Challenges and Opportunities for Biodiversity Conservation in the Brazilian Atlantic Forest

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Abstract: With endangered status and more than 8,000 endemic species, the Atlantic Forest is one of the world's 25 biodiversity hotspots. Less than 100,000 km² (about 7%) of the forest remains. In some areas of endemism, all that is left are immense archipelagos of tiny and widely separated forest fragments. In addition to habitat loss, other threats contributing to forest degradation include the harvesting of firewood, illegal logging, hunting, plant collecting, and invasion by alien species—all despite the legislation that exists for the forest's protection. More than 530 plants and animals occurring in the forest are now officially threatened, some at the biome level, some throughout Brazil, and some globally. Many species have not been recorded in any protected areas, indicating the need to rationalize and expand the parks system. Although conservation initiatives have increased in number and scale during the last two decades, they are still insufficient to guarantee the conservation of Atlantic Forest biodiversity. To avoid further deforestation and massive species loss in the Brazilian Atlantic Forest, the challenge is to integrate the diverse regulations, public policies, new opportunities, and incentive mechanisms for forest protection and restoration and the various independent projects and programs carried out by governments and nongovernmental organizations into a single and comprehensive strategy for establishing networks of sustainable landscapes throughout the region.

Retos y Oportunidades para la Conservación de Biodiversidad en el Bosque Atlántico Brasileño

Resumen: En peligro y con más de 8,000 especies endémicas, el Bosque Atlántico es uno de los 25 sitios de importancia para la conservación de biodiversidad en el mundo. Actualmente quedan menos de 100,000 km² (cerca de 7%) de bosque. En algunas áreas de endemismo, lo único que queda son inmensos archipiélagos de fragmentos de bosque pequeños y muy aislados. Adicionalmente a la pérdida de hábitat, otras amenazas que contribuyen a la degradación del bosque incluyen – a pesar de la legislación existente para la protección del bosque – la recolección de leña, la tala ilegal, la cacería, la recolección de plantas y la invasión de especies exóticas. Más de 530 especies de plantas y animales ahí presentes están amenazadas oficialmente, algunas a nivel de bioma, algunas en Brasil y algunas globalmente. Muchas especies no han sido registradas en ningún área protegida, lo que indica la necesidad de racionalizar y expandir el sistema de parques. Aunque las iniciativas de conservación han aumentado en número y escala durante las dos últimas décadas, aún son insuficientes para garantizar la conservación de la biodiversidad del Bosque Atlántico Brasileño. El reto, para evitar mayor deforestación y pérdida masiva de especies en el Bosque Atlántico Brasileño, es integrar a las diversas regulaciones, políticas públicas, nuevas oportunidades y mecanismos para incentivar la protección y restauración del bosque y los diversos proyectos y programas independientes llevados a cabo por los gobiernos y organizaciones no gubernamentales en una estrategia amplia y única para el establecimiento de redes de paisajes sustentables en toda la región.

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The Atlantic Forest

The Atlantic Forest is the second largest rainforest of the American continent, once stretching almost continuously along the Brazilian coast and extending inland in the south and into eastern Paraguay and northeastern Argentina. In the past, it covered more than 1.5 million km²—92% of it in Brazil (Fundação SOS Mata Atlântica & INPE 2001; Galindo-Leal & Cámara 2003). It is one of the world's 25 biodiversity hotspots. Even though it has been largely destroyed, it is still home to more than 8000 endemic species of vascular plants, amphibians, reptiles, birds, and mammals (Myers et al. 2000).

Extremely heterogeneous in composition, the Atlantic Forest extends from 4° to 32°S and covers a wide range of climatic belts and vegetation formations, from tropical to subtropical. Elevation ranges from sea level to 2900 m, with abrupt changes in soil type and depth and average air temperature (Mantovani 2003). Longitudinal variation is also marked. Forests further inland are increasingly seasonal, with average annual rainfall dropping from 4000 mm to 1000 mm in some areas of the Serra do Mar (Oliveira-Filho & Fontes 2000; Mantovani 2003). Along with the tropical rainforest, the Atlantic Forest encompasses mixed Araucaria pine forests and distinct Lauraceae-dominated forest in the south and deciduous and semideciduous forests inland. A number of associated formations include mangroves, restingas (coastal forest and scrub on sandy soils), high-elevation grassland (campo rupestre), and brejos (humid forests resulting from orographic rainfall in otherwise semidesert scrub in the northeast of Brazil; Cámara 2003).

The history of the Atlantic Forest has been marked by periods of connection with other South American forests (e.g., Amazon and Andean forests) that resulted in biotic interchange, followed by periods of isolation that led to geographic speciation (Silva et al. 2004). Consequently, the forest’s biota is composed of both old (pre-Pliocene) and young (Pleistocene) species (Silva & Casteletti 2003), and a number of areas of endemism (defined by both old and young species) have been identified (Silva et al. 2004). Although the extent and the current location of these areas are still controversial, at least five can be recognized based on the distribution of terrestrial vertebrates and plants: Brejos Nordestinos, Pernambuco, Central Bahia, Coastal Bahia, and Serra do Mar, all in Brazil (Silva & Casteletti 2003; Silva et al. 2004).

Habitat Loss

More than 93% of the original forest is already gone (Myers et al. 2000), and <100,000 km² of vegetation remains. Some areas of endemism, such as Pernambuco, now have <5% of their original forest (Galindo-Leal & Cámara 2003). Ten percent of its remaining cover was lost just between 1989 and 2000, despite considerable investments in surveillance and protection (A. Amarante, unpublished data). Covering enormous areas, remaining forest has been reduced to immense archipelagos of small to tiny, widely separated forest fragments (Gascon et al. 2000). Forests in the northeast were already largely devastated (cattle ranching and timber shipped to Europe) in the sixteenth century (Coimbra-Filho & Cámara 1996). Dean (1996) identified the proximal causes of habitat loss: overexploitation of forest resources by human populations (timber, fruits, firewood, poaching) and the expropriation of land for human activities (pasture, agriculture, and silviculture). Brazilian government subsidies have fueled agricultural expansion, stimulating high-yield agriculture (sugar, coffee, and soybean; Galindo-Leal et al. 2003; Young 2003). Forest clearance has been especially severe in the last three decades; 11,650 km² of forest have been lost in the last 15 years (2.84 km² per day; Fundação SOS Mata Atlântica & INPE 2001; Hirota 2003).

Deforestation rates defy the legislation that exists to protect the Brazilian Atlantic Forest. The Forest Code of 1965 requires that 20% of the area of any rural property in the region be managed as a legal forest reserve (reserva legal) and that gallery forest (the width determined by the width of the river) and forest on steep slopes (for example) be areas of permanent protection (áreas de proteção permanente) and preserved as such (Schaffer & Prochnow 2002). Federal Decree 750 of 1995 delimited the Brazilian Atlantic Forest and its associated ecosystems and determined that any logging, forest cutting, or disturbance requires prior permission by the appropriate government agencies (reviewed by Cámara 2003).

Many threats persist despite this legal protection; for example, there is a permanent lobby to expand agricultural lands (by changing the legislation governing the legal forest reserve), residential areas, and land settlements. From 1985 to 1998, for example, the National Institute for Colonization and Agrarian Reform (INCRA) converted 50 large rural properties into land settlements, resulting in the clearance of at least 150 km² of forest—10% of the remaining forest in southern Bahia (Rocha 2002). Despite recent improvements in staff capacity, the Brazilian Institute for the Environment (IBAMA) and state agencies are still generally unable to penalize offenders with any alacrity, and only a negligible portion of fines are ever paid (Laurance 1999).

In addition to the relentless loss of habitat, the remaining forests continue to be degraded through the harvesting of firewood, illegal logging, collection of plants and plant products, and invasion by alien species (Galetti & Fernandez 1998; Tabarelli et al. 2004). Poaching continues to deplete wildlife even within protected areas in the regions that contain the last few large forest remnants, such as the cacao-growing region of southern Bahia and the coastal mountain ranges (Serra do Mar) in Rio de

The majority of the species officially threatened with extinction in Brazil are inhabitants of the Atlantic Forest (Tabarelli et al. 2003). Currently, more than 530 plants, birds, mammals, reptiles, and amphibians of the Atlantic Forest are threatened—some at the biome level, some at the country level, and the endemic species at the global level. It is reasonable to speculate that as global warming occurs and habitats change, this already alarming number of threatened species will increase because the widespread fragmentation of the Atlantic Forest limits species migration and colonization necessary for the long-term persistence of their populations.

**Conservation Status**

The Brazilian Atlantic Forest is probably one of the South American regions with the highest number of strictly protected areas (parks, reserves, ecological stations, and private reserves)—more than 600 new areas were created during the last 40 years (Fonseca et al. 1997; Galindo-Leal & Câmara 2003). Large numbers alone are insufficient, however. The system is far from adequate: (1) protected areas cover <2% of the entire biome; (2) strictly protected areas (World Conservation Union’s [IUCN] categories I and II) protect only 24% of the remnants; (3) most are too small (about 75% of protected areas are <100 km²) to guarantee long-term species persistence (Silva & Tabarelli 2000); and (4) among the 104 threatened vertebrate species, 57 have not been recorded in any protected area (Paglia et al. 2004).

The fragility of the Atlantic Forest protected area system is not restricted to its extent and distribution. The lack of trained staff and adequate financing in government environmental agencies severely limits protected area management (Fonseca et al. 1997), and there is conflict with indigenous and local communities over a number of protected areas, both within and around park boundaries (Arruda 1997; Rocha 1997; Galetti 2001). Indigenous peoples have claims that overlap a large number of protected areas in Brazil, notably in two key parks in the Atlantic Forest (Monte Pascoal National Park and Ilha do Cardoso State Park; Galetti 2001).

Much of what is left to preserve in the Atlantic Forest is on private land (Rambaldi & Oliveira 2003), and the establishment of a large and well-designated network of private reserves is now recognized as indispensable in the protection of the region’s biodiversity. The Reservas Particulares do Patrimônio Natural (RPPN) is an official protected area category that private landowners can create voluntarily and in perpetuity. There are now 415 RPPNs in the Atlantic Forest, totaling almost 1000 km² (Vieira & Mesquita 2004). Several, such as the RPPN Frei Caneca in Pernambuco, which protects one of the two known populations of the critically endangered Alagoas Foliage-Gleaner (*Philydor novaesi*) and a number of other threatened birds (Barnett et al. 2003), are of global importance.

Reversing current levels of habitat loss and fragmentation will require improved law enforcement and innovative incentive mechanisms, including those aimed at alleviating poverty and promoting social development. This is essential because more than 100 million people live in the Brazilian Atlantic Forest (Fundação SOS Mata Atlântica & INPE 2001; Hirota 2003), and most forest fragments are privately owned (Rambaldi & Oliveira 2003).

One promising instrument is fiscal compensation, based on area under official protection, given by states to municipalities (ecological ICMS). Since the state of Paraná adopted a program of this sort, the number of protected areas in the state increased by 165% (Alger & Lima 2003). This initiative is expected to enhance the interest of decision makers in creating new protected areas and in implementing and improving the management and administration of existing protected areas (Alger & Lima 2003). Further public policies, incentive mechanisms, and economic opportunities (including the Kyoto Protocol) for the protection and restoration of the Atlantic Forest have been developed recently (Alger & Lima 2003).

**Major Conservation Initiatives**

The massive wave of industrialization, economic development, and environmental degradation that began in Brazil in the 1950s has, since the mid-1970s, resulted in a surge in concern and actions dealing with now grave environmental issues, particularly in terms of effective mechanisms for protecting biodiversity. Initiatives are emerging from public policies and from an escalating involvement of nongovernmental organizations (NGOs) (Jacobi 2003). A brief review of the major conservation programs, projects, and investments in the Atlantic Forest is in Critical Ecosystem Partnership Fund (2001). Here we mention a few.

The National Biodiversity Program is a biome-level conservation-planning initiative, launched in 1996 by the Brazilian Ministry of the Environment and supported by the World Bank and the Global Environment Facility. An important component of this strategy is the Project for the Conservation and Sustainable Use of Brazilian Biological Diversity (PROBIO), for which the Ministry of the Environment has partnered with numerous organizations—universities, research centers, and NGOs—to establish priority areas for conservation in the Brazilian Atlantic Forest. For the Atlantic Forest and southern grasslands, the project involved more than 200 scientists, who mapped 182 priority areas for biodiversity conservation and outlined essential measures required for the protection of its unique biota (Conservation International do Brasil et al. 2000). The results of this project consolidated
a strategy for conservation action at the landscape level that fosters the creation of biodiversity corridors (Sanderson et al. 2003) in three regions: fragments in northeastern Brazil (the Pernambuco Corridor) and southern Bahia and Espírito Santo (the Central Corridor), and corridors uniting the montane forests of Rio de Janeiro and São Paulo (the Serra do Mar Corridor) (Conservation International do Brasil et al. 2000; Fonseca et al. 2004).

The Atlantic Forest is also benefiting through a specific subprogram of the Pilot Program to Conserve the Brazilian Rain Forest (PP-G7), an international initiative approved and supported by the Group of Seven (G7) countries in 1991 (MMA 2004). Although the poor cousin to the Amazonian components, it has resulted in various bilaterally financed conservation projects (so-called demonstrative projects) in a number of states in the south and southeast. An action plan for the conservation of the Atlantic Forest was first drawn up by the SOS Atlantic Forest (Fundação SOS Mata Atlântica), São Paulo, in 1991 (Câmara 1991), but a subsequent plan was produced specifically for the PP-G7 in 1998 and approved by the Brazilian government and PP-G7 participants, including the World Bank, in 1999. The result was a decision, in 2000, to step up investment in this subprogram, initially with the creation of an advisory nucleus for environmental planning in the Atlantic Forest (Núcleo Assessor de Planejamento da Mata Atlântica [NAPMA]) within the MMA’s Secretariat for Biodiversity and Forests. A frenetic agenda of meetings, seminars, and workshops resulted in NAPMA producing a proposal for the PP-G7 Atlantic Forest subprogram. In this proposal, the principal stated objectives are (1) conserve biodiversity in the Atlantic Forest, (2) promote the sustainable and fair use of its natural resources, and (3) promote measures for its restoration (MMA 2004).

Two major, regional, conservation planning initiatives are continuing in the Atlantic Forest. One is the implementation of the Central Biodiversity Corridor in Espírito Santo and southern Bahia, which is sponsored by the World Bank through the PP-G7 Atlantic Forest subprogram in collaboration with Ministry of the Environment, state environmental agencies, and NGOs (Fonseca et al. 2004). This corridor embraces 8500 km² of one of the world’s most species-rich regions (Thomas et al. 1998; Fonseca et al. 2004). The second is the implementation of the Atlantic Forest Biosphere Reserve, created in stages from 1993 to 2001, which extends through 14 Brazilian states and covers 29473484 ha. The essential strategies and objectives are the same—to develop conservation policies and create and manage protected areas on a landscape scale (Corrêa 1995).

At the site level, we highlight the Brazilian World Natural Heritage Sites Program, a 10-year initiative supported by the U.N. Education Scientific and Cultural Organization and a pool of Brazilian institutions. Three of the seven sites in Brazil are in the Atlantic Forest: the Iguaçu National Park (1986; 185,262 ha); Atlantic Coast Southeast Reserves, which includes 29 protected areas (1999; 1,691,750 ha); and the Discovery Coast Atlantic Forest Reserves, which includes eight protected areas (1999; 111,930 ha). This program seeks to develop mechanisms to support key protected areas and to promote training, awareness, and capacity building for the local communities. The second large initiative is promoted by the German Kreditanstalt für Wiederaufbau Bank in close partnership with some state agencies of southeastern and southern Brazil. This initiative has involved a major investment in the implementation of a number of protected areas in the states of Paraná and São Paulo. Currently, the states of Minas Gerais, Santa Catarina, and Rio Grande do Sul are also benefiting.

Initiatives focused on the protection of threatened and flagship species have a long history in the Atlantic Forest. At present, among the most visible and successful are the conservation programs for the four lion tamarins (Leontocebus) and the muriqui monkeys (Brachyteles) (Stier 1999; Kleiman & Rylands 2002). Since the early 1980s, they have matured from focusing on saving an endangered species to focusing on broad multidisciplinary conservation programs. These programs have yielded important insights and innovations for designing community-level conservation strategies, including technical capacity building (e.g., Valladares-Padua et al. 2002; Procópio de Oliveira & Rambaldi 2003).

The CEPF was launched in 2002 to safeguard threatened biodiversity hotspots in developing countries. It is supporting projects in the Atlantic Forest that approach the spatial relationships of land use and public and private protected areas, and the dynamics of forest fragments (CEPF 2001). Within three broad programs (species protection, support for private reserves, and institutional strengthening), support has been specifically provided for (1) innovative economic incentives for conservation; (2) expansion of the protected area system within the biodiversity corridors mentioned previously; (3) implementation of biodiversity corridor conservation strategies; (4) studies to fill gaps in biodiversity knowledge; and (5) public awareness of biodiversity issues. Particular emphasis is placed on ensuring that the initiatives supported complement existing strategies and frameworks established by local, regional, and national governments.

The Way Forward

Although the number and scale of conservation initiatives have grown considerably during the last few decades, they are still insufficient to guarantee the conservation of the Atlantic Forest’s biodiversity. Effective law enforcement is needed as a basic foundation of any conservation strategy. Particularly important is the implementation of the Forest Code, requiring protection and/or the restoration of “legal forest reserves” and “areas of permanent
protection” on all proprieties. This would significantly increase the amount of forest habitat under protection and ensure that rural properties comply with social and environmental goals set forward in the Brazilian Federal Constitution (Alger & Lima 2003). To avoid further deforestation and massive species loss in the Brazilian Atlantic Forest, the challenge is to integrate the diverse regulations and public policies, new opportunities and incentive mechanisms for forest protection and restoration, and various independent projects and programs carried out by governments and NGOs into a single and comprehensive strategy for establishing networks of sustainable landscapes throughout the region (Galindo-Leal 2003; Rambaldi & Oliveira 2003). Such networks, which have been called biodiversity corridors, represent the basic foundation of any effective strategy of biodiversity conservation in highly fragmented biomes (Sanderson et al. 2003).

An integrated strategy to implement networks of sustainable landscapes along the Brazilian Atlantic Forest should follow five general guidelines. First, conservation actions must be planned based on natural boundaries (conservation priority areas or biodiversity corridors), rather than political boundaries (municipalities or states). Second, full collaboration between government agencies and other partners is vital for the design and implementation of sustainable landscapes. Third, large conservation corridors should be anchored on a greatly expanded system of protected areas. Fourth, the restoration of gallery forests is fundamental to establishing connectivity among forest patches and as a means to guarantee that critical water resources are maintained in the region. Finally, the implementation of networks of sustainable landscapes should be monitored using the best-available biological, social, and economic performance indicators to ensure that resources are used effectively.

Literature Cited


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