threats is potentially more threatening). In the upper right quadrant, combining the "more important" ES with the ones that have "more drivers of change," "ES.1.1. Food" stands out.

This type of analysis may have an important role to play when developing ES management policies in the protected area. Combined with information of the supply of ES, decision-makers may establish priorities and direct measures to most important and threatened ES. However, as discussed by Martín-López et al. (2014), it is also critical that managers look into the most threatened and less important ES (upper left quadrant), otherwise these services may be at risk.

Establishing Stakeholder Dependency Networks and Following-Up of Scoping Activities

To conclude the testing of the collaborative ES scoping approach to the ANP, a social network analysis was performed to elicit the dependency relationships established between stakeholder groups and the ES identified during the workshop. Considering each category of ES (ES.1; ES.2; ES.3; ES.4), we asked respondents of the ex-post online survey to select the ES from which their organization depended. Participants were also able to specify the degree of dependence, i.e., the type of dependency and/or to which extent the dependency exists. Figure 7 depicts the obtained network graphs representing stakeholders' dependencies from the different types of ES.

The two ES that generated more dependencies (i.e., a higher indegree value of 13 and 12 respectively) were "ES.2.2. Climate regulation" and "ES.4.2. Recreation and eco-tourism." The subsequent group of ES with more associated dependencies include "ES.2.3. Water regulation," "ES.3.3. Primary production," "ES.2.4. Erosion regulation," "ES.1.1. Food," and "ES.4.3. Cultural diversity." It should be noted that while

"ES.4.2. Recreation and eco-tourism" was also pointed as one of the most important services for workshop participants (Fig. 4); "ES.2.2. Climate regulation" was not perceived as important. As observed in Fig. 7, stakeholders expressed a higher degree of dependency to regulation ES than the voting procedure suggested during the workshop. This is an interesting result, which demonstrates the value of combining different participatory exercises to validate perceptions of stakeholders regarding the multiple value dimensions of ES.

Additionally, this tool also allows to analyze the stakeholder groups with more recognized dependencies. For example, in Fig. 7 stakeholder group, Research Institutions (RI) is the one with lower intensity of dependencies on provision (ES.1.) and cultural services (ES.4.), with both participants in this group revealing no more than three links with these ES categories. Stakeholder group Government Authorities (GA) showed a similar outdegree value for all ES categories. With respect to the six business stakeholders represented (Group B, Business), results indicate a diversity of recognized dependencies, with at least one respondent showing the highest outdegree value for all ES categories. Finally, the two stakeholders in the Civil Society group (CS) recognized dependencies with at least four examples of ES in all the four main categories.

As illustrated in this example, the social network analysis is an useful complementary tool in the participatory scoping process. These dependency webs offer a network map that may support managers in the definition of follow-up activities, namely by creating awareness of dependencies of different stakeholder groups on specific ES. This information may be used to target involvement of stakeholder groups in management decisions and engaging them in the assessment of the demand side of ES.

As a first step within an integrated participatory process for valuing ES, managers may obtain a rich scoping picture on relevant ES provided in the area and how this is interpreted by local stakeholders. As such, new information may be used to communicate the importance of natural areas, while integrating multiple stakeholder views in management decisions as a means to articulate different

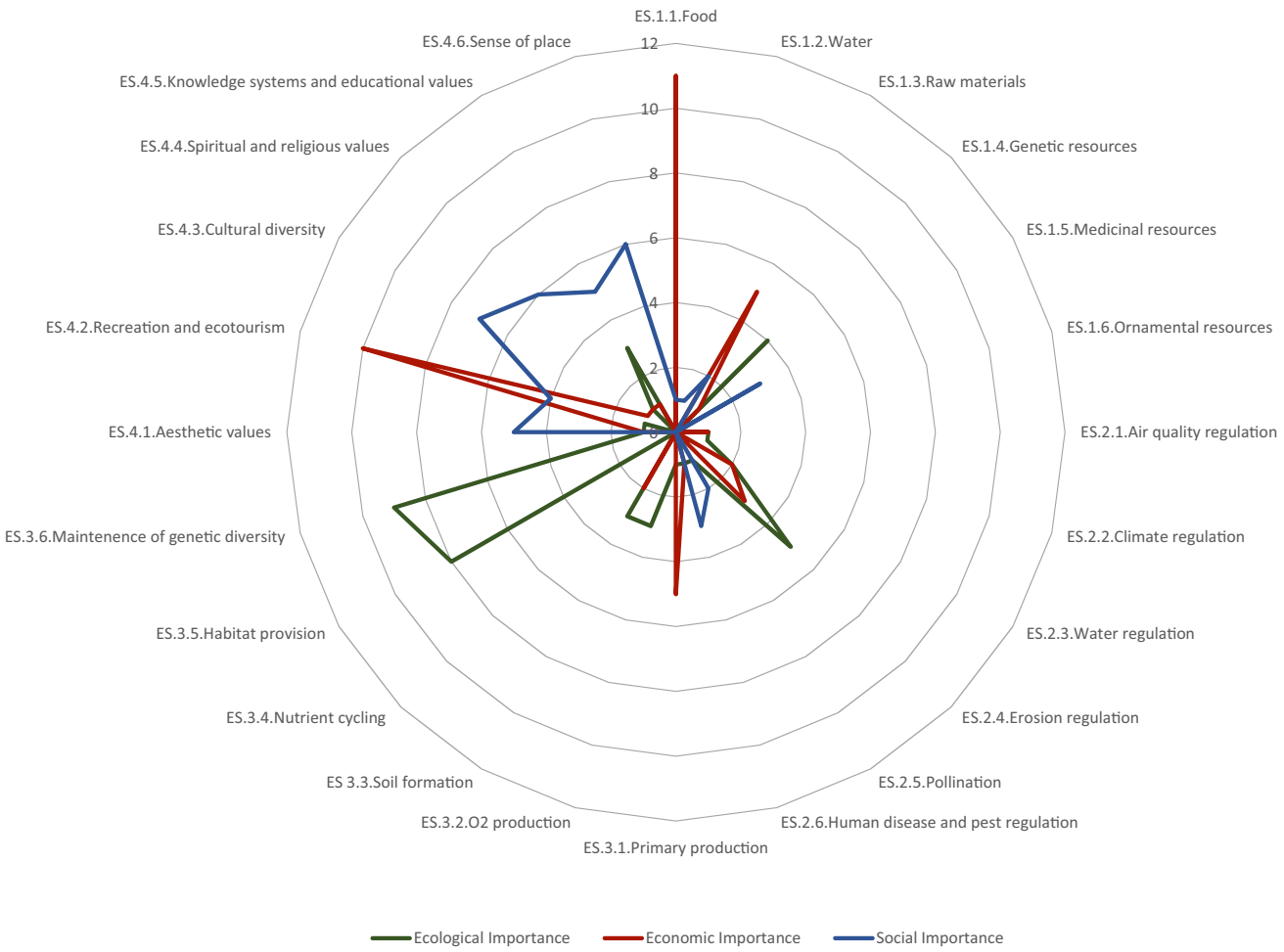


Fig. 5 Number of votes in each type of ecosystem services according to the three value dimensions

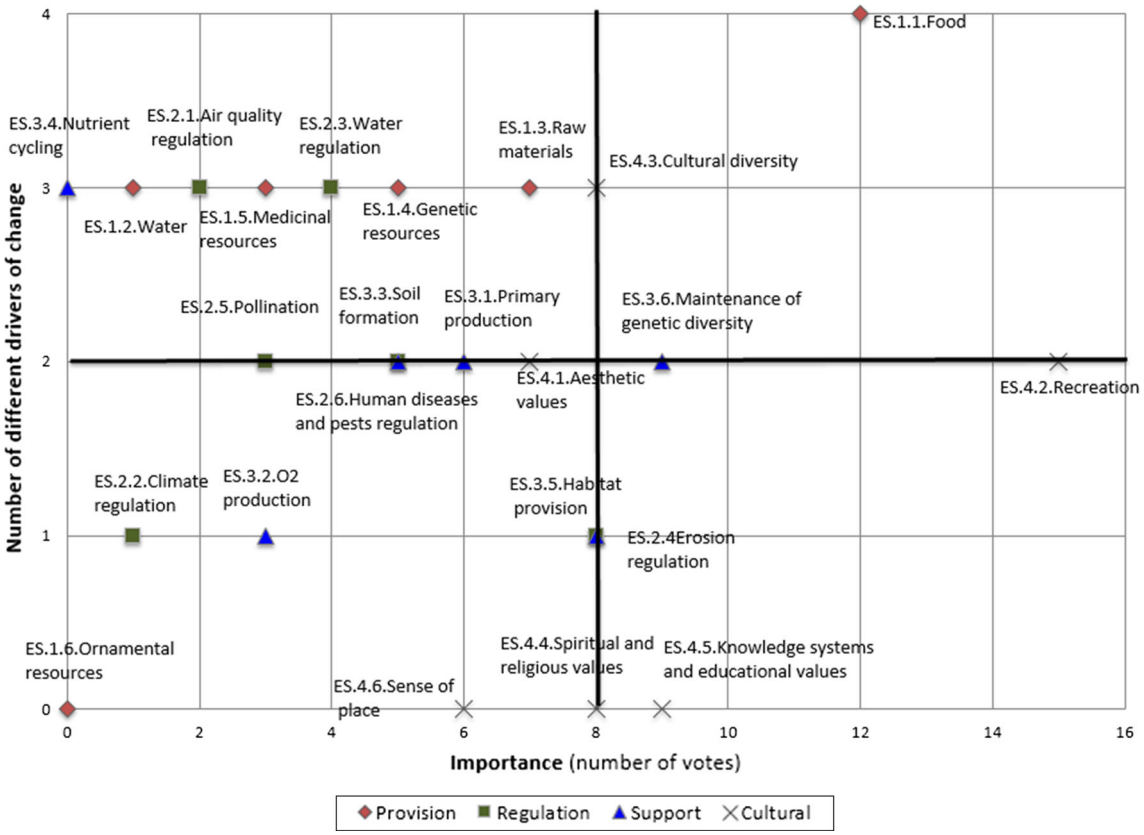


Fig. 6 ES in the ANP according to the importance and number of different drivers of change recognized by workshop participants

values. The ES concept discloses links between humans and nature allowing the recognition of crucial ES in protected areas, particularly in those with a strong human presence in the territory, such as the case of ANP. On the other hand, the integration of a collaborative ES scoping approach in management structures may face some challenges, namely with respect to the institutionalization of the concept. This requires time to allow ES approaches to be adopted and formally recognized in the rules for action, thus implying a change in worldviews and how problems are defined.

As presented in Fig. 2 the proposed collaborative scoping approach tested in the ANP sets the scene for further ES assessment and management processes. Natural resource managers, such as those involved in the ANP, may implement the collaborative scoping methodology to support several decisions, for example, in development and assessment of land use plans, selection of alternative conservation projects, sourcing of conservation funding or designing new monitoring programs.

By opening up ES assessment to interest parties since the very early stages, the proposed scoping approach may subsequently be combined with other methods and tools to provide a deeper understanding and articulation of ES values. Hence, scoping results may provide useful input to support follow-up activities, such as, spatial mapping of ES (e.g., García-Nieto et al. 2013), development of ES value matrices (e.g. Kandziora et al. 2013; Burkhard et al. 2014), quantification of ES indicators (e.g. Villamagna et al. 2014) or application of ES valuation techniques (e.g. TEEB 2010).

Conclusions

With increasing calls for active involvement of stakeholders in assessment and valuation of ES, this paper advanced a scoping approach to engage diverse social actors in the collaborative identification of ES. Such participatory processes are expected to capture, from the bottom-up, stakeholders' perceptions on ES and foster the incorporation of different types of knowledge in decision-making processes. The presented approach is anchored on a participatory workshop wherein stakeholders deliberate on a set of scoping tasks, namely the identification of ES, their drivers of change, the linkages between ES and human wellbeing, and the screening of the relative importance of different ES values. Complementing these group activities, the approach also takes into account preparatory tasks

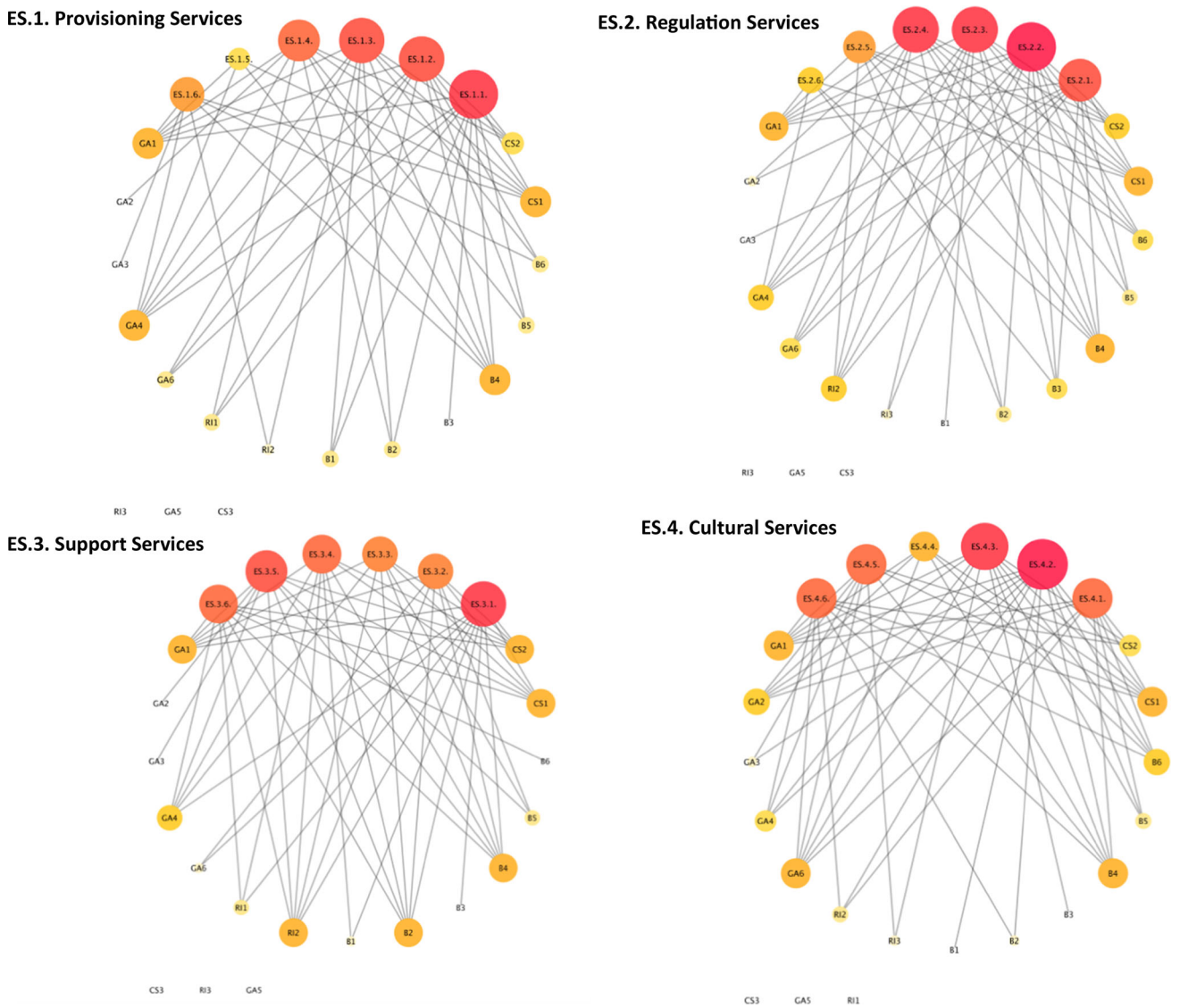


Fig. 7 Conceptual networks representing dependency relationships between stakeholders and ES according to the four ES categories. *Note*: Networks developed in Cytoscape software (Shannon et al. 2003). The larger nodes and darker colors represent a higher value for indegree (i.e., the number of arcs that end on a node, here representing the expression of ES causing more dependencies) or higher values of outdegree (i.e., the number of arcs that starts from one node, here representing the expression of dependence on ES by respondents). Ecosystem services use the terminology presented in Table 1 and Stakeholders groups use the terminology presented in Table 2: *GA* Government Authorities, *RI* Research Institutions, *CS* Civil Society, *B* Business

regarding the institutional and stakeholder analysis and follow-up activities involving validation of workshop results and the establishment of stakeholder dependency networks affecting ES.

The testing of such collaborative scoping framework to the Arrábida Natural Park case study provided positive indications towards the usefulness of the approach. Throughout the process, we were able to engage distinct stakeholder groups ensuring the integration of plural perspectives. By having more than one participatory procedure the process provided multiple opportunities for participation, thus reducing the risk of excluding stakeholders who may not be present in a one-off event. Invited participants have developed a comprehensive list of ES in the protected area. Throughout the series of interactive exercises developed a preliminary shared understanding was achieved on the underlying values and management implications. The majority of participants agreed that the used methods allowed to structure the discussion on ES values in the ANP and led to integration of ES knowledge. The sequence of steps was also effective in disclosing information related with multiple value dimensions.

We conclude that this proposal supports the practical implementation of the ES concept by opening up ES

assessment and management processes to interest parties since the very early stages, raising stakeholders' awareness and fostering integration of knowledge. This is especially relevant for achieving a comprehensive identification of ES beyond the generic categories considered in reference ES frameworks. On the other hand, since this is but the first stage in the adoption of an ES approach (Lopes and Videira 2013), we suggest to follow-up on scoping results to strengthen the integration of ES in decision-making processes. By considering the "stakeholder-driven" (Menzel and Teng 2010) nature of the ES concept and stakeholder participation as a value articulating institution, the proposed scoping methodology is expected to facilitate debates and set-the-scene for involvement of stakeholder groups in broader ES assessment processes.

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