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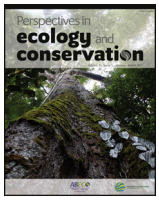

Policy Forums

Appealing the death sentences of the Doce, São Francisco and Amazonas rivers: stopping the Mining Lobby and creating ecosystem services reserves

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ABSTRACT

The Brazilian Mining Lobby uses Congress to weaken the Mining Code. In November 2015, the Fundão Dam, which was retaining a reservoir of mining waste, collapsed in Minas Gerais State, causing the largest socio-environmental disaster in Brazilian history. We propose actions for the restoration of the ecosystems of the Doce River Basin based on maps of taxonomic, functional and phylogenetic diversity of plants as potential providers of vital ecosystem services. To achieve these goals, a databank will be established by compiling existing databases on the vegetation of the Doce River Basin. We propose mapping biodiversity potential for ecological restoration and the conservation of ecosystem functions and services. Such mapping will facilitate the identification and establishment of ecosystem services reserves. Only with this effort will actions to restore and maintain the ecosystem services of the basin be achievable. The same effort can be applied to other impacted river basins such as those of the São Francisco and Amazonas rivers.

During the first centuries of mining exploitation in Brazil, mining profits were based on two factors, in addition to the international prices for the mined products: (1) mining without attention to environmental costs; and (2) the exploitation of slave labor. Thus was the origin of the socio-environmental carelessness of mining in Brazil. During the last 200 years, the Portuguese Empire has collapsed, slavery has been abolished, and environmental concerns have come to the forefront of political debates around the world.

In the 1960s, two sets of laws, the Forest Code and the Mining Code, were created to govern rural and mining activities in Brazil. In 2012, the Forest Code was deeply weakened through the influence of the Farm Lobby on the Brazilian Congress. Thus, after a series of approved amendments, the original Forest Code now accommodates many environmentally damaging activities (Marques et al., 2010).

The Brazilian Congress has handled the Mining Code in a manner similar to that of the Forest Code (Meira et al., 2016). However, unlike the Farm Lobby, the Mining Lobby pumps money into a long and highly branched pipeline that finances electoral campaigns. The main representative of the Mining Lobby in the Brazilian Congress was caught managing money of suspicious origin, was banished from politics in August 2016, and was arrested in October 2016. He had been the speaker of the Brazilian Congress and up to 2013 had presented 89 amendments to the Mining Code (Câmara dos Deputados, 2013), all of them reducing its power and improving profits for mining companies. Despite the speaker's eviction and arrest, all amendments that he presented will be voted on, and the Mining Lobby has already outlined new strategies for the years following the arrest. For instance, the Mining Code has been dismantled in such a way that each alteration can be voted on separately.

Recently, a brutal reality became clear to the world. In September 2015, more than 300 mining employees were found to be working around the clock under conditions considered to be slavery by Brazilian law (Sandy, 2015). The Mining Lobby in the Brazilian Congress is addressing this problem by narrowing the definition of slave labor under Brazilian law (Sandy, 2015). Then, in November 2015, the SAMARCO disaster took place in the municipality of Mariana, Minas Gerais State, Brazil, when the Fundão Dam collapsed and spilled an entire reservoir of mining waste into the Doce River Basin, causing the largest socio-environmental disaster in Brazilian history, with dramatic consequences. SAMARCO, the company

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that owns the collapsed dam, is a joint venture between Vale and BHP Billiton, the two largest mining companies in the world (Meira et al., 2016; Meira-Neto et al., 2016; Nazareno and Vitule, 2016). Now, the Mining Lobby is narrowing the Mining Code's environmental restrictions to make future disasters less inconvenient for mining companies. It is horrifying that after five centuries the way human beings and the environment are exploited has not changed.

Politically and environmentally, there are four important assumptions to consider regarding mining in Brazil: (1) employees of mining companies are generally well-intentioned toward both people and the environment; (2) the majority of Brazilian society is well-intentioned toward people and the environment; (3) the majority of mining activities are conducted by mining executives indifferent to the socio-environmental consequences of mining; and (4) these indifferent mining managers finance indifferent politicians who, as representatives, are voted on by Brazilian society. These four points have profound consequences not only for politics and socio-environmental policies, but also for the conservation of natural resources and the provision of ecosystem services. Well-intentioned people must be aware of the Mining Lobby and deny it influence or, in other words, deny it from purchasing votes. In the Brazilian Congress, representatives must set laws that meet the expectations of Brazilian society. Within mining companies, restrictive laws produced by representatives should create pressure sufficient to replace indifferent mining executives with those of conscience. If the four aforementioned assumptions are not true, then maybe there is no hope to avoid an environmental crisis that threatens the existence of humanity.

Brazilian scientific societies are important to the country for many reasons. Perhaps the main duty of these societies right now is to organize a list of representatives who are working against the socio-environmental expectations of the vast majority of the populace. This list must include presidents, ministers, senators, deputies, governors, mayors, and anyone who ignores public expectations in relation to protecting people and the environment from the greed of the Mining Lobby, mining companies and other negligent actors.

If the socio-environmental consequences of disasters, such as that of the Doce River Basin, are frightening, the potential is even greater for larger basins, such as the basins of the São Francisco and Amazonas rivers. The collapsed dam of the SAMARCO disaster was less than nine kilometers from the divide between the Doce River Basin and the São Francisco River Basin, and less than 60 km from Belo Horizonte and its neighboring cities, one of the largest urban centers in Brazil with a population of more than 4 million people. From the origin of the watersheds between the São Francisco River and the Doce River basins to the sea there is more than 2600 km of, riverbed and riverbank representing the fifth largest river basin in South America. The São Francisco River crosses the driest region of Brazil, where millions of people, and their agriculture and livestock, depend on its water. In fact, there are many dams in the São Francisco Basin, and disasters have already happened there, such as the Herculano Mining disaster in the municipality of Itabirito in 2014. The São Francisco Basin has at least 41 dams retaining reservoirs of mining waste containing iron, gold and even uranium, many of which are unstable; such dams have caused too many disasters in Brazil (Nazareno and Vitule, 2016). A large disaster will be catastrophic, yet it is highly likely in the short term; in the long term, it is almost a certainty if irresponsible mining continues. A huge disaster in the world's largest basin is not unthinkable, either. There are nearly 53,000 active mining licenses in the Amazon Basin (Edwards and Laurance, 2015). A sequence of oil spills have already impacted human beings and biodiversity there (Azevedo-Santos et al., 2016), and much regarding its biodiversity of the region remains a mystery yet to be learned and understood (Oliveira et al., 2016).

Given the current state of mining policy, there are many recommendations that would serve to avoid additional disasters like SAMARCO, or worse (Nazareno and Vitule, 2016; Neves et al., 2016). However, the technology needed to address the current scale of destruction is still lacking. We are still waiting for the support to develop projects to address the SAMARCO disaster. Such support must be tangible to be effective (Meira-Neto et al., 2016), and coordinated by a panel formed by governments, companies, technological institutions, and universities. The development of scientific and technological tools is necessary to address a disaster of such enormous magnitude and scale, and the companies responsible are also responsible for financing the development of such tools.

Regarding the SAMARCO disaster, we propose actions to restore the ecosystems of the Doce River Basin based on maps of taxonomic, functional and phylogenetic diversity of plants as potential providers of ecosystem services. To achieve this goal, a databank will be compiled from existing databases on the vegetation of the Doce River Basin. Then, using the databank, and based on spatial information, we will produce a map of biodiversity potential for ecological restoration and for conservation of ecosystem functions and services. Only when this is accomplished will we be able to use technologies to take action to restore and maintain the ecosystem services of the basin. We propose the fundamental strategy of creating *ecosystem services reserves*, which protect the services and functions provided by the Doce River Basin – or any other basin affected by environmental disasters – based on mapped taxonomic, functional and phylogenetic dimensions of biodiversity. These dimensions of biodiversity are positively related to ecosystem services and functions (Cadotte et al., 2012; Díaz et al., 2005; Duarte et al., 2016; Liang et al., 2016), and the proposed reserves will conserve biodiversity as a potential provider of ecosystem functions and services such as water purification, soil conservation and food production for the future (Li et al., 2011; Neves and Barbieri, 2016). The reserves must encompass the preservation of services and functions of all the different affected ecosystems such as rivers, lakes, swamps, forests, rock outcrops, coastal dunes, coral reefs and mangroves, among others (Lambertz and Dergam, 2015; Meira et al., 2016).

Existing databases are the basis of our proposal for the Doce River Basin, but biodiversity data are still missing for much of Brazil (Oliveira et al., 2016), and around the world. Therefore, existing databases are fundamental, but continued surveys are still absolute necessities.

We are striving to extract practical lessons from the SAMARCO disaster, and are hurrying to better understand our biodiversity before it is lost. We propose that the best way to maximize the protection of the majority of our ecosystem services – to ensure human welfare – is to create a system of *ecological services reserves* for the maintenance of fundamental services based on mapped biodiversity information.

Conflicts of interest

The authors declare no conflicts of interest.

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