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Claudia M. Jacobi, Flávio F. do Carmo & Iara C. de Campos

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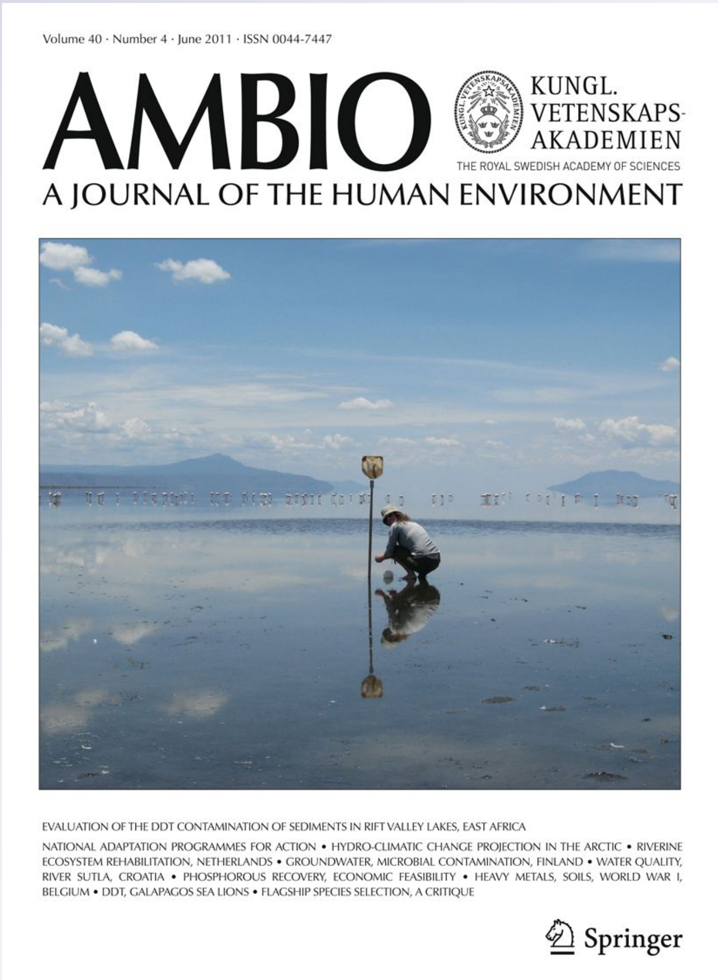

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SYNOPSIS

Soaring Extinction Threats to Endemic Plants in Brazilian Metal-Rich Regions

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INTRODUCTION

Environmental degradation due to mining activities is pervasive in most mineral-rich countries and has been given little attention by the authorities. Surface mining frequently targets very specific and evolutionary unique ecosystems, usually on mountaintops, and is characterized by high environmental impact and irreversibility (Jacobi and do Carmo 2008; Gibson et al. 2010). Recently, the negative impacts of coal surface mining were exposed in relation to ecosystem degradation and damages to human health, underlining the need to improve regulatory measures to mitigate them (Palmer et al. 2010). The loss of plant species associated with mineral-rich areas should be added to the list of ecologic and genetic damages recurrently derived from surface-mining activities.

CONVENTION ON BIOLOGICAL DIVERSITY TARGETS AT RISK

The conservation of metal-rich ecosystems represents a major challenge to the signatories of the Convention on Biological Diversity (CBD). This seminal global effort for protecting and judiciously exploiting biological diversity was opened for signature in 1992 at the Earth Summit in Rio de Janeiro, and is currently endorsed by almost 200 countries. In 2002, special focus was given to the flora, with the adoption of the Global Strategy for Plant Conservation (GSPC), aiming at restraining incessant species loss. In addition, the CBD launched the Programme of Work on Protected Areas (PoWPA) in 2004, which stressed the essential role of national and regional public protected areas networks to guard species against the major threat of habitat loss. This situation is well illustrated by the irreversible mountaintop habitat loss represented by opencast (surface) mining.

Metalliferous (metal-rich) regions worldwide host a flora characterized by high percentages of species with restricted geographic distribution and of exceptional evolutionary value due to their adaptation to high-concentration metal substrates (Brady et al. 2005; Ginocchio and Baker 2004). These regions, in which vast natural areas are being quickly transformed to provide for an unprecedented global demand for metallic ores, are distributed mainly in Australia, Brazil, Cuba, New Caledonia, Sierra Leone, Papua New Guinea, and South Africa (Finger et al. 1999).

THE BRAZILIAN DILEMMA

The continental extension of Brazil, around 8.51 million km^2, favors the existence of a multiplicity of eco- and geosystems. Brazil combines both huge global reserves of metallic ores—and has sustained increasing production annual rates of 10% in the last years (National Department of Mineral Production 2006)—and the most diverse flora in the world (Giulietti et al. 2005). Brazil clearly has a leading role in enforcing the protection and rational use of plant diversity. Mining activities are spread throughout the country with investments of US$ 75 thousand millions for the 2004–2011 period (National Department of Mineral Production 2009). The country's chief investments in production are concentrated on mostly six metallic ores, all extracted by opencast mining: iron, manganese, bauxite, chromium, nickel and niobium. Brazil is among the ten countries with the largest reserves, around 44 $\times 10^9$ tons, and is one of the main global providers of these products (Brazilian Mining Association 2009; National Department of Mineral Production 2010). This macroeconomic scenario has propelled a huge growth of the mining sector, boosted by the expansion of international commerce and unusually high commodity prices. Between 2000 and 2009, the mineral rights (from research licenses to extraction permits) of these six metals increased by 420%, reaching 698,000 km^2, or 8.2% of Brazil. Of this, more than 100,000 km^2 are already in the last licensing stage, and therefore subjected to immediate ecosystem degradation.

These mining permits are concentrated in key plant diversity world centers. On a broad scale, they overlap with the Espinhaço Range, the Cerrado, one of the 34 biodiversity hotspots, and the Amazon Rainforest, one of the 37 Earth's Last Wild Places. On a fine scale, these regions are home to 34 Brazilian key biodiversity areas (KBA), where at least 212 rare plant species occur, roughly 10% of all known rare plant species in the country (Giulietti et al. 2009). Most of these narrow endemics are known to only one location. About 80% of them occur in iron-rich substrates, 10% in substrates rich in chrome, niobium, bauxite, and manganese, and 10% are associated to nickel-rich substrates, where more than 40 metal hyper-accumulating species have been confirmed (Reeves et al. 2007). This last group of plants was proposed as priority for conservation on account of their extremely specialized bioaccumulation mechanisms and remediation potential (Whiting et al. 2004).

In observance of its commitment as a signatory of the CBD, and in view of the rising conversion of vast natural areas, the Brazilian government accelerated the creation of new protected areas that fulfill two main attributes: high biological importance and high vulnerability (Silva 2005). As a result, the surface of 'strictly protected areas'—corresponding to the International Union for Conservation of Nature categories I to III—jumped from 243,000 km^2 in 2000 to almost 500,000 km^2 today (Fig. 1). This commendable accomplishment, however, has proved inefficient to protect metal-rich ecosystems, because not a single protected area was created in metalliferous regions, except for a small state park regained from iron ore mining rights. This, in part, reflects the high cost of indemnifying mineral rights owners. This gap is aggravated by past governmental budget priorities (2003–2010), aimed at accelerating economic growth, and focusing on the development of the mining sector (Regalado 2010). In the last 3 years, the metallic minerals sector received mean annual investments (public and private) of 3.9 thousand million US$, and by 2030 a threefold increase in iron ore and bauxite production, and a fivefold increase in nickel production are expected (Brazilian Ministry of Mines and Energy 2010).

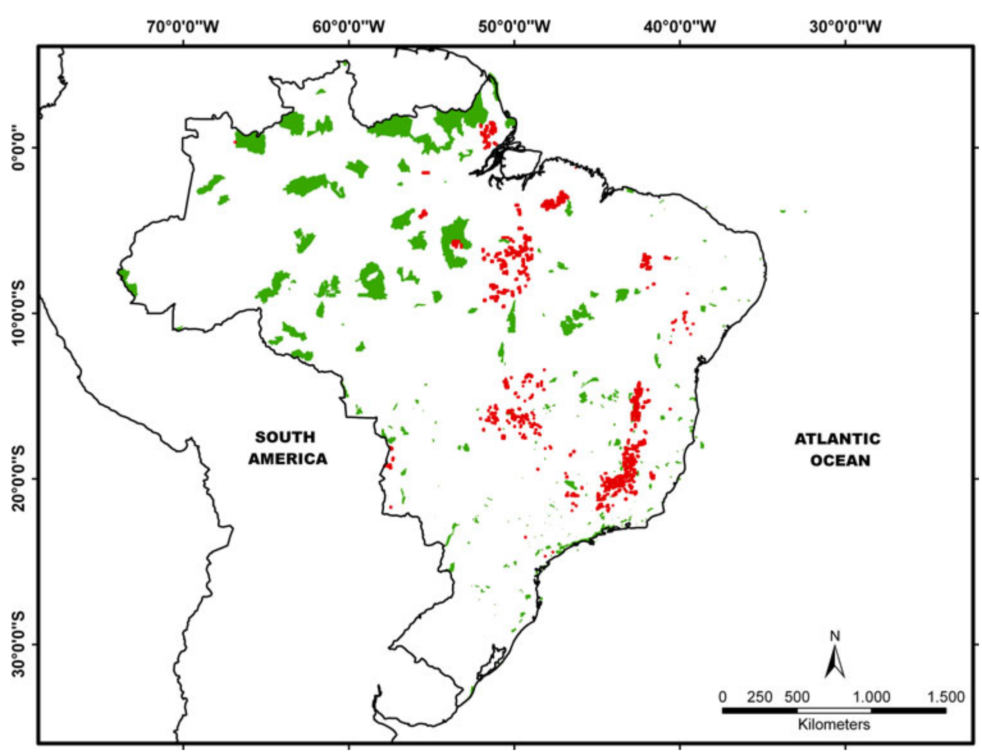

Fig. 1 Distribution of Brazilian strictly protected areas (*green*) and deposits of the chief six metallic ores (*red*). The highest concentrations of these ores overlap with outstanding world centers of floristic richness and endemism: the Espinhaço Range (parallel to the coast), Cerrado (Central Brazil), and Eastern Amazon (Northern Brazil). The largest protected areas are concentrated in the Northern sector, contrasting with the small-sized protected areas in the Central-South. *Sources*: National Department of Mineral Production (2009) and Brazilian Ministry of the Environment (2010)

On the other hand, for the last 8 years, the Ministry of the Environment has worked with a mean annual budget of 820 million US$, or only 0.12% of the federal budget (Brazilian Ministry of the Environment 2009).

INTERNATIONAL SCENARIO AND NATIONAL POLICIES

Currently, there is an increasing worldwide awareness and advancement of scientific knowledge concerning biodiversity associated with metal-rich ecosystems, and the need to preserve them is one of the major challenges to the signatories of the CBD. In Australia—the largest iron ore producer—the urgency to create specific environmental public policies for protecting these ecosystems has already been addressed, in view of their strong correlation with the occurrence of rare plants and of their probable decimation through expansion of iron mining (Gibson et al. 2007). Parallel to the world effort of creating protected areas, several global forums were initiated by the main mining companies to grant sustainable development in accordance to the CBD. One of the most promising efforts to combine preservation of metalliferous regions while still attaining a suitable level of mining profitability is “The Good Practice Guidance for Mining and Biodiversity”, defined by the International Council on Mining and Metals (ICMM), in which the main mining companies must commit to the conservation of biodiversity and the integrated planning of land use.

The creation of public policies for conserving metalliferous ecosystems should become a major priority for Brazilian environmental policy makers in the near future and take into account the current and projected economic pressures and lack of representation of these regions in strictly protected areas. The current scenario points to an increasing and irreversible loss of specialized ecosystems to expanded mining activities, as evidenced by exploitation of remote mountain sites in the Amazon and Espinhaço Range. As from 2007, the areas corresponding to mineral rights of the six metals under discussion have surpassed that of all strictly protected areas.

The persistent lack of protection for metal-rich areas may seriously compromise and undermine the Brazilian credibility of meeting targets established by the GSPC, in particular those related to evaluating the conservation status of plant species, preserving at least 10% of the most relevant ecological regions, and protecting at least 50% of the most important areas for the global conservation of plants. Brazil has an advanced environmental legislation that ensures relevant financial resources originated from compensation of industries whose activities cause environmental impact. It would be wise if part of this income was immediately allocated to creating protected areas within metal-rich regions. Otherwise, continuation of current trends in opencast mining will soon result in the extinction of a significant proportion of Brazil’s total rare plant species catalogued to date, a threatened biological patrimony that demands immediate actions for its preservation.

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Claudia M. Jacobi (✉)
Address: Department of Biology, Universidade Federal de Minas Gerais, Av. Antônio Carlos 6627, Belo Horizonte, MG 31270-901, Brazil.
e-mail: jacobi@icb.ufmg.br

Flávio F. do Carmo
Address: Department of Biology, Universidade Federal de Minas Gerais, Av. Antônio Carlos 6627, Belo Horizonte, MG 31270-901, Brazil.

Iara C. de Campos
Address: Department of Biology, Universidade Federal de Minas Gerais, Av. Antônio Carlos 6627, Belo Horizonte, MG 31270-901, Brazil.