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Integration of ecosystem services in strategic environmental assessment across spatial planning scales

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ABSTRACT

Spatial planning is a key policy instrument for decision-making which drives future changes to land systems, and subsequently to the quality, quantity and spatial distribution of ecosystem services (ES). Supply and demand of ES vary from local to regional and global scales affecting a wide range of stakeholders. Therefore, a strategic analysis of the potential impacts is highly relevant. Strategic environmental assessment (SEA) is considered a suitable instrument for analyzing these impacts as well as for integrating ES during the planning process given its focus on sustainability and environmental aspects at strategic levels. However, an essential task consists of testing the applicability of the SEA-ES framework in real-world spatial planning. The objective of this research is to explore how ES have been considered in the development of spatial plans at different scales by considering a sample of SEA reports. We focused on a case study in Chile, where we conducted a content analysis of different stages of the SEA process at regional, inter-municipal and municipal planning scales. Our results demonstrate that ES were always present across each SEA stage and planning scale. Additionally, we suggest a relation between specific ES and the scope and focus of the different spatial planning instruments. Although ES are clearly necessary for achieving a number of development objectives and dealing with a range of environmental problems, a critical aspect is the lack of an explicit consideration which might decrease the potential advantages offered by the integrated framework SEA-ES.

1. Introduction

Land is one of the most important and limited resources and provides a range of essential ecosystem services (ES) for human well-being (Fürst et al., 2013). However, increasing human demands for natural resources, cultivable lands, and a variety of ES along with intensive changes to biogeophysical structures and processes might negatively impact the development of societies (Mooney et al., 2009; Sonter et al., 2017). In this context, land management and policy decision-making are recognized as the most important drivers for these impacts and the subsequent losses in the ES supply at multiple scales (Schosser et al., 2010; Verburg et al., 2015). Spatial planning is a key instrument for decision-making in terms of coordinating human activities and their influences on land systems, and subsequently on the quality, quantity and spatial distribution of ES (Geneletti 2011, 2013; Mascarenhas et al., 2015). Including ES in spatial planning is considered to be a suitable approach for informing, communicating and facilitating consensus building among different actors because it provides a basis for multi-sectoral and interdisciplinary collaboration (Albert et al., 2014; Galler et al., 2016).

An essential aspect in the integration of ES in spatial planning is the issue of scale and the multiple levels of decision-making involved. Supply and demand of ES, as well as their interrelations, vary from local to regional and global scales, which at the same time affect a wide range of stakeholders (Geijzendorffer and Roche, 2014; Hein et al., 2006). Thus, spatial planning has the potential to mainstream ES across multiple governance levels, since it provides an umbrella for coordinating different policy instruments in a more strategic manner (Greiber and Schiele, 2011). As discussed by Geneletti (2011) and Mascarenhas et al. (2014), the integration of ES into spatial planning should consider existing instruments, such as strategic environmental assessment (SEA). This is considered a suitable instrument for integrating ES given its strategic role in the development of policies, plans and programs (Geneletti 2011; Partidario and Gomes 2013; Rozas-

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Vásquez et al., 2017). The considerable benefits of SEA for including ES in strategic decisions have led to a rapid increase in the number of scientific papers, analyses of legislation and practices (Geneletti, 2015). Similarly, international organizations such as OECD and DAC (2008), UNEP (2014) and World Resource Institute (Landsberg et al., 2013) have developed guidance material focused on the integration of ES in environmental assessment (Baker et al., 2013).

An essential task consists of testing the applicability of the SEA-ES framework in real-world spatial planning and environmental policy making (MA, 2005; Ruckelshaus et al., 2015). Some studies propose the use of content analysis and recommend it for exploring the degree of integration of ES in decision-making (e.g. Honrado et al., 2013; Rosa and Sánchez 2015; Mascarenhas et al., 2015; Diehl et al., 2016). Krippendorff (2004) defines content analysis as a research technique for making replicable and valid inferences of answers to specific research questions from textual information as provided through SEA reports. These inferences are more systematic, explicitly informed and verifiable than a normal read of a text. Consequently, content analysis of SEA reports is a valuable approach for helping to clarify how this process supports the integration of ES in spatial planning. This is highly relevant for evaluating opportunities and challenges for practical implementation. A critical aspect in this approach pointed out by Honrado et al. (2013), is the mainly implicit consideration of ES along the SEA reports. Thus, special attention needs to be paid to this aspect when conducting the content analysis.

The objective of our study is to explore how ES have been considered in the development of spatial plans at different scales of planning. We analyzed a sample of SEA reports in order to answer the following research questions:

i) How has the ES concept been addressed throughout the SEA process?
ii) Does the spatial planning scale affect the consideration of specific (groups of) ES?
iii) Is there a planning scale that appears more suitable for the integration of ES?

Chile was selected as a case study because it meets three fundamental criteria. First, the administrative system is based on a tiered structure with national, regional, provincial and municipal levels (OECD, 2013). This allows exploring the ES integration at different scales of planning. Second, SEA has been mandatory in Chile for all levels of spatial planning since 2010 (Rozas-Vásquez et al., 2014). Hence, a sufficient number of recent SEA reports is available. Finally, the concept of ES has progressively been introduced into the political discourse in Chile to the point that in 2015 it was included in a national guideline for sustainable spatial planning (MMA, 2015).

For a consistent classification of ES, we used the Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin, 2013). CICES classifies ES in three sections, mostly in concordance with those ES groups defined by the Millennium Ecosystem Assessment in 2005 and currently also in use by IPBES (Díaz et al., 2015): 1) provisioning, 2) regulation & maintenance, and 3) cultural (supporting ES were excluded in CICES). Each section is hierarchically structured for its assessment into division, group, class, and class type where it is possible to increase the detail of the ES classification in relation to the different spatial and thematic scales under analysis (Haines-Young and Potschin 2013; Díaz et al., 2015).

2. Methodology

2.1. Study area

Chile is located in South America, bounded by the Pacific Ocean in the west, the Andes mountain range in the east, the Atacama Desert in the north and the Chilean Antarctic in the south (Fig. 1). It extends over 4300 km and a it presents a high variety of landscapes and biodiversity with unique autochthonous species given its location as a biogeographic island (Moreira-Muñoz, 2011; Squeo et al., 2012).

In Chile, until 2009 the integration of environmental objectives and impact assessment in the spatial planning process was included only through a standard environmental impact assessment (EIA). However, in 2010 EIA was replaced by SEA, which is today mandatory for the elaboration of any policy or plan, allowing the incorporation of environmental criteria for sustainable development (Rozas-Vásquez et al., 2014). SEA is applied for spatial planning instruments from regional to municipal level (it also includes some specific sections within the municipal level), as well as for the zoning of the coastal areas and integrated watershed management plans (MMA, 2012). Table 1 provides an overview on the most relevant spatial planning instruments applied in Chile.

A major concern in the current SEA application during the elaboration of spatial plans is a lack of approaches which allow combining nature conservation and territorial development by adding value to the nature for the society in the sense of a socio-ecological system (Rozas-Vásquez et al., 2017). For this reason, the ES approach has been formally included in national guidelines for sustainable spatial planning (MMA, 2015), but its real consideration has not yet been analyzed.

2.2. Framework for analyzing SEA reports

In this research we analyzed a set of SEA reports at regional, intermunicipal and municipal spatial planning scales. The methodological approach consisted of a content analysis of different stages of the SEA process. For each, we formulated analytical questions aimed to explore both the explicit and implicit consideration of ES and to reveal if they are more relevant or consistently considered at a specific scale of planning. To avoid terminology restricting the explanatory power of our study, we extended the analysis to related terms such as “environmental services”, “environmental functions” and “natural capital” usually used interchangeably to make reference to ES (Lamarque et al., 2011; Rozas-Vásquez et al., 2017).

The analysis of the SEA reports was based on a modified version of the approach proposed by Geneletti and Zardo (2016), where a “direct content analysis” was performed. This type of content analysis is conducted in a more structured process than a traditional content analysis by using existing theories or previous research. While traditional content analysis avoids using preconceived categories, direct content analysis makes use of the available knowledge that helps to focus the research questions as well as to identify key concepts or variables throughout the documents (Hsieh and Shannon, 2005). Consistent with Geneletti and Zardo (2016), we did not consider a “keyword-based analysis”, since in the fields of ES and SEA terminologies are not yet standardized (Braat and de Groot, 2012; da Silva et al., 2014).

For the content analysis, we divided the SEA reports into four stages which represent methodological steps at the moment of coupling ES in the SEA process. In a traditional SEA report, these stages are often not clearly defined. However, for operationalizing the content analysis, we considered the reflections of previous works by OECD and DAC (2008), Partidario and Gomes (2013) and Geneletti (2016, 2015) and divided the reports in: 1) context and objectives, 2) scoping and ES prioritization, 3) strategic analysis of alternatives, and 4) follow-up.

In each stage, we analyzed how ES have been included in the SEA process by using a set of analytical questions formulated in concordance with the aim of the respective stage (Table 2). We characterized the different stages according to how often one or more specific ES were identified, in which specific manner they were considered, and according to the planning scale.

2.3. Selection of the sample of SEA reports

We selected SEA reports of all the available spatial plans in Chile at

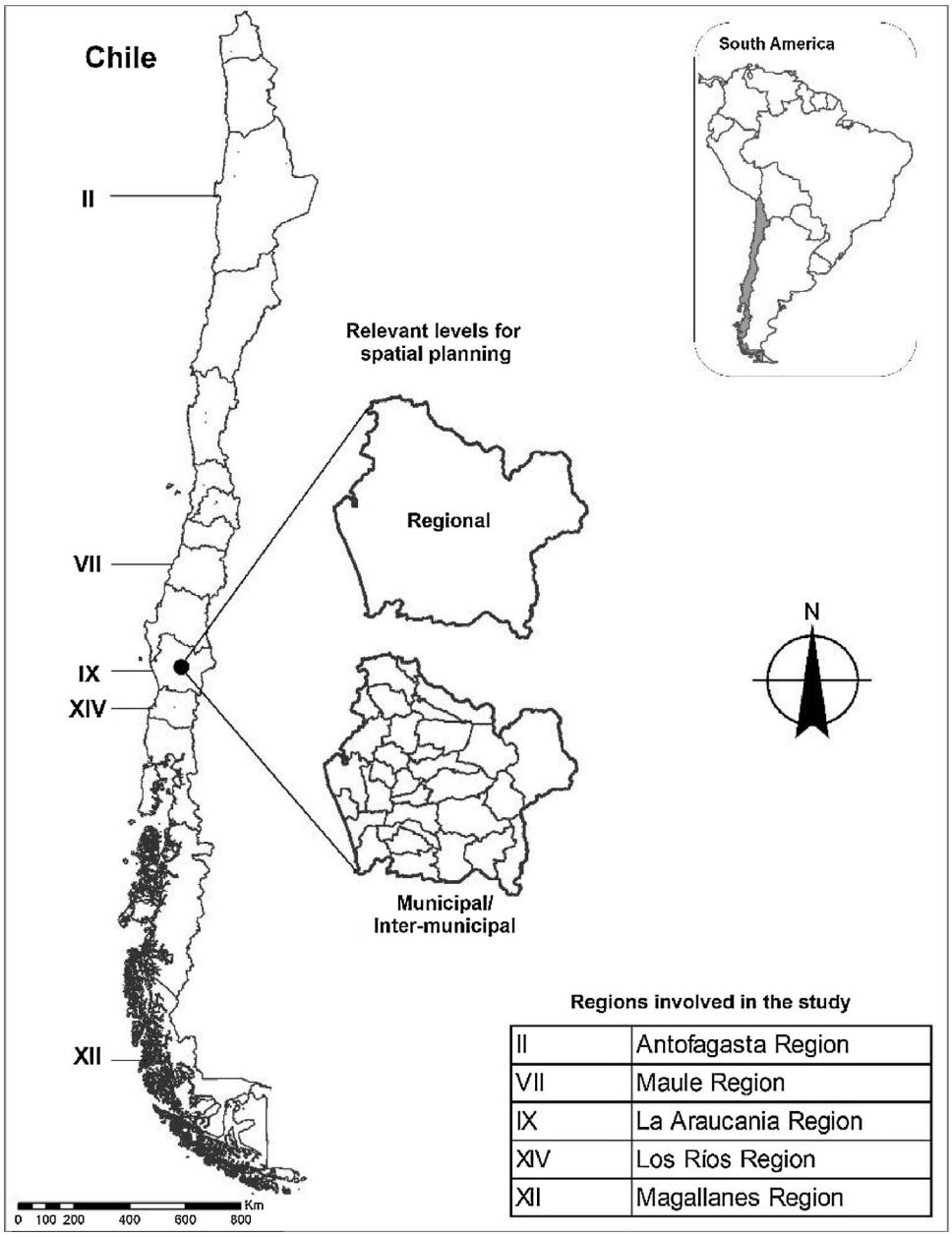

Fig. 1. Chile and the main spatial planning levels using La Araucanía region as example. The numeration of the regions is not consecutive because in 2007 two of them were split.

Table 1
Overview of spatial planning instruments in Chile and their role.
Source: own elaboration based on MINVU (2011) & OECD (2013).

Planning Level	Instrument	Role
Regional	Regional Land-Use Plan	Involves the complete region; its role is to identify potentials and limits for development by considering the achievement of the economic, social, cultural and ecologic objectives proposed by the Regional Strategy of Development[a] but in a spatially explicit way.
Inter-municipal	Inter-Municipal and Metropolitan Regulating Plan	Regulates the physical development in urban areas between two or more municipalities and the rural space which connects the urban centers.
Municipal	Municipal Regulating Plan	Determines infrastructure location, urban limits and population densities. Promotes functional relations and connectivity across the municipal territory but is focused on urban questions.

[a] The Regional Strategy for Development is a navigation chart with orientations of where to go and how to reach a desirable future based on a regional diagnosis. It states priorities, courses of action and strategic objectives in a region but without explicit spatial considerations.

regional, inter-municipal and municipal level according to the following criteria: 1) online availability in the national system of information of SEA (http://eae.mma.gob.cl/index.php/ficha); 2) timeliness: reports elaborated after 2010 because in that year the ES concept was mentioned for the first time in a national document (Figueroa, 2010), and SEA became mandatory for the elaboration of any spatial planning instrument (Rozas-Vásquez et al., 2014); 3) level of progress: reports in an advanced level of progress, where only few changes are expected between the current and the final version, or finished; 4) representation of the three levels of spatial planning: regions with

Table 2
Framework for analyzing the integration of ES in the selected SEA reports.

SEA stages	ES questions
1. Context and objectives	- Does the SEA process recognize the dependency on ES for the achievement of the environmental objectives of the plan? Which ES? Are ES explicitly mentioned? - Are the main ecosystem types identified in the SEA report? Do they allow evaluating the ES context? - Does the SEA report make a link with other strategic actions or legal instruments with potential influence on ES? Which type of strategic action or legal instrument?
2. Scoping and ES prioritization	- Which ES are the most relevant for achieving the environmental objectives of the plan? - Are the environmental problems identified in the strategic diagnosis related to the performance of any ES? Which ones? Are they explicitly mentioned? - Does the SEA process include an assessment of ES values (social, economic or ecological values)?
3. Strategic analysis of alternatives	- Does the SEA process consider ES in the strategic analysis of alternatives of the plan? Which ES? Are they explicitly mentioned? How are they included?
4. Follow-up	- Does the SEA process propose any measures for monitoring and managing ES? Which measures? Which ES are included? Are they explicitly mentioned?

available SEA reports at regional, inter-municipal and municipal level.

Moreover, we aimed to include SEA reports that illustrate different geographic, social and cultural settings in the country to avoid concentrating our analysis on only one specific regional context. In order to standardize the number of selected reports at different scales and in different regions, we used a standard number of one report for level of planning per region.

3. Results

Our analysis included five regions and 15 SEA reports (Table 3).

3.1. Consideration of ES across the SEA process

The results show that ES were considered in all analyzed SEA reports, independent of the type of spatial planning instrument or the local spatial context. However, differences were found across the SEA stages in terms of the type of ES most frequently identified as well as in their explicit or implicit recognition.

In the SEA stage "context and objectives", cultural ES was the predominant CICES section including 53% of all the identified groups of ES across the three spatial scales of analysis. In this section, "intellectual and representative interactions" and "physical and experiential interactions" were the most representative groups. Regulation and maintenance ES were second representing 33.3% of all ES. However, this section showed the largest diversity of the considered groups (6) compared with cultural and provisioning ES (3 groups per section). Examples of environmental objectives extracted from the SEA reports and related to the performance of ES are "improvements in the management and protection of water resources", "identification of locations for the development of non-conventional renewable energy", and "preservation of relevant areas for natural and cultural heritage", among others.

In this stage, we also analyzed whether the SEA process included relevant ecosystems or land covers in the reports and if such information is useful as a proxy to characterize the ES context in each planning scale. Our results reveal that only the regional scale presented information enough for a further evaluation of the ES context, mainly as land-use maps (40% of the plans). The inter-municipal and municipal scale only provided partial information and sometimes without any spatial reference.

A final aspect addressed in this stage was related to the link between the SEA report and a set of strategic actions or legal instruments included in this process for supporting the plan elaboration and with potential influence on ES. We found that all reports considered a range of instruments with influence on ES, where "spatial planning instruments" and the "regional strategy for development" were the most frequently identified in all the planning scales. Table 4 lists the identified instruments and their relative presence at different scales.

In the SEA stage "scoping and ES prioritization", the ES section regulation and maintenance was most frequently identified (61%) in the strategic diagnosis of environmental problems. In addition, this section also presented the largest variety of groups (9) in comparison with cultural (4) and provisioning (5) services. Examples of environmental problems related to the presence of regulating and maintenance ES are "soils with presence of contaminants", "water pollution", and

Table 3
SEA reports and planning levels for each selected region. RLUP: Regional land-use plan, IMRP: Inter-municipal regulating plan, MRP: Municipal regulating plan.

SEA report	Region	Planning Scale	Year
RLUP Región de Antofagasta	II	Regional	2015
RLUP Región del Maule	VII	Regional	2015
RLUP Región de La Araucanía	IX	Regional	2014
RLUP Región de Magallanes	XII	Regional	2014
RLUP Región de Los Ríos	XIV	Regional	2015
IMRP Oasis Andinos	II	Inter-municipal	2012
IMRP of Curicó	VII	Inter-municipal	2014
IMRP Villarrica-Pucón	IX	Inter-municipal	2015
IMRP Punta Arenas – Río Verde	XII	Inter-municipal	2011
IMRP Borde Costero y Sistema Fluvial Región de Los Ríos	XIV	Inter-municipal	2014
MRP of Mejillones	II	Municipal	2011
MRP of Teno	VII	Municipal	2015
MRP of Cunco	IX	Municipal	2015
MRP of San Gregorio	XII	Municipal	2013
MRP of Río Bueno	XIV	Municipal	2015

Table 4
Policy instrument and strategic actions considered by SEA at different scales with potential influence on ES.

Policy instrument and strategic actions in the SEA reports	Frequency at different scales		
	Regional (%)	Inter-municipal (%)	Municipal (%)
Regional strategy for development	100	80	80
Spatial planning instruments	100	100	100
Municipal development plan	20	0	0
Regional strategy of biodiversity	100	60	60
Regional policies	80	20	80
International agreements	40	40	0
Sectoral policies	40	100	40
Regulation for protected areas	60	60	20
Normative for natural disasters	40	0	0
National environmental policy	20	0	0
Sectoral studies	60	100	60
Indigenous law	0	20	0
Local plans and programs	0	0	40

"floods and landslides". Second were cultural ES with 24.1%, and finally provisioning ES with 15%.

Furthermore, in this stage we searched for the presence of formal assessment of ES values as a baseline information for subsequent prioritization. However, we did not find any type of ES assessment, even though in some cases ES were explicitly mentioned. Only in one SEA report we found an identification of a set of freshwater ES at regional scale (RLUP Región del Maule).

In the stage "strategic analysis of alternatives", we evaluated whether ES are included or not at the moment of defining a set of alternatives for future development. The results show that 100% of the plans included at least one ES group in the strategic analysis, which was mainly based on scenario assessment. Throughout the SEA reports, different elements were considered for defining scenarios and where ES were included, such as sustainability criteria, environmental problems, critical decision factors, and environmental objectives. Only in one particular SEA report we found the use of an assessment matrix instead of the predominant scenario analysis (MRP of San Gregorio).

Regarding the ES consideration in this stage, the section regulation and maintenance presented the highest presence across the scales with 41% of all the ES as well as the largest variety of groups (7). The most relevant group within this section was "liquid flows", while others like "gaseous/air flows" and "lifecycle maintenance, habitat and gene pool protection" were hardly ever mentioned. Cultural ES were also often considered in the strategic analysis (35.5%), and the three ES groups identified in this section, namely "physical and experiential interactions", "intellectual and representative interactions" and "spiritual and/or emblematic", were equally considered. The least important section was provisioning services (23.7%) even though it showed a higher variety of ES groups in comparison with cultural ES (4 groups).

In the stage "follow-up", we found that all plans included one or more ES in their proposals for monitoring and management. In this stage, regulation and maintenance ES was the predominant section (42%) and also the most diverse in terms of groups (7). In this section, "liquid flows" was the most important ES group. Cultural ES were second most important (33%). "Intellectual and representative interactions" and "physical and experiential interactions" were the most important groups in this section. The section provisioning ES represented only 25% of all the ES with "biomass" as the most frequently mentioned group.

Regarding the explicit consideration of ES across the different SEA stages and scales of spatial planning, in most of the cases ES were mentioned rather implicitly within the environmental objectives, environmental problems, and others SEA components. For instance, an environmental objective such as "…protection of relevant areas for hydrological regulation such as basin headwaters and wetlands, through identification and zoning of these spaces…" is clearly related to regulation and maintenance ES but without an explicit mention.

The SEA stage "context and objectives" at the regional scale was predominant in terms of the explicit consideration of ES (23.1%) followed by the inter-municipal scale (11.8%). In the stage "scoping and ES prioritization", ES were hardly ever mentioned in an explicit way (5.3% at inter-municipal scale), while in the following stages they were not mentioned at all, even when all plans included at least one ES group for the "strategic analysis" and "follow-up".

3.2. Consideration of ES across spatial planning scales

Our analysis indicates that ES were also considered in all the scales of spatial planning. Fig. 2 gives an overview of the explicit and implicit consideration of the different ES sections grouped by scales of spatial planning and broken down by SEA stages.

The inter-municipal scale was characterized by the largest number of ES mentions in the SEA reports (Fig. 2). The most relevant section was cultural ES, mainly present in the stage "context and objectives". The CICES groups "physical and experiential interactions" and "intellectual and representative interactions" were the most frequently mentioned. Regulation and maintenance ES were also relevant at this scale, mainly addressed within the environmental problems identified in the stage "scoping and ES prioritization". Characteristic ES groups were "mediation by ecosystems", "mediation by biota" and "mass flows". In the case of provisioning ES, these were least relevant with "biomass" as the most important group followed by "water provision".

The regional scale was characterized by a clear predominance of regulation and maintenance ES mainly included in the stage scoping and ES prioritization, with "liquid flows", "mediation by ecosystems" and "mediation by biota" as the most representatives ES groups. The sections cultural and provisioning ES were close to each other in terms of the number of mentions, but were far less often considered than the section regulation and maintenance (Fig. 2).

The municipal scale was characterized by the least presence of ES. Here, the section regulation and maintenance ES was the most important (Fig. 2). The most representative ES group at this scale was "liquid flows. Cultural ES were second most important, while provisioning ES were hardly ever mentioned.

4. Discussion

4.1. General assessment of the approach

The integration of the ES concept in decision-making has been increasingly promoted in the scientific literature as well as in policy guidelines at different strategic levels (Grêt-Regamey et al., 2016; Posner et al., 2016). However, at present little evidence is available in terms of analyzing its implementation in real-world decision-making contexts and particularly in instruments oriented to sustainable territorial development as, for instance, in spatial planning and strategic environmental assessment (examples in Geneletti 2011; Honrado et al., 2013; Mascarenhas et al., 2015).

In this study, we carried out direct content analysis to explore the implicit and explicit consideration of ES in a sample of SEA reports at different scales of spatial planning. We consider this method as a valuable approach for supporting this type of analysis, and it has been also used and recommended in previous studies on this matter (Geneletti and Zardo, 2016; Jacobs et al., 2016; Presnall et al., 2015). The main advantages of this approach are its power and flexibility, since it allows both qualitative and quantitative operations, thus facilitating the analysis of relations between keywords and/or concepts. It also makes use of previous knowledge on the topics; which is relevant for validating or extending an existing framework. At the same time; performing a direct content analysis by using previous theories makes it easier to focus the analysis in a more accurate way with respect to research objectives (Hsieh and Shannon, 2005). In contrast; it present some limitations mainly related to possible bias at the moment of performing the analysis. Hsieh and Shannon (2005) provide some examples of inherent sources of bias: 1) researchers could be more inclined to consider evidence that supports the background theory than the one which does not; 2) in answering the probe questions; some respondent might answer in a way that agrees with the questions or pleases researchers; and 3) an excessive consideration of the theory might overlook contextual aspects of the object under study. For dealing with these limitations; the same authors suggest an audit process before starting the study; which helps to achieve more unbiased results.

Regarding the number of examined SEA reports, an important constraint for obtaining a more precise view of the current situation was given by the limited scope of our study. The reduced number of reports was based on their availability, timeliness, level of progress (many of the currently available SEA reports are at an initial progress level) and representativeness for all planning scales. However, the purpose of those case studies was to illustrate an overall picture of the current state rather than to propose a representative sample. Similar works have been carried out by Baker et al. (2013), Partidario and

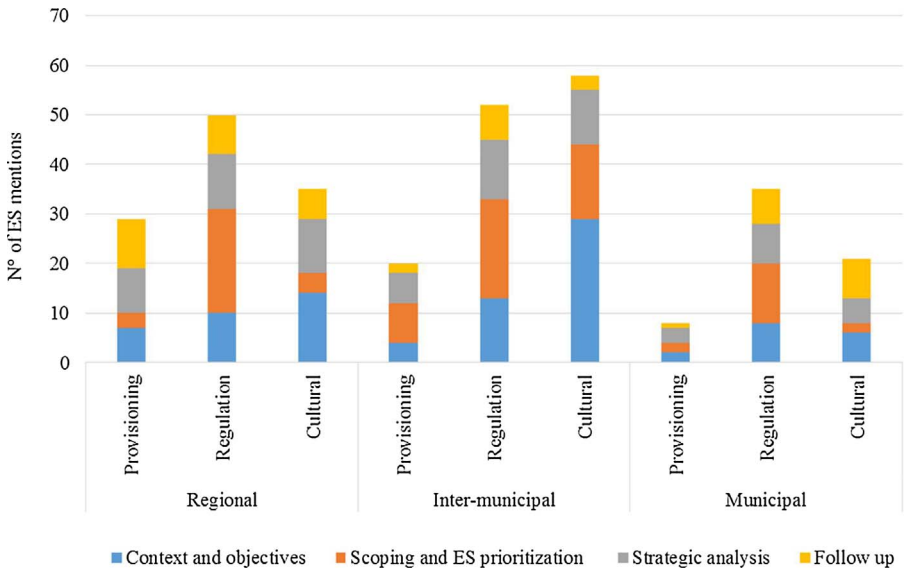

Fig. 2. ES sections considered at different scales of spatial planning and SEA stages.

Gomes (2013) and Mascarenhas et al. (2015), who also focused on a reduced number of SEA reports, but provided significant conclusions on the integration of ES in SEA.

Unfortunately, to our knowledge no works are available that were conducted under the same multi-scale approach that would allow comparison of the results and enhance our conclusions. In further studies on this field, we strongly recommend extending the analysis to the complete population of SEA reports, at least at the regional scale, by considering the selection criteria proposed in this work.

4.2. Integration of ES across SEA and planning scales

In our case study, we found that the ES concept was present in each of the stages of the SEA process as well as across the different scales of spatial planning. However, its presence was not equally distributed.

In the case of SEA, the stages 'context and objectives' and "scoping and ES prioritization" were the most related to a range of ES and also the only ones that showed some degree of explicit consideration. Apparently, these stages represent more concrete demands over the territory, and consequently this was expressed by stakeholders and decision makers at the moment of defining environmental objectives and identifying environmental problems. The definition of environmental objectives is the starting point of the SEA process and these objectives also represent concrete intentions of the plan for future development (Abaza et al., 2004). Similarly, the environmental problems represent a possible degree of risk for human well-being and/or the environment (Ahmed and Sánchez-Triana, 2008), which is clearly perceived by the actors involved in the planning process. We also expected such a relevance in the stage "strategic analysis of alternatives", which is crucial in SEA. However, our results showed a low ES consideration here, the same as in the case of the stage "follow-up". A possible explanation is provided by González et al. (2015) who points out that the development and assessment of alternatives is one of the most poorly conducted stages of the SEA process, including limited participation, lack of systematic approaches for analysis, and inadequate reporting of the "storyline" behind the selected alternatives. In addition, there is also a certain level of abstraction (Selin et al., 2015), which might make the relations fuzzy between ES and future territorial development.

A critical aspect related to this unbalanced consideration of ES along the SEA process is that we found neither a single ES nor a specific ES group linking each SEA stage. This might decrease the possibilities of SEA for integrating ES in spatial planning given this lack of a logic and structured connection, which is crucial for an effective process (Partidario, 2012).

In the case of the planning scales, ES can be supplied to or demanded by the society at a range of institutional levels, from local householders to the national and global community. Stakeholders at each different scale might add different value to ES based on their cultural background, social or economic interests, and the relevance of the ES for their well-being (de Groot et al., 2010; Hein et al., 2006). In our case study, we found that even though in most of the cases the ES concept was not explicitly considered in the development of the SEA, there was a clear demand of specific ES sections across the planning scales.

The different priorities for ES sections at different spatial scales suggest a relation with the planning scope and focus. For instance, at the regional scale the focus is mainly on rural development. Here, regulating ES and herein particularly hydrological ES were the most relevant. One of the reasons could be that they provide the basis for all other ES sections (Jin et al., 2015), which is not acknowledge as such by the planners even though these ES are usually part of or support key objectives. Besides, many regulating ES need to be managed strategically in a larger (catchment/basin) context (Geijzendorffer and Roche, 2014). At inter-municipal scale, the focus is on the urban-rural space which connects neighboring municipalities, i.e. two or more municipalities depending on their functional relations. The gradient between urban and natural/semi-natural landscapes in this planning area and the important presence of population as well as different stakeholders/stakeholder groups might explain the high relevance observed for cultural ES (for more details see MA, 2005). Regulating ES were also relevant at this scale, particularly landslide protection and flood regulation. This could be explained given the need to prevent potential negative effects on the inter-municipal connectivity and damage to industrial facilities. At municipal level, the focus is exclusively on urban areas and the associated infrastructure. At this scale, we found regulation as the most relevant ES section (primarily flood regulation) and cultural ES with a slightly lower priority than at the inter-municipal scale. These results agree with those obtained by Juntti and Lundy (2017), who describe a high potential for delivering regulating and cultural ES in urban areas.

Across the scales, our case study showed a high relevance of regulating ES, which contrast with previous works that indicated a general dominance of provisioning ES (e.g. Foley et al., 2005; Rodríguez et al., 2006; Martín-López et al., 2014). However, our results are consistent with the findings of Castro et al. (2014) who, after an analysis of preferences in a range of landscapes, reported that regulating ES were perceived as the most important by different stakeholders.

While the ES concept was always present across SEA stages and spatial scales, one fundamental concern is the very low frequency of explicit consideration. Similar results can be found in the analysis of a range of policies and programs by previous studies focused on the link between SEA and ES (Geneletti, 2015; Honrado et al., 2013; Mascarenhas et al., 2015; Rega and Spaziante, 2013) as well as in other studies with a more general scope (Costanza et al., 2014; Hauck et al., 2013). A key role of SEA is to explicitly address possible trade-offs and synergies among different objectives (Geneletti, 2015). Hence, incorporating ES in SEA would enhance a strategic analysis for preventing that the supply of certain ES is favored at the expense of others. Moreover, an explicit ES-based analysis of territorial conflicts and/or strategic problems might help to identify and address the root causes, thus improving the quality of spatial plans and policy decisions (Partidario, 2012). In contrast, a lack of an explicit consideration of ES could decrease the expected advantages of the integration SEA-ES.

4.3. Suitable scales for integrating ES in spatial planning

Based on the evidence obtained through our case study, we suggest that a proper and consistent integration of ES in spatial planning does not rely on a particular scale, but rather on the current possibilities offered by the available policy instruments and guidelines for implementing spatial planning and SEA. This idea is supported by the work of Albert et al. (2014), who point out that integrating ES in planning is highly dependent on the governmental planning instruments and on how rigid or flexible this planning system is. In rigid systems, a formal integration of ES might require a political mandate and active support along with some persistence. In contrast, in planning contexts where stakeholders play a more active role, this integration may have many more possibilities.

In Chile, this situation has been already described by Rozas-Vásquez et al. (2017), who argue that a lack of institutional guidelines and methodological support is considered a critical challenge for implementing this integrated approach. The normative body of spatial planning in Chile, contained principally in the General Law of Housing and Urban Development, presents a very limited scope in terms of environmental issues and sustainability. The only planning instrument which considers sustainability beyond urbanistic issues is the Regional Land-Use Plan (SUBDERE, 2011), however, there are no examples so far where the concept of ES has been considered for supporting planning decisions. In the same way, SEA also does not include explicitly the concept of ES. Nevertheless, as it is described by Rozas-Vásquez et al. (2017), SEA is moving towards a more significant contribution, where the ES concept is now being used in national guidelines (MMA, 2015) and evaluated for incorporation in the current development of policies, and is gaining increasing attention by SEA practitioners and planners. Thus, an interdisciplinary team appears crucial for addressing the complexity of the spatial planning process (Ives et al., 2015) and shifting it from a predominant urbanistic paradigm to one oriented to the sustainable development of cities and regions.

As we have argued, in our case study the integration of ES in spatial planning did not suggest a scale dependency. However, since this new approach is still in an initial development stage in Chile, we recommend a gradual process for incorporating ES starting at the regional scale. The advantages are, for example: 1) the regional plan is the only spatial planning instrument in Chile with an explicit focus on territorial sustainability (SUBDERE, 2011); 2) at this scale many sectoral policies are established and coordinated, therefore this might promote collaborative work in a multi- and transdisciplinary manner (Fürst et al., 2013); and 3) regional scale defines a strategic framework of planning that is linked with the national level and at the same time sets guidelines for spatial planning at local levels (Mascarenhas et al., 2015), therefore it might promote and facilitate the integration of ES at multiple scales.

5. Conclusions

The integration of the ES concept for supporting real-world decisions is increasingly gaining relevance in science as well as in policy and planning. Our case study has shown that SEA is a suitable instrument for including ES at different scales of spatial planning, even though the consideration is not yet explicit in most of the cases. In this sense, the ES concept was always present across each of the SEA stages and planning scales. Regarding the latter, we suggest a relation between specific ES and the scope and focus of the different spatial planning instruments, where regulation and cultural ES were identified as the most important sections according to the CICES classification.

However, although ES are clearly necessary for achieving a number of development objectives and dealing with a range of environmental problems, a lack of an explicit consideration is seen as a great challenge to be addressed when carrying out the spatial planning process. If this critical issue is not considered, the potential advantages offered by the integrated framework SEA-ES could be decreased given a deficient practical implementation. As we stated earlier, the ES concept is increasingly being recognized in decision-making within the Chilean context. Therefore, it is possible that it will be incorporated in some of sectoral laws, and certainly in a range of guidelines from different government departments, e.g. forest, water, indigenous affairs. However, major modifications oriented to include ES in the general legislative body of natural resources, environment or territory, are not expected at least in the short term, which is also in agreement with the findings of Mascarenhas et al. (2015). Thus, we emphasize the importance of having informed stakeholders, able to demand the integration of ES through a bottom-up process of planning and decision-making, as well as prepared and conscious decision makers and public officers. We also encourage the formation of interdisciplinary teams within both the consultant and public office in charge of the plan and SEA elaboration. This is recommended in order to promote a substantial discussion and to deal with the task of moving spatial planning from the traditional urbanistic paradigm to one focused on the sustainable development of cities and rural territories.

Conflict of interest

None

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