



Areas between forest fragments under recovery in Extrema, Minas Gerais

Life goes on

Environmental legislation helps reconnect Atlantic Forest fragments in agricultural regions across Brazil

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The restoration of riparian forests on the banks of lakes, rivers, and springs by agricultural workers has nearly doubled the coverage of Atlantic Forest on rural properties in the states of São Paulo, Minas Gerais, Rio de Janeiro, Paraná, and Mato Grosso do Sul over the last two decades. In a study published in the journal *Tropical Conservation Science* in July, researchers evaluated how efforts by private landowners to comply with Brazilian legislation has affected Atlantic Forest cover and connectivity on 2,408 farms scattered over 748,000 hectares of Brazil. The land is mostly used to grow coffee, oranges, and sugarcane, as well as for grazing.

Environmental legislation has fostered the creation of ecological corridors, which are essential to biodiversity conservation. Despite improvements, the total forest cover area on the evaluated properties is still below the 20% that was anticipated by Brazilian law. The research group, coordinated by biologist Ricardo Ribeiro Rodrigues, from the Department of Biological Sciences of the Luiz de Queiroz College of Agriculture at the University of São Paulo (ESALQ-USP), reached their conclusions after analyzing the Brazilian Forestry Code, satel-



Permanent preservation areas (outlined in white) were fragmented in the surrounding region of this sugarcane mill in São Paulo state

Forest cover is still lower than the targets set by Brazilian legislation

lite images, and data from ESALQ-USP's Environmental and Agricultural Adaptation Program, which has been working in partnership with farmers to develop environmental and agricultural planning strategies in Brazil for the past 20 years.

The program began at a time when environmental oversight of agricultural properties in Brazil was becoming stricter. "Many agricultural producers who were worried about complying with legislation asked us to perform an environmental analysis of their farms," says Rodrigues. He explains that farmers are required to maintain or restore riparian forests in permanent preservation areas, as well as a proportion of natural vegetation called "legal reserve," which can be sustainably exploited within limits established by the law. "We began to prepare plans for establishing these properties, taking into account the type of original vegetation to be recovered, the most ap-

propriate methods for restoration, and the presence of low-capacity agricultural areas to be converted into legal reserve." The program has already been implemented on 4.2 million hectares (ha) of agricultural land within the country, with more than 20,000 ha of riparian forest being actively restored and more than 150,000 ha of forest fragments gaining protection and undergoing recovery.

By comparing past and present satellite images, the researchers found that since the ESALQ-USP program was launched, Atlantic Forest cover has doubled in the permanent preservation areas under study, from 57,554 ha in 1999 to 108,337 ha in 2012. "We are mainly talking about the recovery of riparian forests along the banks of rivers and springs, which help protect these bodies of water from silting," explains agronomist Ricardo Viani, from the Center for Agricultural Sciences at the Federal Uni-

versity of São Carlos (UFSCAR), one of the authors of the study.

In addition to greater forest cover, the researchers also found that the Integral Index of Connectivity (IIC), which is used to estimate the level of connection between remaining fragments of native vegetation, significantly increased. At a sugarcane mill in Araras, São Paulo state, for example, the connectivity of forest fragments in permanent preservation areas increased by 236% (*see map*). This led to the formation of ecological corridors and the restoration of animal and insect flows.

"Fragmentation is considered a serious environmental problem because it affects the migratory routes used by animals and plants to move from one area to another, compromising the sustainability of these regions," explains Rodrigues. This can damage a number of ecological functions that are important to natural



In just under a decade, the connectivity between these fragments increased by 236%, enabling the formation of ecological corridors (highlighted in red)

regeneration and forest maintenance, such as pollination and seed dispersal. "Most Atlantic Forest fragments are now partially isolated on private land scattered around the country," says Viani.

LASTING EFFECTS

Permanent preservation areas and legal reserves account for approximately 20% of the land on rural properties. "However, restoration of these environments is essential to the conservation of many species, some of which are close to becoming extinct." In June 2017, after analyzing 22 forest fragments surrounded by sugarcane plantations in the state of São Paulo, a team led by biologist Mauro Galetti, from the Ecology Department at São Paulo State University (UNESP) Rio Claro campus, was able to identify 90% of the medium and large mammals expected to be found in the state. Environmental restoration strategies are

important, but there is a consensus that it is impossible to fully restore past biodiversity levels and ecosystem services.

The animals found included giant anteaters (*Myrmecophaga tridactyla*), tapirs (*Tapirus terrestris*), and peccaries (*Tayassu pecari*), all of which play important roles in native seed dispersal. However, in the smaller forest fragments, only 20% of the species expected in the region were recorded, suggesting that up to 80% of them are locally extinct. The study, published in the journal *Biological Conservation*, suggests that it may still be possible to protect the mammals of Brazil, as long as ecological corridors continue to be recovered, reconnecting these forest fragments.

"Our findings suggest that recovery projects designed to comply with environmental legislation can significantly help to increase the connectivity of agricultural landscapes through the restoration of ecological corridors," says Rodrigues. However, he points out that the total remaining forest cover on the evaluated properties is approximately 13%, which is below the 20% established by law as ideal for avoiding the extinction of certain species in agricultural regions.

According to biologist Ramon Felipe Bicudo da Silva, from the Center for En-

vironmental Studies and Research at the University of Campinas (UNICAMP), the study clearly demonstrates how environmental restoration and conservation can be reconciled with agricultural activity. "The research also highlights that these practices are most effective when they are accompanied by a restoration plan that considers neighboring properties in a joint effort to connect fragments," says Silva, who did not participate in the study. For Rodrigues, compliance with environmental programs by rural landowners has the power to strengthen production chains through environmental certification. "This can increase the added value of agricultural products," concludes the biologist. ■

Project

Ecological restoration of riparian forests, native forests used for economic production, and degraded forest fragments (in PPAs and LRs) based on the restoration ecology of reference ecosystems to scientifically test the precepts of the New Brazilian Forest Code (no. 13/50718-5); **Grant Mechanism** Thematic Project; **Program** Biota; **Principal Investigator** Ricardo Ribeiro Rodrigues (USP); **Investment** R\$1,945,311.16.

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