Need for a cross-sector approach in protected area management

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1 Abstract

2 The need for various stakeholders to harmonize their policies and practices has emerged as a
3 dominant paradigm for 21st century natural resource management. Cross-sector coordination is
4 promising because it can enhance policy consistency, enable the realization of synergies and
5 resolve conflicts among sectors regarding resource management. The extent to which ministries
6 and their main stakeholders make efforts to achieve integrated policies for nature conservation
7 requires further research. Therefore, the aim of this study was to explore the consultation reports
8 of ministries from relevant fields (i.e., environmental protection, agriculture, spatial planning,
9 and security) regarding the management plans for Romania's protected areas. We analysed and
10 visualized 152 consultation reports (2013-2016) covering 15% of Romania's protected areas
11 using self-organizing maps (SOMs), an unsupervised machine-learning method. Our results

showed that considerable attention was paid to formal issues in these reports. The cross-sector issues that emerged as the most important were those related to forest landowner consultation, and the harmonization of agricultural and forestry practices, as well as spatial plans for conservation. The resulting SOMs could be used as a tool to strengthen protected area management in the future because they can (i) guide managers of protected areas to develop plans that ensure that resources will be used in the best way according to the visions of multiple sectors and (ii) help the relevant ministries to improve future consultation reports.

Keywords: consultation; nature conservation; protected area; self-organizing map; Romania

1. Introduction

The changing views on nature and conservation (Mace, 2014) as well the complex and uncertain problems in resources management made the central governments to adhere to decentralized conservation decision making (Berkes, 2010). Continuous efforts are made at the EU level to move toward a participatory approach (i.e., through Public Participation Directive (2003/35/EC); Public Access to Information on the Environment Directive (2003/4/EC), Environmental Assessment Directives (2011/92/EU and 2001/42/EC); and Water Framework Directive (2000/60/EC)). According to these directives it is highly recommended that member states ensure stakeholders' consultation and encourage participation in order to enhance the legitimacy of decision making.

Public participation ranges from state actors' consultation toward more citizens involvement (Orenstein et al., 2008). While state actors may offer technical expertise on complex and urgent issues (Newig and Fritsch, 2009a), the non-state actors may provide valuable local knowledge that can complement expert knowledge (Reed et al., 2007). In practice, public participation has proved effective in increasing the quality of plans and their legitimacy (Burby, 2003; Newig et al., 2016), achieving more inclusive conservation solutions (Whitehead et al., 2014) and driving positive changes in biodiversity conservation (Hill et al., 2015). However, resource management plans are often abstract, lack detail and present vague indications about the implementation of measures. This is especially the case if they are only developed to meet the European Commission requirements (Newig et al., 2016).

Protected areas are among the most effective institutional arrangements for safeguarding biodiversity (Possingham et al., 2007) and ensuring the well-being of a community (Thapa Karki, 2013). They have achieved significant prominence in many countries around the world

(Joppa et al., 2016). The Natura 2000 network is the most extensive protected area system in European Union (EU), and covers approximately 18% of the EU territory (EC, 2016).

Government-controlled protected areas for which the responsibility lies with public authorities represent one of the most common forms of management (Borrini-Feyerabend and Hill, 2015). A key condition for a socially and ecologically acceptable management of protected areas is related to the capacity and willingness of the various stakeholders to collaborate for nature conservation (Avdibegović et al., 2015). This is a challenging task, especially because the economic sectors related to natural resource management (i.e., agriculture, forestry) and spatial planning either (i) have no experience in protected area management and ‘conservation thinking’ and/or (ii) exploit natural resources, which often conflicts with conservation. Indeed policies on key economic sectors are primarily concerned with optimization of production and sectoral policy mandates are often conflicting (Roux et al., 2008).

Cross-sector coordination is thus important. It can ensure that the same concepts and thinking are used in all sectors which enhances policy consistency (Stringer et al., 2014) and that synergies across different sectors can be realized (Roux et al., 2008). When issues (such as protected areas management) are of cross-sector importance, stakeholders from different sectors should engage in dialogue to formulate common goals as well as clarify and resolve disagreements through negotiation and consensus building (Innes and Booher, 2003). This can facilitate knowledge exchange which in turn can lead to innovative policy outputs. Even though mainstreaming of conservation in sectoral strategies is increasingly common (EC, 2012), it does so far not deliver the expected benefits of cross-sector coordination since conservation continues to receive little weight compared with other policy sectors (Spierenburg, 2012).

Management plans are key instruments by which managers of protected areas promote conservation activities. For ministerial acceptance of the management plans in Romania, consultation with various relevant stakeholders is mandatory (Figure 1). These stakeholders are typically asked to review the content of the management plans and to propose modifications for various issues they consider relevant.

In Romania, as in most other countries, inter-ministerial consultation is common in both the policy development and implementation stages, helps to ensure a better understanding of the activities to be regulated (Staronova and Mathernova, 2003), develops mutually agreed management measures across different sectors (Olsen et al., 2014) and prevents resource conflicts (Schilling-Vacaflor, 2014).

The resulting consultation reports are documents that consist of comments and observations regarding the substantive aspects of each stakeholder's policy (Matei and Dogaru, 2013). Specifically, in the consultation reports of protected area management plans, ministries, local public authorities or NGOs make requests (i.e., modifying conservation activities to best manage a protected area, recommending the consideration of additional threats that may affect a protected area, or harmonizing legislation). At the EU level, there is no obligation for stakeholders' involvement in the development of protected area management plans (Unnerstall, 2008) and no obligation for the managers of the protected areas to revise plans according to stakeholders' requests. In Romania, the Government Decision. no. 561/2009 (GD No 561, 2009) creates the opportunity for stakeholders to comment on draft management plans. The resulting requests are considered by the managers of the protected areas but without any obligation to address them in the plan. This procedure is common in other countries such as the Netherlands and Germany (Unnerstall, 2008). In fact, Newig et al., (2016) found in their analysis of

Germany's implementation of the EU Water Framework Directive that the written feedback from participatory processes was often not included in the final plans (Koontz and Newig, 2014).

In Romania, the experts write the consultation reports with the goal of providing feedback in line with the policies governed by the institutions they represent to harmonize their policies with nature conservation policies. These experts are instructed to note the incompatibilities between the management plans and policy, to suggest solutions to strengthen biodiversity conservation using arguments specific to their interests, as well as to note contradictions with existing legislation.

Because Romania has a high proportion of protected areas which is growing every year (Ioja et al., 2010), solid knowledge about their management is a top priority. Romania is a particularly appropriate country in which to conduct this study for the following reasons. First, Romania is extremely rich in genuine cultural landscapes that support a high level of biodiversity (Sutcliffe et al., 2015). Some of these landscapes are veritable 'biocultural refuges' due to high biodiversity, local ecological knowledge and skills related to nature resource management (Barthel et al., 2013). Second, the socio-economic goals of the inhabitants of these landscapes are strongly oriented towards western ideals, while most ecosystem services and biological legacies are less of a priority (Hartel et al., 2014). This, together with the scarce government revenue increases conflicts related to resource management (Ioja et al., 2010). As is commonly the case across contexts, nature conservation is perceived as barrier to economic development (Newig and Fritsch, 2009b). However, when nature conservation supports economic well-being, it gains support from local communities (Newig and Fritsch, 2009b). Third, cross-sector cooperation is scarce in Romania (Nita et al., 2016) which may hamper the good governance of protected areas (Lockwood, 2010). Fourth, since its entry into the EU (2007) Romania has had

the obligation to delineate Natura 2000 protected areas and to fund their conservation management (Ioja et al., 2010) which requires supporting research.

The aim of this study is to explore the content of the consultation reports in order to assess the extent to which they focus on cross-sector issues. We expect these consultation reports placed a substantial emphasis on cross-sector issues by either describing how each ministry's interests interfered with nature conservation or by addressing procedural issues of cross-sector harmonization as protected areas serve multiple goals and encompass multiple resources with overlapping management responsibilities (Apostolopoulou and Pantis, 2009). These multiple goals are often conflicting (Hersperger et al., 2015; Tudor et al., 2014) and management plans are created to coordinate such conflicts (Young et al., 2015).

In the context of our paper, interfering interests take place when a ministry's interest is affected by conservation actions. For example, the request in the management plan to manage a forest located in a protected area for high biodiversity or for certain red-listed species interferes with the interest of the ministry of forestry.

The issue of cross-sector harmonization refers to harmonizing among existing practices and legislation in the ministries and the newly developed management plans.

Self-organizing maps (SOMs), a method that performs content-based organization of consultation reports was used to reveal the general and most frequent requests made by the selected stakeholders regarding the management plans for Romania's protected areas.

2. Methods

2.1. Study area

Romania's protected area network includes 608 Natura 2000 protected areas (437 Sites of Community Importance - SCIs and 171 Special Protection Areas - SPAs), 29 natural and national parks and over 900 other protected areas such as natural reserves or natural monuments that occupy more than 23% of the country's area (EC, 2016). Most protected areas have their own administrations (or custodians) and the larger ones have a Scientific Council and an Advisory Council which deals with complex issues. These councils include both state and local stakeholders with a stake in protected area management. The Ministry of the environment delegates the management to other stakeholders, via competition, such as agencies in the ministry, NGOs, local governmental authorities, or even private parties (Borrini-Feyerabend and Hill, 2015).

The conservation activities in protected areas are established through management plans. Management plans for protected areas are required to engage multiple stakeholders in the development process and address potential threats to a protected area as well as the action taken to improve conservation (Szabo et al., 2008). More than 15 years after the revalidation of the national protected area network (Law no. 5/2000 - the legal basis for declaring a protected area) and almost 10 years after the establishment of the first protected areas in the Natura 2000 network, the development of management plans is still ongoing. In fact, only 43% of protected areas have an approved management plan today (Romanian Government, 2015). This is partly because limited financial resources for conservation and lack of financial incentives to cover immense costs related to compensation (Ioja et al., 2010) as well as the newly established Natura 2000 sites which do not have yet a management agency (Ministry of the Environment, 2016) or the agency did not have yet the time to develop a management plan.

Management plans are developed by the protected area manager and have to be officially approved by the ministry of the environment. This study considers the last step preceding official

approval and specifically addresses the inter-institutional consultation (Figure 1). At this stage, the ministry of the environment first evaluates a plan by itself or hires experts to perform the evaluations according to a specific process. The plans are then sent back to the protected area manager for revision. Before a plan is finally approved by the ministry of the environment, it is sent to other ministries who provide written feedback (i.e., inter-institutional consultation).

Figure 1: Steps in the approval of a protected area management plan

In the context of our paper, ministries are conceptualized as institutions, following the definition of Ostrom (1990), since they embody a set of rules, public norms, practices, policies or other outcomes. Furthermore, the experts that write the consultation reports and represent a ministry can be defined as organizations, following the definition of North (1990), since they are a group of actors having the common goal to comment on the protected areas management plans.

2.2.Dataset

Consultation reports by the ministries in the fields of environmental protection, agriculture, spatial planning, and security were used as input data for our analysis (Table 1)¹. The interests of these ministries are closely linked to protected area management. The ministry of environmental

¹ We refer broadly to the ministry's field since the names of the ministries have repeatedly changed in the past.

protection is responsible for coordinating policies across several domains, such as biodiversity, forest and water management, climate change, etc. It sees protected areas as spaces which can contribute to the achievement of environmental goals and counter-balance the negative effects of social and economic development. The ministry of agriculture aims at the sustainable development of agricultural activities, including the sustainable use of resources. In terms of spatial planning, protected areas are often perceived as spaces useful for balancing the economic and demographic pressures of other areas. The ministry of security is responsible for protecting the country's natural resources and ensuring access to recreational and leisure areas (including different types of protected areas).

This paper assessed 152 consultation reports (2013-2016) concerning management plans of 91 of Romanian protected areas (15% of the total number of protected areas) (Table 1). The number of the consultation reports is higher than the number of protected areas because (i) when a consultation report contained requests on both a management plan and a regulation (a separate section of the management plan, which consists of a set of rules regarding permitted or restricted human activity in a protected area) we considered it as two separate reports, one referring to the management plan and one referring to the regulation and (ii) some consultation reports were general, i.e., done for a group of protected areas. These general reports were not assigned to a specific protected area.

Some consultation reports were short, often less than one page, while others were 4-5 pages. Many protected areas received reports on their management plans from one ministry, while other got reports from two or three ministries.

Table 1: Ministries involved in the consultation reports of protected areas (PAs) management plans (MPs); Number of consultation reports and protected areas

Ministries	Ministry of the environment, Waters and Forests	Ministry of Agriculture and Rural Development	Ministry of Regional Development and Public Administration	Ministry of Internal Affairs
Main area	Environmental Protection	Agriculture	Spatial planning	Security
Common interests with natural resources managers	Biodiversity conservation; Control of environmental degradation sources	Soil conservation	Natural resource conservation	Complying with rules on natural resources exploitation
Conflicting interests with natural resources managers	Forestry; Water management	Agricultural activities (including subsidies)	Urbanization; Infrastructure development	Management of the areas relevant for national security
Measures for reducing conflicting interests	Sustainable forestry; Environmental Impact Assessment; Sustainable Water Management	Ecological farming	Sustainable spatial planning; eco-buildings; green infrastructure	
Coordinated strategies	Strategy for Sustainable Development; Strategy for Biodiversity Conservation; Strategy for climate change mitigation; National Strategy for Forest Management	Fisheries National Strategic Plan; National Strategy for Rural Development	National Spatial Plan, Strategy for Territorial Development	National Strategy for Security, Public Administration Law
Consultation reports (Total - no.)	47 (from which 39 are on individual MPs assigned to a different PA; 6 are general on a group of MPs assigned to a group of PAs, 2 are on a regulation of a PA)	66 (from which 46 are on individual MPs assigned to a different PA; 4 are general on a group of MPs assigned to a group of PAs, 16 are on a regulation of a PA)	30 (from which 25 are on individual MPs assigned to a different PA; 5 are general on a group of MPs assigned to a group of PAs)	9 (from which 7 are on individual MPs assigned to a different PA; 2 are general on a group of MPs assigned to a group of PAs)
Consultation reports (Total – pages)	50	120	16	5
Protected Areas PA (Total – no.)	39	46	25	7

Consultation reports of the cultural ministry contained sparse information and identical text and were therefore omitted. The transportation ministry did not compile any consultation reports, although transportation infrastructure crosses many protected areas, and conflicts exist (Pătru-Stupariu et al., 2015). The ministry argues that Romania's General Transport Master Plan includes sections on biodiversity conservation (Mobbs et al., 2014) and that a consultation report from that agency is therefore unnecessary.

The local public authorities did not deliver consultation reports. This may result from the fact that local public authorities are not usually involved in conservation actions (Rozyłowicz et al., 2017).

The consultation reports delivered by the non-governmental organization (NGOs) were not included in the analysis due to their limited number. NGOs usually are not interested to participate in this last step of inter-institutional consultation (Figure 1). They are active participants in an earlier step (when the management plans need to get the environmental approval from the national or local environmental protection agencies (EPAs), Figure 1), specifically in SEA (Strategic Environmental Assessment) consultation. The NGOs also participate in the development of management plans (Rozyłowicz et al., 2017) especially when they are developed within EU projects (Cent et al., 2014). Furthermore, often the NGOs are themselves the managers of protected areas (21% of the total number of protected areas (Manolache et al., 2017; Ministry of the Environment, 2016)). This explains why in this last step of inter-institutional consultation only few reports were delivered by NGOs. The NGOs likely react in this last step only when: (i) serious issues arise (i.e., the management plans do not take into account a certain category of local population whose interests the NGOs are representing); or (ii) when they may be in conflict with the managers of the protected areas (such as EPAs, forestry agencies, county councils, universities etc.). In Romania, the former communist government has marginalized the impact of the NGOs. However, in recent years the NGOs are increasingly becoming engaged in the protection and conservation of the natural resources (Rozyłowicz et al., 2017).

2.3. Self-organizing map

We organized and visualized the content of the consultation reports by using the Self-Organizing Map (SOM), an unsupervised artificial neural network developed by Teuvo Kohonen (Kohonen, 1981). We chose this method because it allows to extract patterns from unstructured data, including textual documents, and classifies their content into topics. It is a visualization clustering method, which maps high dimensional and complex data in a low dimensional grid of nodes, known as neurons (usually two-dimensional) (Kohonen, 2001). In the resultant grid (the output space, i.e., Figures 2-5) the topological relations that exist in the original data (the input space, specifically the consultation reports) are preserved and mapped accordingly.

SOM has been widely used with documents as the input data (Lei and Kelly, 2015; Mayer and Rauber, 2011) and is a useful tool for document classification based on content (Isa et al., 2009). SOM is a clustering method, superior to traditional clustering because it employs a more rigorous grouping procedure and does not assuming the existence of a particular number of groups (Jain et al., 1996). It is an alternative to content analysis because it does not require *a priori* knowledge of the data structure or a coding guide (Lei and Kelly, 2015).

To work with the data from a document, SOM converts the words into a set of vectors by assigning weights. This is done by counting the frequency of the words in a document (Mayer and Andreas, 2011). During the training procedure, a sample vector from the input data set is compared with the weight vectors using some distance measure to find the best-matching unit (Kohonen, 2001). Therefore, documents are grouped together in the resultant map based on the similarity of their semantic content and the words are displayed close to one another according to their importance in the document.

SOM has been applied in a broad array of studies in natural resources for the examination of public discussions in a collaborative natural resource management process (Lei and Kelly, 2015),

to predict the outlet concentrations of nutrients in integrated constructed wetlands by using water quality variables (Zhang et al., 2008), to identify the factors that characterize the risk of pine forests being affected by insect pests (Park et al., 2013) as well as to analyse the interrelationships of multidimensional soil data (Merdun, 2011).

2.3.1. Data pre-processing

To create SOMs of optimal quality, the input documents must be pre-processed. First, the consultation reports were scanned as Portable Document Format (PDF) files and then converted to ASCII format. Second, the documents were split up into 152 consultation reports as explained in section 2.2. (Table 1), because a single document often contained the consultation reports for multiple protected areas. The length of the consultation reports ranged from a few sentences to hundreds of sentences. Finally, we used the text mining (*tm*) (Feinerer, 2015) and *SnowballC* packages (Bouchet-Valat, 2014) in the R software (Team RC, 2014) to remove the punctuation marks and numbers, convert the text to lower case, remove the auxiliary verbs and the very commonly used words in the Romanian language as well as to convert the words to their stem words. The *SnowballC* package implements a stemming algorithm described in Porter (1980) for the Romanian language (i.e., “*med*” is the stem word for “*mediu*”, “*mediului*” which is the word for “environment”). Keeping the documents in the Romanian language enabled us to keep the language specifics.

2.3.2. Vectorization and training

The pre-processed documents were converted to vectors using the SOMLib parser script included in the Java SOMToolbox developed at the Institute of Software Technology and Interactive System at the Vienna University of Technology (<http://www.ifs.tuwien.ac.at/dm/somtoolbox/>, (Mayer and Andreas, 2011)). The vectors

(represented by the weights assigned to the words) were calculated by setting thresholds for specific parameters, such as the minimum and maximum frequency for a word in a document to be included or removed from the feature space. The thresholds were adjusted (lowered or raised) for each training process until a reasonable dimensionality of the feature space was achieved. For example, we used a minimum document frequency of 5 documents, so that those words included in at least 5% of the documents were kept in the analysis, and a maximum document frequency of 0.6, so that those words that appeared in more than 60% of the documents were removed from the feature space. This conversion process allowed us to remove the stop words remaining from the text mining pre-processing, including those words with less than three characters, or those which appear too frequently or too rarely in the documents. The resulted vectors were used to train the SOM map (Kohonen, 2001). The training parameters for Java SOMToolbox included a random seed of 7, a learning rate of 0.7 and 1500 iterations (Mayer and Andreas, 2011). A rectangular map of the size of 20 x 14 neurons (or nodes) (a total of 280 neurons) was trained using the Java SOMToolbox.

2.3.3. Visualization

The resultant map was separated into clusters using Ward's clustering algorithm, which is an agglomerative hierarchical clustering procedure that treats each node on the map as a separate cluster. Next, clusters with minimum Euclidean distances between them were combined into groups until a single cluster emerged on the SOM map (Yorek et al., 2016). Next, we used the labelling method (Merkl and Rauber, 1999) which automatically generated labels for the SOM map to identify the most prominent words in each cluster. Furthermore, the Java SOMToolbox offers a set of SOM visualizations to discover structures in the data. We used the Cluster Map in which the input data was divided into a number of clusters and (ii) the smoothed data histogram

(SDH) which shows the smoothed data density on the map, allowing cluster identification in the data (Pampalk et al., 2002).

2.3.4 Interpretation

In each SOM visualization, a cluster is a delimited area on the map which contains documents with similar content. Two words per cluster gave details about the content: the larger word (i.e. the heading of the cluster) reflected the key information content of the specific cluster while the smaller word provided additional information. Together they defined the topic of the cluster. For example, in Figure 3(a) the heading ‘pastures’ shows that pastures management is an important topic, while the word ‘sowing’ shows that sowing, an agricultural activity conducted on pastures, have to be done in certain conditions. In the current study, clusters and topics belong to each other. Each cluster has one topic. The original words in the Romanian language are displayed in Appendix A. A larger cluster indicated a higher number of consultation reports that mapped into that cluster. Neighbouring clusters may show more related topics than distant clusters.

The Cluster Map was used to display the general landscape of the topics discussed in the consultation reports, showing the most important (prominent) topics. The Smoothed data histogram was used to identify the topics that were the most consistently (regularly) discussed in the consultation reports.

We looked for cross-sector issues in the topics that emerged. We considered a cross-sector issue as (i) any issue referring to how a ministry’s interests interfered with nature conservation and (ii) any attempt to harmonize a ministry’s practice or legislation with nature conservation. The issues that did not reflect a cross-sector approach but aimed to enhance plans content quality

(i.e., the length and clarity of sentences, correct spelling, use of adequate maps and images) were considered formal issues.

3. Results

3.1. Topics in the consultation reports of the ministry of environmental protection

The Cluster Map (Figure 2a) showed eight clusters representing distinct topics.

Some topics referred to the structure of the management plan, i.e., the modification of the subchapters structure, the avoidance or use of specific fonts (i.e., bold letters; roman letters for landscape units abbreviations), updating the names of institutions and the replacement of terms, expressions or legislation. These were discussed in documents that are clustered in the topics with the headings "surfaces" "order" and "bold" (Figure 2a,b).

Other topics referred to cross-sector issues because they addressed forests, hunting and biodiversity which are domains in the ministry of environmental protection. For example, several reports called for additional sections related to (i) the process for forest landowners' consultations, i.e., that concerned landowners had to agree with the restrictions imposed by protected area regulations, (ii) collaborative actions with other institutions and (iii) the addition or updating of information about biotic factors, such as plant and animal species and habitats in natural reserves (i.e., a category of protected areas), and data about habitat surfaces. Some reports pinpointed shortcomings related to the weak link between the proposed activities in the management plans and the conservation objectives. The most consistently discussed topics, as shown by the smoothed data histogram (Figure 2b), were related to poaching and clear-cutting pressure. Requirements for such pressures to be revised occurred often, because the actual pressures were considered those related to agricultural activity as the protected areas under evaluation did not include forests, being located on agricultural lands. Requests were made to

rephrase the statement that “clear rules regarding the fight against poaching are lacking in the hunting field”, because it was “not a true statement” according to the Hunting Law. These cross-sector issues were discussed in documents that are clustered in the topics with the headings "conservation", "information", "reserves", "actions", and "hunting" (Figure 2a,b).

Figure 2: (a) A Cluster Map showing eight clusters labelled by the two most prominent words; (b) A Smoothed Data Histogram showing the most consistently/intermittently discussed topics by the ministry of environmental protection.

3.2. Topics in the consultation reports of the ministry of agriculture

The Cluster Map (Figure 3a) showed ten clusters representing distinct topics.

All topics referred to requests for harmonizing legislation and practices between agriculture and nature conservation. The topics focused on agricultural activity such as sowing, grazing and mowing conducted on grasslands (hay meadows and pastures). The consultation reports requested that attention be paid to certain issues. For example, the reports requested that the plan should emphasize that sowing is not permitted on pastures unless they are degraded or accidentally damaged. Another example is requests about grazing-related activities that go

beyond the requirements of existing legal norms, such as “grazing is limited to a maximum of one large animal unit per hectare”. These were discussed in documents that are clustered in the topics with the headings "pastures", "grazing" and "meadow" (Figure 3a,b). Furthermore, the reports requested that the regulations concerning the use of fertilizer near water bodies or regulations about woody vegetation on agricultural land should be removed from the management plans because these regulations overlapped with measures specified by the National Strategy for Rural Development, or other legal acts. Specifically, such a request was formulated as, “please remove the regulations regarding the use of fertilizer on lands adjacent to water, as it is regulated by the code of good agricultural practices concerning the protection of water against pollution caused by nitrates from agricultural sources.” The ministry further emphasized which agricultural activities are already forbidden in protected areas (i.e., mowing at specific times “no later than on the 1st of June” and altitudes “on medium and low altitude pastures”; burning vegetation close to forest habitats) based on legal acts and asked that the natural resource manager update the related information. All these were discussed in documents that are clustered in the topics with the headings "pastures", "water", "keep", "remove" and "habitat" (Figure 3a,b). The smoothed data histogram (Figure 3b) shows that the most consistently discussed topics were those related to the agricultural lands next to natural and scientific reserves since these areas were affected by restrictions. Therefore, the requests were made to add specific legal rules referring to compensation payments into the plans. These were contained in the cluster under the heading "reserves" (Figure 3a,b).

Figure 3: (a) A Cluster Map showing ten clusters labelled by the two most prominent words; (b) A Smoothed Data Histogram showing the most consistently/intermittently discussed topics by the ministry of agriculture.

3.3. Topics in the consultation reports of the ministry of spatial planning

The cluster map (Figure 4a) showed seven clusters representing distinct topics.

Two of the topics displayed showed requests regarding the structure of the management plans, i.e., adding or filling in the appendices as well as updating the name of the ministry of the environment, which was often changed to better reflect its purpose (i.e., from Ministry of the Environment and Forests to Ministry of the Environment and Climate Change). One of the most consistently discussed topics, as shown by the smoothed data histogram (Figure 4b) referred to aspects that should be reworded (i.e., when sentences are ambiguous and the terminology of specific legal norms were not respected) or added (i.e., a legend in the appendices, or graphic and cartographic information). These were discussed in documents that are clustered in the topics with the headings "appendices" and "zoning" (Figure 4a,b).

Other topics that emerged referred to cross-sector issues because they referred to statements in the conservation plans regarding the obligation of the local public authorities to update the

spatial and urban documents as well as the development plans with information regarding the boundary and location of the protected areas. These encompassed the clusters "reserve", "SCIs", "authorities" and "plans" (Figure 4a,b). Furthermore, the smoothed data histogram (Figure 4b) showed that the most consistently discussed topics were related to the internal zoning of the protected areas. In some protected areas, the zoning was absent, and it was not clear which activities were allowed in the various zones and which standards construction should meet to be allowed in a sustainable development zone according to the current legal framework. These were discussed in documents that are clustered in the topics with the headings "allow" and "zoning" (Figure 4a,b).

Figure 4: (a) A Cluster Map showing seven clusters labelled by the two most prominent words; (b) A Smoothed Data Histogram showing the most consistently/intermittently discussed topics by the ministry of spatial planning.

3.4.Topics in the consultation reports of the ministry of security

The cluster map (Figure 5a) showed six clusters representing distinct topics.

Two topics referred to requests about the structure of the plans, for which suggestions were made about avoiding the use of unsuitable terms (i.e., “central public authority for environmental

protection instead of central public authority for environmental and forests protection”), the replacement of the name of an institution (i.e., from “Prefecture to Prefect's Institution”) or updating the number of the custody convention (the official document through which a management plan is assigned to a custodian). These were discussed in documents that are clustered in the topics with the headings "unsuitable" and "convention" (Figure 5a,b).

Four other topics that emerged referred to cross-sector issues. The consultation reports addressed security (police attributions) in the protected areas, the need for the vaccination of police dogs that access the protected areas as well as appropriate means of intervention and precautions to overcome the potential effects of natural disasters. For example, a consultation report stated, “Prohibition against the use of open fire for various activities in the protected areas must be included in the management plans”. Furthermore, requests were made in the consultation reports to include the Prefect’s Institution (i.e., an institution subordinated to the ministry) on the list of the institutions that must be involved in the development of the management plans because the ministry considers that Prefect’s Institution will have an important role in guaranteeing spatial development and environmental safety. Furthermore, “the Prefect’s Institution will contribute to the implementation of the management plans by coordinating the actions that different local institutions are taking and by facilitating communication with state institutions”. The smoothed data histogram (Figure 5b) shows that the most consistently discussed topics were those related to updating the attributions of the police units in terms of the intervention plans as well as listing the name of the people that enforce sanctions in the protected areas. These were discussed in documents that are clustered in the topics with the headings "security", "dogs", "disaster" and "institution" (Figure 5a,b).

Figure 5: (a) A Cluster Map showing six clusters labelled by the two most prominent words; (b) A Smoothed Data Histogram showing the most consistently/intermittently discussed topics by the ministry of security.

4. Discussion and Conclusions

The governance of a protected area requires robust knowledge about the biodiversity of the area as well as strong collaboration between multiple stakeholders to achieve the envisioned nature conservation goals. In case of transition countries, participation in protected areas management is taking place usually at national level (Brescancin et al., 2017) but cooperation between different state actors seems to be a major problem (Kluvankova-Oravska et al., 2009) as a result of a misfit between conservation policies and other policies (Wesselink et al., 2011).

In order to better understand coordination among different sectors represented by ministries, we analysed a large sample of consultation reports about management plans for protected areas from the most relevant ministries and assessed the extent to which they focus on cross-sector issues. In addition to exploring the cross-sector issues in the consultation reports (and documenting the situation in a country that just starts to gain experiences with cross-sector coordination) we found a strong focus on formal issues, such as corrections to the structure and wording of the plans,

in many consultation reports. This focus on formal issues can have different reasons, such as the stakeholders writing the reports do not want to address the real conflicting issues; or they do not understand the purpose of the reports; or the cross-sector interests are already optimally coordinated in the plans, and that is why these are not addressed in the reports; or these comments on formal issues are part of the process of ensuring that common concepts and thinking are used in all sectors which enhances policy consistency. This shows that such formal comments can be important and should be further analysed as they could provide useful insights.

Furthermore, we found differences between ministries regarding the most important topics discussed in the consultation reports. While both cross-sector and formal issues were predominant in the consultation reports of ministries of environmental protection, spatial planning and security, the harmonization of practices and legislation dominated the consultation reports of the ministry of agriculture.

When the whole dataset was considered, similar issues emerged as in the individual consultation reports (Figure 6). These were related to forest landowner consultation, harmonization of agricultural and forestry practices as well as harmonization of spatial plans with conservation. However, agricultural practices, especially those that refer to the management of pastures, were often asked to be reviewed according to the existing agricultural regulations. This topic dominated most of the clusters in Figure 6, which might result from the fact that the ministry of agriculture delivered the highest number of consultation reports.

Figure 6: (a) A Cluster Map showing fifteen clusters labelled by the two most prominent words; (b) A Smoothed Data Histogram showing the most consistently/intermittently discussed topics by all four ministries.

The content of the consultation reports revealed that forest landowners, who are important stakeholders in a management plan, were not informed about restrictions on forest use, which should be put in practice only after agreement by the landowners. Furthermore, the consultation reports stated that the plans included false data regarding forest landowners, and no information about compensation for the landowners affected by the restrictions which may subsequently lead to the total or partial contestation of the plans before their approval by the ministry of the environment. Indeed, the restrictions on forest use imposed by the management plans fuelled conflicts (Redpath et al., 2013). Our finding regarding the lack of consultation of the most important stakeholders confirmed a general deficiency. Public participation and consultation in protected area management plans is rare in Romania as a result of a top-down approach in protected area planning (Ioja et al., 2016), a lack of conservation awareness of landowners (Hersperger et al., 2015), weak local institutions (Hartel et al., 2014) as well as a lack of governmental incentives for participation (Stringer and Paavola, 2013). The lack of proper

compensations for landowners made them to evoke negative attitudes (Szell, 2012) toward Natura 2000 network which have hindered their involvement in participatory processes (Cent et al., 2014). Furthermore, the pre-established management rules established in the plans may hinder public consultation because people are afraid that only limited modifications to a plan can be made (Bockstael et al., 2016).

There seemed to be a strong interest in coherent and consistent plans in terms of overlapping practices because the ministry coordinates the National Strategy for Rural Development since Romania's entrance into the European Union in 2007. This strategy makes possible, through the financial support of specific measures, the development of the agricultural sector and rural areas. As through this strategy measures are already established for the management of natural resources, the ministry requested the harmonization between these measures and those proposed in the newly developed management plans. The ministry of agriculture wants to remain as the agency that provides compensatory payments to farmers even in protected areas. Specifically, the comments in the consultation reports were geared towards preventing a shift of this responsibility to the ministry of environmental protection, which is responsible for managing the country's protected areas.

Furthermore, requests were made to include information about protected areas in the spatial and urban plans. This is an important issue because one requirement for the approval of a spatial urban plan is to be in accord with the objectives of protected area management plans.

Some surprises revealed by the SOM method refer to the role of security officers (i.e., the police and gendarmerie) in the enforcement of regulations in protected areas which has been emerged as being unclear in the plans. Therefore, the management plans could be an opportunity to bring this issue into the political arena. Other surprises refer to formal issues that were

regularly discussed in the consultation reports. Most of them address changing fonts, adding diacritical marks to letters, a bibliography, rewording terms or updating names. The consultation reports in which such issues prevail might have been written by lawyers, who focused rather on aligning the content of the management plan with a ministry's legal framework than on cross-sector issues.

Practical suggestions

The analysis revealed that the consultation reports did not provide comprehensive coverage of relevant cross-sector issues. To take full advantage of inter-institutional consultation, we suggest the ministries should focus more on (i) identifying which conservation activities are incompatible or may fuel conflict, (ii) proposing specific conservation activities for a protected area under evaluation, when such actions are formulated too generally in the plan, and (iii) providing best practices for protected areas management. One way to improve inter-institutional consultation could be to integrate it earlier in the process, specifically during the preparation of the management plans, as it is conducted in SEA (2001/42/EC). Although in Romania the decision-making process has made progress toward a consultative approach, it turns out that consultation remains more a formal step than inclusive activity (Matei and Dogaru, 2013). This focus on formal issues may come from ministries' reluctance to interact with other public administrations and private stakeholders (Matei and Gaita, 2016).

To harmonize the national development policies with the conservation policies and avoid further conflict, all important areas (i.e., industry, forestry, agriculture, defence, transportation, etc.) must collaborate. In Romania, the lack of collaboration between different stakeholders in conservation matters may arise from an emphasis on economic rather than ecological goals (Grădinaru et al., 2017; Tudor et al., 2015, 2014), and the government's reluctance for more

530 inclusive environmental governance approaches (Stringer and Paavola, 2013). Furthermore, the
531 legacy of the Romania`s communist past may also be a reason for the less effective opening of
532 institutions for collaboration (Stringer and Paavola, 2013).

533 The harmonization of other policies with nature conservation policies is also difficult in other
534 countries which are experiencing rapid economic development and are heavily dependent on
535 natural resources (Chunmei and Zhaolan, 2010), where nature conservation is influenced by binding
536 or non-binding international norms (Hiedanpää and Bromley, 2011), or in countries where the
537 most effective policy entrepreneurs are influential economic stakeholders. However, consultation
538 reports may provide a suitable venue for dealing with cross-sector issues.

539 Protected-area managers and ministries may take advantage of SOMs of consultation reports
540 as developed in this study. These maps might facilitate the development of future management
541 plans (almost half of the Romania`s protected areas do not still have a management plan) because
542 the maps indicate which topics are of the most concern to the ministries. Managers might react
543 accordingly by developing specific plans, which in turn might accelerate the process of
544 management plan approval. Showing these maps to ministries is important to allow them to
545 understand the focus of their consultation reports and adapt future reports by focusing more on
546 harmonizing their policies with the management plans than on formal issues.

547 The formal issues that emerged from the consultation reports could be included in a standard
548 for the preparation of the management plans. This would eventually improve the quality of the
549 management plans and help to focus consultation reports on relevant and substantial issues.

550 The SOMs have been demonstrated to be useful for identifying the information in the
551 consultation reports. Furthermore, SOMs can be applied to any domain and almost any type and
552 amount of data, especially to very large data sets (Olteanu and Villa-Vialaneix, 2015). As it is an

unsupervised learning algorithm, no *a priori* knowledge on both domain and input data is required. Despite the unsupervised nature of the SOMs, a strong familiarity with the consultation reports is required to properly interpret the results. SOMs potential has been exploited in retrieving information from websites content (Chifu and Letia, 2010), complex ecological data (Chon, 2011), environmental quantitative data (Tran et al., 2003), and even music and images (Mayer, 2011). SOMs applicability to predict and produce management practices has been shown by Zhang et al., (2008) who used SOM to predict nutrient removal in integrated constructed wetlands. So far SOM has been mainly used for visualizing and clustering nonhomogeneous and complex data. Considering clustering quality, there is no overall agreement that SOM produces the best clusters (Kohonen, 2001) as compared with other self-organizing hybrid algorithms (Isa et al., 2009). Furthermore, as SOM, and any other clustering method, deals with dimension reduction, some information may be lost. Therefore, scholars have proposed several extensions of SOM algorithm (Olteanu and Villa-Vialaneix, 2015) and even used SOM in combination with other methods (such as PCA, linear regression analysis, genetic algorithms) to counteract such shortcomings.

Future research can examine the consultation reports of various departments subordinated to the same ministry. This might highlight common or conflicting views regarding nature conservation across departments. Future research could also assess the consultation reports from NGOs in an earlier step in the process so a more complete view of stakeholders' concerns regarding protected area management plans could be attained.

Exploring consultation reports from various ministries has been useful to gain an understanding of the issues that most concern the ministries regarding nature conservation. Monitoring the topics of these reports may help protected area management in the future by

576 revealing the most important issues that require careful consideration to ensure the effective
577 implementation of nature conservation policies.

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APPENDIX A

Table A.1: Clusters with topics from the consultation reports of the ministry of environmental protection

Renamed clusters	Original cluster labels in the Romanian language (stem words)
conservation/activities	indic/activităț
information/elements	informaț/element
reserves/biotic	rezervaț/biotic
surfaces/replace	suprafaț/înlocu
order/subchapter	ordonanț/subcapitol
actions/agreement	acțiun/acord
bold/use	bold/folos
hunting/parks	vânat/parc

Table A.2: Clusters with topics from the consultation reports of the ministry of agriculture

Renamed clusters	Original cluster labels in the Romanian language (stem words)
pastures/sowing	pajișț/însămânțăr
grazing/pastures	pășun/pajișț
meadow/activities	pajișț/activ
reserves/update	rezervaț/complet
pastures/mowing	altitud/dat
water/fertilizers	apă/prevăz
keep/wood	mențin/vegetaț
remove/activities	elimin/mențin
grazing/activities	pășun/activităț
habitat/forest	habit/stăr

Table A.3: Clusters with topics from the consultation reports of the ministry of spatial planning

Renamed clusters	Original cluster labels in the Romanian language (stem words)
reserves/spatial documents	rezervaț/aprobăr
SCIs/spatial documents	comunit/importanț
appendices/names	anex/climat
authorities/public	administr/public
plans/ATUs	dezvolt/administr
allow/constructions	art/construcț
zoning/rewording	zon/formul

SCIs - sites of community interest

ATUs – administrative territorial units

TableA. 4: Clusters with topics from the consultation reports of the ministry of security

Renamed clusters	Original cluster labels in the Romanian language (stem words)
security/ attributions	constatăr/paz

dogs/vaccination	dovez/vaccinăr
convention/custody	convenț/invoc
unsuitable/terms	abiot/aduc
disaster/intervention	autor/intervent
institution/prefect	institui/prefect

TableA. 5: Clusters with topics from the consultation reports of all four ministries

Renamed clusters	Original cluster labels in the Romanian language (stem words)
grazing/pastures	pășun/pajișt
pastures/grazing	pajișt/pășun
habitat/forest	habit/sens
pastures/wood	pajișt/vegetaț
meadow/keep	pajișt/mențin
grazing/plants	pășun/plant
pastures/wild	pajișt/sălbăt
pastures/requirements	pajișt/cerinț
pastures/grazing	pajișt/pășun
landowner/payments	termen/plăț
forest/landowner	forestier/proprietar
land/restrictions, reassess/chapter	funciar/reanaliz
urban/plan	urbanist/amenaj
institutions/public	institui/public
ordinance/provisions	ordonanț/urgent