Best practices for corporate commitment to biodiversity: An organizing framework from GRI reports

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Abstract

Corporate operations can have significant impacts on biodiversity. Nevertheless, the literature has overlooked the analysis of the organizational practices underlying corporate commitment to biodiversity. The objective of this article is to contribute to this under-researched issue by shedding light on the best practices of biodiversity conservation of companies whose operations pose high risks to biodiversity. For this purpose, we carried out a systematic analysis of the sustainability practices reported by 163 mining and forestry companies whose operations pose high risks to biodiversity. The article proposes an organizing framework describing the main approaches and practices for corporate biodiversity management. The contributions and implications for managers, policy makers and other stakeholders are discussed.

1. Introduction

Corporate operations can have significant impacts on biodiversity. This is especially the case for natural-resource based organizations from the mining and forestry sectors. In those sectors, the complexity of biodiversity impacts and the issues at stake may require significant changes and the implementation of specific managerial practices. As a result, the integration of biodiversity issues into environmental management practices is not the responsibility of experts alone but tends to concern managers and organizations as a whole. Nevertheless, while managers seem to be increasingly concerned by biodiversity, corporate commitment often remains insufficient (Bonini and Oppenheim, 2010; Overbeek et al., 2013; Jones and Solomon, 2013). According to a recent study of 126 companies from sectors with significant impacts on biodiversity, only 32% of these companies have implemented a formal policy or program in this area (CERES, 2014). Moreover, this type of company tends to release little or no information about their practices for biodiversity nor on their performance in this area (van Liempd and Busch, 2013; Rimmel and Jonäl, 2013).

This lack of information also exists in the scholarly literature on corporate environmental management. Most research on the practices for this type of environmental management has remained quite general and has not specifically focused on biodiversity problems (Boiral and Heras-Saizarbitoria, 2017). Studies from environmental sciences have investigated specific

practices or issues related to biodiversity such as impact assessments, measurements of habitat value, biodiversity offsets, ecosystem services payments, cost-benefit analyses of restoration projects, and the implementation of specific conservation programs and the adoption of market-based instruments (e.g. Pirard, 2012; Schiappacasse et al., 2012; Reale et al., 2016). Nevertheless, as is emphasized in the next section, these studies do not analyze the practices associated with corporate commitment to biodiversity. In order to fill this gap in the literature the objective of this study is to shed light on best practices with regard to corporate approaches to biodiversity by analysing practices observed among a large number of mining and forestry organizations whose operations pose high risks to biodiversity. More specifically, best practices are analyzed in order to infer an organizing framework, i.e. a general picture of corporate approaches to biodiversity.

The remainder of the paper is structured as follows. First, the literature review describes the main research on corporate commitment to biodiversity and practices in this area. Second, the methodological section outlines the main steps of the qualitative content analysis conducted. Third, the findings are focused on the main research question of this study: what are the best practices in this area? Finally, the conclusion discusses the study's primary results, contributions, implications, and avenues for further research.

2. The practices for corporate biodiversity management

Most studies of the practices for biodiversity management have focused on specific technical measures, notably impact assessments, conservation programs, definitions of biodiversity indicators, mitigation actions and ecological restoration. For example, studies of biodiversity impact assessment have analyzed a wide variety of issues (e.g. assessment methods, biodiversity offsets, impacts of farming operations and electricity transmission lines) that can be related to specific organizations (e.g. von Haaren et al., 2012; Virah-Sawmy et al., 2014). Studies of conservation programs have mainly focused on biodiversity initiatives in specific areas and the development of natural reserves, which may involve the participation of companies (e.g. Hastings and Botsford, 2003; ICMM, 2010). A few studies have also focused on the development of biodiversity indicators, which are essential to monitor natural inventories and measure corporate performance in this area (e.g. Sizemore 2015; Failing and Gregory, 2003; Willison and Côté, 2009). Nevertheless, the reliability of these measurements remains uncertain and the development of biodiversity indicators tends to reflect the predominance of the economic discourse over more ecological and humanistic perspectives (Spash and Aslaksen, 2015; Boiral, 2016). Lastly, the literature has focused on the integration of biodiversity in restoration, rehabilitation and mitigation operations such as reforestation, closure of operations, and offset policies (Lamb et al., 2005; Schiappacasse et al., 2012; ICMM, 2010).

Although this highly specialized literature is essential to understand specific biodiversity issues, it does not allow us to paint a global picture of the possible practices that organizations can implement, in particular in the forestry and mining sectors. Although the study of Sizemore (2015) provides interesting examples of measures for biodiversity, it remains focused on technical measures in the dairy industry. Overall, the organizational and human aspects of biodiversity management have been overlooked. The few managerial

studies of the integration of biodiversity into organizational practices have essentially focused on the disclosure of information and relationships with stakeholders. First, the managerial literature has stressed the importance of developing biodiversity accounting to improve the information provided to stakeholders and to reinforce organizational accountability (Jones, 1996, 2003; Sizemore, 2015 Boiral and Heras-Saizarbitoria, 2017). Over the last few years, various models and methods have been proposed to measure the complex interactions of organizations with ecosystems and the critical importance of different species (Jones, 1996, 2003; Houdet et al., 2012; Siddiqui, 2013). Nevertheless, recent studies have revealed the paucity of information actually released by companies, including large organizations whose activities threaten biodiversity (van Liempd and Busch, 2013; Rimmel and Jonäll, 2013). Second, the managerial literature has focused on the role and importance of collaborations with stakeholders involved in biodiversity projects (Mahanty and Russell, 2002; Young et al., 2013 Boiral and Heras-Saizarbitoria, 2017). For example, studies of partnerships between organizations and NGOs specializing in biodiversity conservation such as the WHC and the UCN have shed more light on the complexity of biodiversity management and the importance of developing multi-stakeholder approaches (Westley and Vredenburg, 1997; Cardskadden and Lober, 1998; Mahanty and Russell, 2002). Nevertheless, as stressed by Young et al. (2013), the effectiveness of stakeholder involvement in biodiversity conservation remains uncertain. Moreover, the analysis of collaboration with stakeholders on biodiversity initiatives has remained quite descriptive and under-theorized. More importantly, the current literature has essentially focused on very specific cases and analyzed only a few approaches or practices that are not necessarily representative of the wide range of activities that can be implemented by companies.

Overall, how companies manage biodiversity issues in practical terms and the different approaches in this area clearly remain under-researched. To encourage companies to integrate biodiversity issues more systematically, various industrial associations, NGOs and governmental agencies have developed specific guidelines and standards. This is the case of the International Council on Mining & Metals (ICMM), which has developed the "Good Practice Guidance for Mining and Biodiversity" (ICMM, 2006). These guidelines propose various practices to manage biodiversity at different operational stages: project development (e.g. land clearance, construction-related infrastructure), operations (e.g. extraction, management of tailings) and closure planning (e.g. rehabilitation, restoration of vegetation). Organizations in the forestry sector have also developed similar guidelines, such as the Biodiversity Offset Implementation Handbook (Forest Trends, 2009), the Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales (Ontario Government, 2010) and the Guidelines for the Conservation and Sustainable Use of Biodiversity in Tropical Timber Production Forests (ITTO/IUCN, 2009). Whatever the relevance and usefulness of these tools, their implementation by various organizations has not been thoroughly investigated. Moreover, the possibility of using the existing guidelines in different sectors of activity remains uncertain, as does the existence of common practices that could be implemented by various types of organizations. Finally, the initiatives for biodiversity identified in the industrial guidelines and in the literature in general remain quite technical, focused on a few aspects, and do not necessarily provide a comprehensive overview or map of the actual practices in this area. The systematic analysis of the information on biodiversity practices reported by companies whose operations pose high risks to biodiversity can contribute to develop such a map of different good practices.

3. Methods and data

As underlined by Barkemeyer et al. (2015) many regulatory bodies and international organizations have been involved in developing guidelines designed to enable companies to report on sustainability aspects. Some of the most commonly used are those provided by the Global Reporting Initiative (GRI), which include information on biodiversity management (see Box 1). The specific focus on mining and forestry sectors of economic activity is justified by their direct and significant impacts on biodiversity (Wishart, 2012; Fisher et al., 2011; Didham, 2011). The analysis of two sectors sheds light on sector-based similarities and differences that are valuable to identify best practices.

Box 1
The GRI framework and the information on biodiversity management

The GRI framework and the GRI database[1] provide a common reference point to analyze, from a large sample of mining and forestry organizations, the practices of corporate biodiversity management. Biodiversity issues are covered by five specific indicators that include initiatives for biodiversity conservation, risks and possible impacts on biodiversity and management of these impacts. The GRI Framework includes three categories (Economic, Environmental and Social). Within the Environmental category there is an 'aspect' devoted to biodiversity. In this category companies have to report on four indicators:

- EN11: Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas
- EN12: Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas
- EN13: Habitats protected or restored
- EN14: Total number of IUCN red list species and national conservation list species with habitats in areas affected by operations, by level of extinction risk

The GRI framework has had different versions (e.g. G3, G4). The latest one is version G4.

The data analysis was based on qualitative content analysis, which can be defined as the interpretation of textual information through a systematic process of coding and categorization intended to group information around recurring concepts or themes (Hsieh and Shannon, 2005; Schilling, 2006). This categorization process is similar to the grounded theory approach, which is frequently used for qualitative studies (Strauss and Corbin, 1990; Kohlbacher, 2005). The field-work was finished in 2014 and was based on the analysis of sustainability reports available in the GRI database between 2008 and 2012. The focus on a period of several years was necessary to collect a substantial amount of information on biodiversity management. All in all, 430 sustainability reports released by 163 companies

[1] This database is available at http://database.globalreporting.org/.

from the mining and forestry organizations where analyzed. More specifically, 151 reports released by 53 companies from the forestry sector and 279 reports by 110 mining companies were analyzed (Table 1 shows the Geographical distribution of the sample). The data analysis process followed these steps:

1. Extraction and collection of information: Data was extracted and collected from the sample of GRI reports. For this purpose, specific keywords and the code number of relevant GRI indicator were used. This information was saved in a specific file for each report and then was exported to a program for qualitative and quantitative content analysis. QDA Miner version 4.0.4 software was used to store; compare and analyze the information.
2. Development of the categorization framework: A categorization framework was developed. Initially it was based on a few preliminary categories related to the main objective of the study. In line with grounded theory and qualitative analysis approaches (Strauss and Corbin, 1990; Kohlbacher, 2005), this preliminary framework was further developed and reorganized through the process of data analysis.
3. Categorization: The information extracted from the GRI reports was systematically analyzed and coded with QDA Miner. In total, 4656 passages from the GRI reports were analyzed. In order to reduce possible bias in the development and interpretation of categories, the coding of GRI reports from each sector of activity (forestry and mining) was conducted independently by two coders. Once categories/subcategories were identified, reliability was evaluated with a check-coding (Miles and Huberman, 1994). An inter-coder agreement of 80% was obtained by examining the proportion of agreement out of the total coded for each. Inconsistencies were reconciled prior to analysis.
4. Analysis and interpretation of data: The results related to each category were summarized and representative quotations were identified to illustrate them. The link of each category to the mentioned quotations was facilitated by QDA Miner. When possible and relevant, the relative importance of results was estimated from the proportion of passages coded in different categories or the number of reports mentioning specific themes. Estimations of the relative importance of various issues were not intended as a sophisticated statistical analysis but to provide an overview of the main results and to facilitate, when relevant, comparisons (e.g. between the two sectors of activity). These estimations were facilitated by the measurement tools of the QDA Miner software.

Table 1

Geographical distribution of the analyzed companies.

	Africa	Asia	Europe	North America	Oceania	South America
Mining	25 (23%)	10 (9%)	21 (19%)	26 (24%)	17 (15%)	11 (10%)
Forestry	2 (4%)	3 (6%)	20 (38%)	11 (21%)	3 (6%)	14 (26%)
Total	27 (17%)	13 (8%)	41 (25%)	37 (23%)	20 (12%)	25 (15%)

4. Findings

4.1. Integrative organizing framework of biodiversity practices

The sustainability reports analyzed contain a wealth of relevant information regarding corporate practices for biodiversity. Although these practices are quite diverse, they can be placed along two main axes:

1. The focus on management issues essentially under the responsibility of managers (e.g. organizational aspects, implementation of policies and management systems, training programs) versus technical issues which are more the responsibility of experts and specialists (e.g. biodiversity inventories, implementation of ecological corridors, control of invasive species);
2. The focus on internal and operational actions implemented by the organization itself (e.g. internal procedures, development of a team in charge of biodiversity issues, implementation of performance indicators) versus external actions implemented in partnership with various stakeholders (e.g. donation and sponsorship, research programs in collaboration with universities, voluntary agreements).

The relationships between these two dimensions provide an integrative and comprehensive organizing framework for the main approaches and practices for biodiversity management (see Fig. 1). Four main approaches can be distinguished:

- Implementation of biodiversity management systems;
- Management of relationships with stakeholders;
- Implementation of technical and operational measures;
- Development of partnerships on research and conservation programs.

These approaches are not mutually exclusive but rather complementary. In the following sub-sections findings for each approach will be summarized. Although the qualitative content analysis is not aimed at quantification, whenever possible sector-level differences regarding specific aspects of each approach are given (these differences are summarized in Table 2). No evidence was found for either significant regional differences or changes over time in the analysis, with the exception of the case of certifiable management systems for biodiversity management, whose impact increased in the most recent years of the period analyzed (i.e. in 2011 and 2012). In order to provide a more detailed but brief perspective, Table 3 summarizes the main best practices evidenced in the two sectors. Similarly, Fig. 2 shows some relevant best practices all over the world by region.

Fig. 1. Organizing framework for the corporate practices for biodiversity.

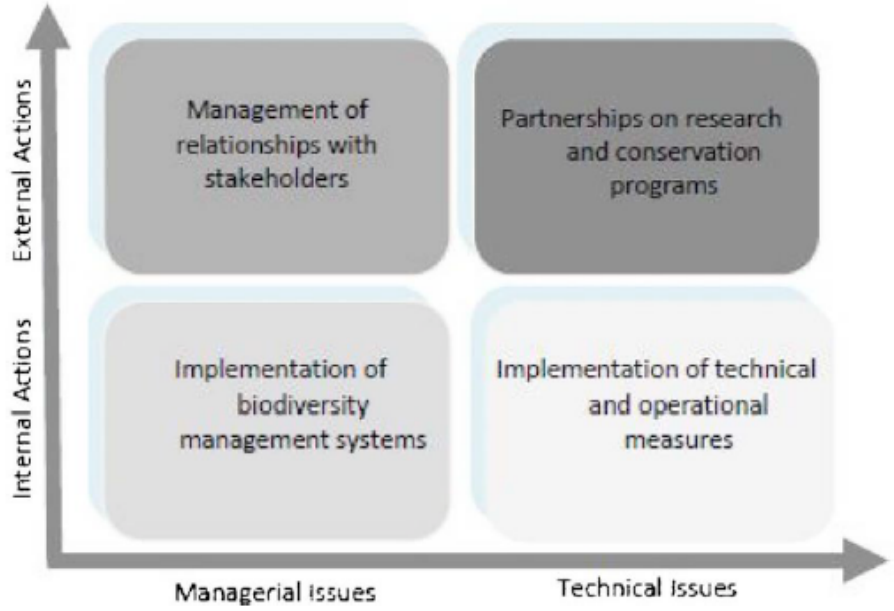

Table 2
Main sector-level differences in approach.

	Forestry	Mining
Implementation of biodiversity management systems		
General Environmental Management Systems (ISO 14001 or simuar)	40%	50%
Certifiable Biodiversity Management Systems (FSC, PEFC or similar)	20%	15%
Management of relationships with stakeholders		
Consultation and exchanges with stakeholders	10%	20%
Implementation of technical and operational measures		
Impact assessments	25%	60%
Implementation of habitat, ecological or wildlife corridors	25%	5%
Partnerships on research and conservation programs		
Programs with NGOs, scientists, universities, etc.	55%	35%

4.2. Implementation of biodiversity management systems

One of the most significant set of actions is related to the implementation of management practices for biodiversity inside the organization. Although few reports use the concept of a biodiversity management system, more than two thirds of reports disclose information on formalized managerial practices for biodiversity similar to those proposed by environmental management systems (EMSs) such as the ISO 14001 standard: implementation of a policy, objectives, plans, programs, control and measurement. These practices are based on the PDCA (plan, do, check, act) model of traditional management and can be implemented by managers. Thus, in this approach best practices such as the adoption of certifiable sectoral

standards for biodiversity management (e.g. FSC and PEFC in forestry) are considered, together with other self-regulation initiatives such as corporative standards, codes, guides, and international guidelines.

Although a few companies, such as Exxaro and Portucel Soporcel, have implemented a specific policy for biodiversity, this issue is more usually integrated into a global policy for environmental or sustainability issues. Nevertheless, other managerial measures are more specifically focused on biodiversity issues. For example, around 25% of all reports mention the development of specific biodiversity action plans (BAPs) including information on threatened species, objectives for conservation, timelines, and resources. Performance indicators and employee training programs related to biodiversity conservation are also mentioned in 15% to 20% of all reports. Interestingly, these managerial measures are rarely integrated into conventional EMSs. Although nearly 20% of reports refer to ISO 14001 certification, very few of them explain how the measures proposed by this standard (i.e. environmental policy, objectives, training programs, indicators, audits) have been used to promote biodiversity actions. Conversely, nearly two thirds of reports refer to the implementation of more specific EMSs, standards, or guidelines explicitly covering biodiversity issues. Some of these management systems have been audited or certified by third-party auditors such as the WHC. Such certification clearly reinforces the legitimacy and credibility of biodiversity management practices:

> "Over the past year, wildlife habitat teams at every Fairmount facility participated in a variety of activities aimed at preserving and protecting natural habitats. Today, seven Fairmount Minerals facilities are certified by the Wildlife Habitat Council (WHC) for commendable wildlife habitat management and environmental education programs" (Fairmount Minerals, 2009 p.50);

> "A programme of third-party environmental management-system audits and biodiversity peer reviews is used to provide operations with guidance on how to improve their performance and achieve full compliance with Anglo American standards, as well as to promote learning and sharing best practices" (Anglo American PLC, 2010, p. 56).

4.3. Management of relationships with stakeholders

Another set of actions that managers may implement are related to stakeholder management. These actions are focused on the improvement of stakeholder relationships more than the implementation of programs for biodiversity in relation to specific corporate activities. First, around 20% to 25% of all reports list donations to and sponsorship of biodiversity initiatives. These initiatives may support specific projects (e.g. conservation of threatened species, identification and preservation of hotspots of fauna biodiversity) or be based on the general financial support of wildlife conservation organizations. Second, between 10% (forestry sector) and 20% (mining sector) of reports cite consultation and exchanges with stakeholders through committees, public hearings and assessment programs. These measures are generally associated with large and specific projects.

Table 3

Summary of a set of relevant best practices of corporate commitment to biodiversity.

	Forestry	Mining
Implementation of biodiversity management systems	● Set a supply policy which avoids the purchase of wood from sources that violate the rules of the FSC and PEFC, particularly as concerns illegal logging without regard to the value of biodiversity. ● Fix and amount of certified wood bought over the 80% to support sustainable forest management and safeguard rich biodiversity in forest operations. ● Use certification as a tool to ensure the sustainability of the supply chain by tracing the origin of wood and promoting sustainable forestry. ● Maintain the Integrated Fauna and Flora Monitoring Program in High Conservation Value Forests and in High Conservation Value Areas.	● Certify facilities against the Conservation Certification of the Wildlife Habitat Council (WHC). ● Develop and adopt a specific in-company Biodiversity Standard to integrate biodiversity into project planning and decision-making (e.g. to assess the direct and indirect impacts of new projects). ● Develop and adopt a specific in-company Biodiversity Standard to minimize adverse impacts on flora and fauna throughout the mine life cycle analysis. ● Develop a mine Closure Toolbox defined against the company biodiversity management standards. ● Set Group biodiversity good-practice guidelines, aligned with the International Council on Mining & Metals (ICMM). ● Set Biodiversity Action Plans based on companies' biodiversity risk profile.
Management of relationships with stakeholders	● Work with public administrations to restore grasslands and open forests impacted by forest encroachment. ● Participation in Sustainable Forestry Initiatives with other companies, NGOs and clients. ● Alliances with managed regrowth wood suppliers to ensure that local diverse forest fauna species are protected. ● Set multi-stakeholder process to identify and protect large intact forests and careful forestry practices. ● Forest landowner education programs, sustainable forestry publications, websites and one-on-one contact related to sustainable wood procurement.	● Promote biodiversity on a project-specific basis, often with an NGO (e.g. Wildlife Habitat Council) or agency partner. ● Development of biodiversity management plans by engagement with local communities and environmental NGOs. ● Community advisory forums, joint committees, and forums such (e.g. Coast Forest Conservation Initiative, Northeast Woodland Caribou Advisory Committee). ● Analysis of the impact of the plantations on local communities with the collaboration of NGOs. ● Action Plans in consultation with local communities and regional/ national biodiversity stakeholders.
Implementation of technical and operational measures	● Various measures when harvesting operations are undertaken (e.g. retaining habitat trees to allow for nesting, retaining seed trees to help regenerate the forest, retain buffer zones alongside rivers, creeks and other key environmental features, and retaining additional protection zones where no harvesting is permitted or where harvesting operations are modified). ● Socio-Economic Assessment tools aimed at improving the social and community concerns for a responsible forestry. ● Reforesting measures (e.g. with ecologically suitable species to restore all harvested areas to healthy, native forests). ● Combat illegal logging, which is a major cause of global deforestation.	● Restore mining sites to an environmentally preferable condition to a standard that exceeds those mandated by local regulations. ● Mine biodiversity management plan aims to conserve the biodiversity in its area of operations. ● Set and operate plant nurseries to provide a source for indigenous seedlings for revegetation and reforestation activities on mine-impacted lands. ● Set ecological corridors (e.g. through its eucalyptus plantations) to reduce species isolation. ● Biodiversity Action Plan and Biodiversity monitoring program proposed in BAP to be implemented. African Rainbow Minerals. ● Strip and stockpile any soil that can serve as a growth medium for plants for future rehabilitation purposes.
Partnerships on research and conservation programs	● Specific fauna surveys in forest deemed likely to contain rare or threatened species. ● Undertake field sampling to determine how much coarse woody debris is being left by companies' logging practices. ● Vegetation Monitoring Field surveys were conducted on the environmental impacts of forestry with the engagement of Universities and Research centers. ● Develop practical ecosystem classification systems with the assistance of Universities and Research centers.	● Foster researchers for biodiversity analysis and receive proposals from Universities and Research centers. ● Commitment to research and NGO forums and conferences (e.g. the World Wild Life Fund) to limit some specific activities (e.g. not to conduct activities in barren-ground caribou calving areas). ● Join extensive research programs to ensure the ongoing survival of the biodiversity threatened by companies' activity. ● Biodiversity peer reviews conducted in conjunction with NGOs (e.g. Fauna & Flora International) and/or Universities and Research centers.

Nevertheless, certain reports state that consultation of stakeholders is part of a more global policy or corporate commitment. For example, in its 2012 report, Weyerhaeuser claims that "one-on-one dialogue", "community consultation" and "participation in local, regional, national and global forums with multiple stakeholders" (p.157) represent an important part of their corporate engagement. Third, around 15% to 20% of all reports refer to participation in voluntary agreements and collective commitments to biodiversity issues with governmental or non-governmental organizations. Lastly, around a quarter of all reports refer to education and awareness programs for local populations and other stakeholders. These programs tend to portray the company as a promoter of conservation values and a driving force for change rather than a possible cause of biodiversity impacts:

"The company also develops a broad program on environmental education with Indian communities that contemplates lectures as well as donation of native species seedlings" (Veracel, 2009, p.31).

"Environmental Education Program: This program seeks to convey to residents the importance of biodiversity conservation and management of environmental impacts, contributing to the strengthening of the relationship between the company and its stakeholders" (Fibra, 2010, p.81).

4.4. Implementation of technical and operational measures

Internal measures for biodiversity may be focused on technical and operational actions, mainly implemented by experts and specialists. These measures vary depending on the sector of activity and nature of operations. They may be implemented during the phases of new project development, operations, or closure of activities.

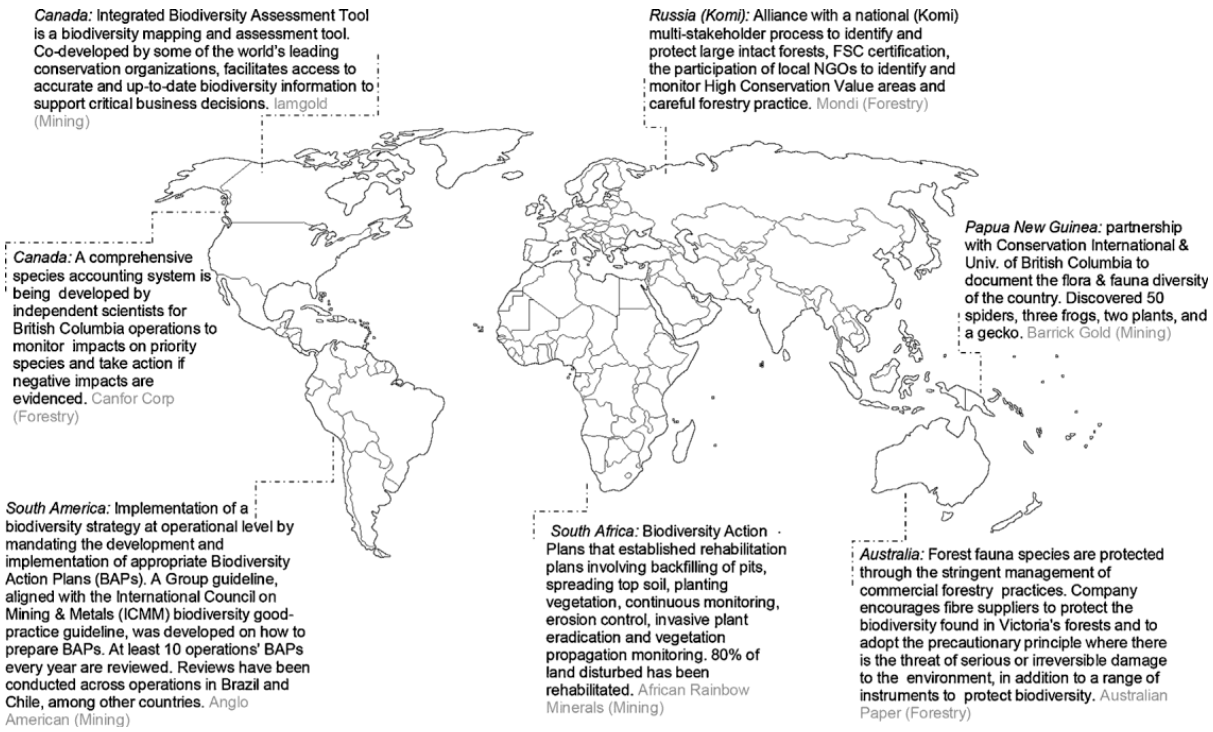

Fig. 2. Selected best practices of corporate commitment to biodiversity by region of origin.

First, a new project development phase often requires impact assessments, which are mentioned in 60% of reports from mining companies, and 25% of those from forestry companies. The importance of these assessments in the mining sector is explained by the more significant environmental impacts related to the extraction of minerals in a specific area. As a result, large mining companies have often implemented internal standards or procedures to systematise the use of biodiversity impact assessments. For example, Barrick's Biodiversity Standard requires the company's operations "to integrate biodiversity into

project planning and decision-making" and "to assess the direct and indirect impacts of new projects (and expansions of existing projects) on ecosystem services" (Barrick Gold, 2009, p.40).

Second, various technical measures for biodiversity can be implemented within operational activities (e.g. implementation of organizational procedures for biodiversity conservation, technology to reduce environmental impacts, protection of specific endangered species). For example, around 25% of reports from forestry companies (and less than 5% of those from the mining sector) describe the implementation of habitat, ecological or wildlife corridors intended to facilitate wildlife movement and reduce the impacts of infrastructure such as roads.

Third, technical and operational measures can be focused on the closure phase of activities, notably in the mining sector. Nearly two thirds of reports from mining organizations refer to environmental and biodiversity measures related to the closure of mining sites, such as reforestation, reintroduction of local species, or management of waste rock dumps and tailings. These closure and rehabilitation measures are often complex, risky and costly, involving environmental, legal, social and financial aspects that can vary significantly from one site to another:

> "Our U.S. operations are subject to various federal and state permitting requirements that include mine closure and mined-land reclamation obligations. These requirements are complex and vary depending upon the jurisdiction" (Freeport Macmoran Cooper, 2008, p.56).

> "Poor or inadequate closure planning can lead to dysfunctional relationships with host governments and communities. Furthermore, without proper planning the company is likely to be exposed to higher costs, missed opportunities, compensation claims and reputational damage" (AngloGold Ashanti, 2010, p.44).

4.5. Partnerships on research and conservation programs

The last category of biodiversity measures observed is related to external actions in partnership with various stakeholders and is focused on technical issues. Most partnerships reported are focused on research and conservation programs involving experts from different organizations. One of the main raisons d'être of these partnerships is the sharing of knowledge and information. Biodiversity initiatives often require considerable technical capabilities and expertise (e.g. knowledge of the native flora and fauna, endangered species, wildlife migration, effects of mining tailings on health and biodiversity) which are not necessarily available within the organization and would be too costly to develop internally. To address this issue, organizations tend to develop research programs with NGOs, independent scientists, governmental agencies or universities. These programs, which are mentioned in 35% of reports from the mining sector and 55% from the forestry sector, are often focused on inventorying and monitoring biodiversity. These inventories can lead to the discovery of new species.

For example, the Barrick Gold's 2009 report highlights that, through a study developed in

partnership with the University of British Columbia and Conservation International, "researchers discovered 50 spiders, three frogs, two plants, and a gecko that are believed to be new to science" (p.38). Technical partnerships with stakeholders can also focus on conservation programs requiring specific expertise, such as the cultivation of threatened plants and seeds in nurseries and their relocation in the wild. One of the most frequent forms of partnership on conservation programs is based on the development and maintenance of protected areas, which is mentioned in around one third of all reports:

> "Establishing new protected areas and adopting forest-management policies require public support and government action, so Weyerhaeuser is also working to engage governments, communities, and indigenous peoples in these efforts" (Weyerhaeuser, 2008, p.59);
>
> "The Diamond Route is the culmination of a partnership between De Beers, the Oppenheimer family and BirdLife South Africa. The project is aimed at maximising the potential of properties owned by De Beers and the Oppenheimer family for conservation purposes. As a result of the project, around 250,000 ha of ecologically protected land has been opened to the public" (De Beers, 2008, p. 88).

5. Discussion and conclusions

Based on the systematic analysis of environmental reports from the mining and forestry sectors, this study provides a global mapping of companies' efforts to manage biodiversity issues. By providing examples of experiences and good practices in this area, the analysis of initiatives implemented in organizations might contribute to better inform managers about the actions that could be implemented in their own organization. Benchmarking and the imitation of practices implemented by other organizations, notably competitors, are one of the main drivers for change and innovation (Bhutta and Huq, 1999; Yang and Hyland, 2006; Sanchez et al., 1999). When they are well documented, sustainability reports can help to identify and analyze the best practices for the environment, which can be useful for managers and researchers alike. Nevertheless, finding, assembling and analysing the relevant information from often lengthy reports that do not necessarily disclose detailed data on biodiversity can be very demanding.

Although certain practices observed in this study − such as the development of policies, indicators, and measures to improve stakeholders relations − have been analyzed in the general literature on environmental management (e.g. Unerman et al., 2007; Christmann, 2000; Delmas and Toffel, 2004), many are quite specific to biodiversity issues or are applied from a different perspective. For example, the development of new management systems focused on biodiversity issues, and distinct from more general EMS such as the ISO 14001 standard, suggests that these issues require specific approaches and practices. Moreover, the study sheds further light on the development, in different sectors of activity, of self-regulation mechanisms to reduce impacts on biodiversity. The role of environmental self-regulation has been analyzed in the literature, notably in relation to voluntary codes of conduct and environmental management systems (e.g. Potoski and Prakash, 2005; Christmann and Taylor, 2001; King and Lenox, 2000). Nevertheless, to our knowledge, it has not been observed in

relation to biodiversity management. In the forestry sector, the self-regulation process is partly driven by market pressures and the development of certifiable standards on sustainable forestry, such as the FSC and the Programme for the Endorsement of Forest Certification (PEFC), which have been adopted by a growing number of companies. Unlike most EMS standards, including ISO 14001, which are limited to organizational practices, these sustainable forestry standards can be used as product labels and therefore have a direct impact on consumers. In the mining sector, market pressures are much lower. Although specific practices for corporate biodiversity management, such as the LIFE certification methodology (Reale et al., 201), are gaining momentum, those certifications have been adopted by a minority of organizations and are not associated with labels and market pressures.

In our opinion, the present study has significant implications for management and elucidates various types of practices for biodiversity that can be implemented by organizations. The diverse corporate practices for biodiversity explored in the study can be integrated in a comprehensive and integrative organizing framework of the main approaches and practices for biodiversity management within corporations. The proposed organizing framework (see Fig. 1) and the findings of the field-work referring to the main approaches (see Table 3) show the variety of practices for biodiversity and highlight the distinction between technical and operational actions and between managerial and organizational actions. Those two main lines of planning and action are under the control of two groups of professionals with different backgrounds and traditions. While environmental experts are generally in charge of technical and operational actions (e.g. biodiversity inventory and monitoring, impacts assessments), managerial and organizational actions (e.g. implementation of biodiversity management systems, consultation with stakeholders, donation and sponsorship) fall more under the responsibility of general managers. The emergence of new certifiable standards for biodiversity, such as the Biodiversity Standard of the European Centre for Nature Conservation and the Conservation Certification of the WHC, reflects the increasing importance of biodiversity for managers and organizations. Those new standards can be used as an institutional tool to promote the social licence to operate, particularly in organizations with high risks for biodiversity. They can also be used as an internal management tool to better integrate biodiversity practices and to strengthen collaboration between managers and environmental experts in charge of technical and operational actions. Overall, the organizing framework that has been presented here can help managers identify relevant approaches and measures according to the objectives, resources and specific biodiversity issues of their organizations. For example, this framework can help organizations evaluate the strengths and weaknesses of their biodiversity and reporting practices. Our study shows that most organizations focus on few measures and very few reports disclose information on the four quadrants of the framework. As a result, it is difficult to find organizations that can be considered good models for comprehensive and substantial biodiversity practices. This situation can be explained by the relative novelty of biodiversity practices in most organizations and the lack of external pressures to implement substantial measures in this area. Moreover, many organizations tend to respond to external pressures by implementing external actions intended to improve the relationships with stakeholders (external-managerial quadrant of the framework) rather than internal and operational measures (internal-technical quadrant of the framework). The portfolio of possible practices for biodiversity is therefore generally unbalanced. The organizing framework proposed in this paper sheds more light on this type of imbalance and can help identify avenues for improvement based on a wide range

of measures implemented in various organizations. The relevance of those measures depends on various factors, including the resources available. For example, large organizations with complex biodiversity issues can implement management systems to better organize and systematise practices in this area. The organizing framework for biodiversity practices can also help stakeholders —including policymakers— focus their pressures for biodiversity on more specific practices depending on the quadrants that are not substantially covered by existing practices. Finally, our study and the proposed organizing framework also helps define responsibilities inside the organization. Managers may be perplexed by the technicalities of biodiversity conservation and the specialized literature on this topic.

The limitations of the study point to various avenues for future research. First, the study has shed light on best practices of two specific sectors with regard to corporate approaches to biodiversity and this research design could give a biased picture if it is not clearly perceived as a compendium of best practices. Second, the field-work was based on the analysis of GRI G3 reports published between 2008 and 2012. This time lag is reasonable considering the time that it takes to publish sustainability reports and it is in line with other works recently published which used the same data-source (e.g. Belkhir et al., 2017; Fuente et al., 2017). Nevertheless, more recent reports based on GRI Version G4, which is supposed to have been used by all GRI reports since January 2016, could be considered, although the requirements and indicators on biodiversity issues (EN11, EN12, EN13, EN14 —see Box 1—) have not changed in this new version. Third, the sample is focused on the mining and forestry sectors. Although various practices seem to be applicable to other sectors, the results of the study are not generalizable to all organizations. Future research could investigate the biodiversity practices in organizations from more diverse sectors of activity to shed more light on similarities and differences. For example, the measures for biodiversity that can be implemented by large retailers, notably through responsible and sustainable sourcing policies, are probably quite specific and have not been, to our knowledge, fully researched. At the same time, the data used in the present study is becoming dated, covering the years 2008–2012. Future research could either try to update the sample, although, as noted above, the main features of the framework used to analyze the biodiversity actions have not changed since 2008. Four, sustainability reports are essentially disclosed only by large organizations. Thus, the biodiversity practices of small organizations, which do not publish such reports, are not covered in this paper. The biodiversity practices of small organizations and the differences between large and small organizations remains a topic for further study.

Future research could complement the results of this study by studying the integration of biodiversity concerns at different steps in the supply chain. The usefulness and reliability of the emerging labels and certification practices related to biodiversity should also be investigated. The transparency of sustainability reports has been criticized in the literature (e.g. Unerman et al., 2007; Cho et al., 2010; Boiral, 2013). Although one can assume that companies are inclined to disclose information on their good practices, including those for biodiversity, the extent to which these practices are implemented in practical terms, as well as their effectiveness, remains uncertain. Future studies could further investigate this issue through cases studies or participant observation. These studies could shed more light on contextual and managerial aspects that are difficult to observe through content analysis, such as the real commitment of employees and the perceptions of stakeholders. The outcomes of organizational initiatives on the local fauna and flora could also be investigated. Nevertheless,

because of its technical nature, geographical constraints and the reluctance of organizations to share sensitive information, this type of investigation in the field would be very difficult to execute and would require an interdisciplinary approach involving experts in ecology, biology and environmental management.

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