ECOLOGY

Biodiversity Conservation Research, Training, and Policy in São Paulo

The BIOTA-FAPESP program is linking a decade of research on biodiversity into public policy in the state of São Paulo.

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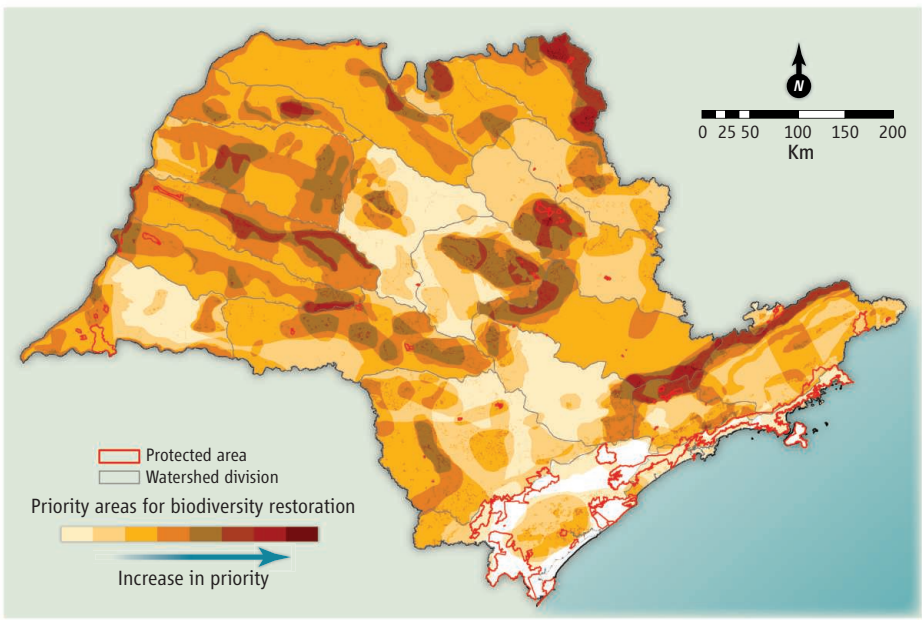
Since the Convention on Biological Diversity (CBD) in 1992, biodiversity conservation (the protection of species, ecosystems, and ecological processes) and restoration (recovery of degraded ecosystems) have been high priorities for many countries. Scarce financial resources must be optimized, especially in developing countries considered megadiverse (*1*), by investing in programs that combine biodiversity research, personnel training, and public-policy impact. We describe an ongoing program in the state of São Paulo, Brazil, that may be a useful example of how conservation initiatives with a solid scientific basis can be achieved.

São Paulo's rich native biodiversity is threatened by changes in land cover and fragmentation (*2*, *3*). This prompted scientists in 1999 to found the Virtual Institute of Biodiversity, BIOTA-FAPESP. FAPESP, the State of São Paulo Research Foundation, is a nonpolitical, taxpayer-funded foundation, one of the main funding agencies for scientific and technological research in Brazil, and a supporter of this program.

The program's scope of research ranges from DNA bar-coding to landscape ecology and includes taxonomy, phylogeny, and phylogeography, as well as human dimensions of biodiversity conservation, restoration, and sustainable use. During its first 10 years, the program supported 94 major research projects, described more than 1800 new species, acquired and archived information on over 12,000 species, and made data from 35 major biological collections available online, a first for Brazilian biological collections.

In 2001, the program launched an open-access, electronic, peer-reviewed journal, *Biota Neotropica* (*4*), to publish research results on biodiversity in the Neotropics. In 2002, the program began BIO*prospec*TA, a venture to search for new bioactive compounds of economic interest that has already resulted in three prototype patents.



Priority areas for biodiversity restoration in São Paulo. The figure also shows the existing network of state parks (red lines) and the state's division of Water Management Units (gray lines). (See SOM.)

Policy Impact

Between 2006 and 2008, BIOTA-FAPESP researchers made a concerted effort to synthesize data for use in public-policy-making. Scientists worked with the state secretary of the environment and nongovernmental organizations (NGOs) such as Conservation International, The Nature Conservancy, and the World Wildlife Fund. The synthesis was based on more than 151,000 records of 9405 species (table S1), as well as landscape structural parameters and biological indices from over 92,000 fragments of native vegetation. Two synthesis maps, identifying priority areas for restoration (see the figure, above) and conservation (fig. S1), together with other detailed data and guidelines (*5*), have been adopted by São Paulo state as the legal framework for improving public policies on biodiversity conservation and restoration, such as prioritizing areas for forest restoration (as one means of reconnecting fragments of native vegetation) and selecting areas for new Conservation Units. There are four governmental decrees and 11 resolutions [see supporting online material (SOM)] that quote the BIOTA-FAPESP guidelines. Before this effort was made, most policy decisions were based on secondary data of heterogeneous quality, not evaluated by a scientific committee.

One of the most striking implementations of BIOTA-FAPESP recommendations is a joint resolution of the state secretaries of the environment and of agriculture to establish an agro-ecological zoning ordinance that prohibits sugarcane expansion to areas that are priorities for biodiversity conservation and restoration (fig. S2). Acceptance of these recommendations may be linked to commercial demands from the international ethanol market, which is increasingly requiring compliance with environmentally sound commodity production practices.

This experience provides an example for other regions. Maps showing priority areas for biodiversity restoration have been produced for the entire area originally covered

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by the Atlantic forest in 17 Brazilian states (*6*). Other Brazilian states have begun long-term programs based on the BIOTA-FAPESP guidelines. The Brazilian National Research Council (CNPq) is planning a similar initiative and, likewise, the U.S. National Science Foundation recently launched the program, Dimensions of Biodiversity.

Keys to Success

What makes a program on biodiversity conservation simultaneously successful in research, training, and policy (*7*)? Several external factors may have contributed to progress thus far: a consolidated network of research institutions, graduate programs, and biodiversity researchers in the state of São Paulo; pressure from commodity markets for certification; increasing social awareness of biodiversity conservation and demand for scientifically sound policies; the large network of 64 state parks and reserves; the political will demonstrated by the state secretary of the environment in supporting the program. Political and economic stability in Brazil were also important factors that allowed FAPESP to make a crucial, long-term (10-year) commitment to funding, providing an average annual budget of U.S.$2.5M.

But particular aspects of the program must also be recognized as important. It is a research-driven initiative—planned, implemented, and coordinated by scientists—in contrast with most previous Brazilian conservation policies. The funding agency, FAPESP, has de facto political and administrative autonomy, which allows it to invest in long-term scientific programs and to ensure quality through a rigid peer-review standard, which is rare in Brazil. The program is evaluated by an international committee every 2 years (*8*). Members of the committee represent diverse areas of scientific expertise; one of the members was from the senior administration of the secretary of the environment, which helped bridge the gap between scientists and policy-makers. The fact that the program is fully based on the CBD, which provides an undisputed legal framework, is another crucial factor.

Strong ties with collaborators are also essential. Many technical staff of both the state and the NGOs developed student projects, supported by the BIOTA-FAPESP program, and became strong allies in producing the synthesis and implementing biodiversity conservation and restoration priorities. Further research by independent, external evaluators is needed.

The program has not been successful in all areas. It failed to translate scientific advancements into teaching material for use in schools. It did not study the entire state well enough to establish priority areas in every watershed, and the marine ecosystems were not studied in the same depth as continental ones. Also, the present distribution and risk of invasive species have not been mapped, and few projects focused on the human dimensions of biodiversity conservation. These gaps were identified during internal and external evaluation in 2009, and are thus priorities in the *Science Plan and Strategies for the Next Decade* (see SOM).

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PUBLIC HEALTH

Global HIV/AIDS Policy in Transition

Resource constraints and peaking of the epidemic should lead to a rebalancing of health assistance for developing countries.

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In 2007, the United Nations Joint Programme on HIV/AIDS (UNAIDS) concluded that "Global HIV incidence likely peaked in the late 1990s" (*1*), due to "natural trends in the epidemic as well as the result of prevention programmes" (*1*). The slow decline in new infections together with a recent rise in antiretroviral therapies (ARTs) halted the rise in the estimated number of AIDS deaths at about 2.2 million per year—equivalent to 4% of all global deaths (*2*). Among adults 15 to 49, the proportion currently infected with HIV (HIV prevalence) plateaued at just under 1% before declining to 0.8% worldwide (*1*, *3*). These trends raise the question of how global health funding should be rebalanced between AIDS treatment and HIV prevention, as well as other health-care investments.

The cost of universal access to treatment is unsustainable. Medical and ethical considerations endow each patient currently on treatment with a life-long "entitlement" to receive at least his or her current treatment regimen (*4*, *5*). Despite rapid growth in resources, less than half of those in need receive treatment, and five new infections occur for each two new persons put on treatment (*3*, *6*). The World Health Organization (WHO) revised its recommendations regarding when to start treatment, raising the threshold from 200 CD4 cells/μl to 350, which could triple the number of people currently needing treatment (CD4 is a type of white blood cell that is killed during HIV infection) (*7*). Reaching these ambitious targets would require the United States to spend half of its current foreign aid budget on AIDS treatment by 2016 and all of it by 2024 (*4*, *5*).

The current allocation of health assistance to developing countries is far from optimal. One would expect resources allocated to a particular disease to be roughly proportional to the potential ill health averted by those expenditures. But the proportion of development assistance for health that is allocated to HIV/AIDS reached 23% in 2007, whereas the proportion of deaths attributable to AIDS in the developing world is less than 5% (*3*, *8*). In a few African countries, foreign HIV/AIDS assistance exceeds the entire budget of the Ministry of Health (*9*). The huge influx of donor funding for HIV/AIDS sometimes crowds out other

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