Among the algae and lianas

Gilberto Stam

Untangled: lianas have helped researchers unravel mysteries behind the origins of the Amazon region's biodiversity

Researchers study the processes of species diversification through surveys of flora

In recent decades, traditional approaches to surveying flora and fauna conducted by the University of São Paulo Biosciences Institute (IB-USP) have been reinforced in an important way, thanks to the use of genetic material in the reconstruction of phylogenies, the branching diagrams that trace the evolutionary relationships between species. As knowledge advanced, however, it became clear that explaining the origin of biodiversity would require a new step, one that could tell the full story about the ecological and geographic changes that led to the great ecosystems, or biomes.

In the case of the region of greatest biodiversity on earth—the Amazon—important parts of this story are now beginning to unfold. "Data gathered from lianas indicate that species diversification in the Amazon region occurred about three million years ago," says botanist Lúcia Lohmann, who specializes in the Bignoniaceae family of plants (which includes

LÉO RAMOS

lianas, ipes and rosewood). "Studies of birds, primates and butterflies also confirm these data," adds Lohmann.

Geological data, in turn, indicate that the Amazon River basin was formed over the same period. A network of rivers traverse the Amazon region, separating populations and interrupting gene flows, thereby causing species differentiation from area to area in a classic example of the dynamics of geographic speciation via isolation as first theorized by Charles Darwin. "In the case of birds," again according to Lohmann, "we have some examples of terrestrial groups whose current distribution fits perfectly into the basin's hydrography."

The lianas offer a good reference for study because they both typify tropical forests and differentiate them from temperate ones. However, because Lohmann had proceeded well into her system of Bignoniaceae classification—up to then a big headache for botanists—she could only use these plants as a group model for the project as a whole. The researcher then redid the entire classification to reflect inter--species lineages. This work, cross-checked with current data on the geographic distribution of the species, led to the identification of the places of origin of numerous lineages, as well as the biogeographic history of that particular group.

The origin of vines, also known as lianas, can be traced back approximately 50 million years to the Atlantic Forest region. A little more than 40 million years ago, these plants arrived in the Amazon region, where they underwent vast diversification. Ten million years later, a liana lineage went on to occupy parts of the Cerrado and rupestrian regions, undergoing profound transformation and adaptation to scrub fire. Some species became shrub, losing their tendrils, while others developed a buried stem that—like a bulb—allowed them to bloom again after a fire. Later, particular species occupied the Atlantic Forest, reaching their current number of 400.

Molecular markers work as species barcodes

OCEANS

Our growing knowledge of biodiversity is not limited to the information we gather on land, however. Research into marine algae through the use of phylogenetic techniques is expanding the number of known species in our seas. "Our diversity has been thoroughly studied but is still not sufficiently recognized," says Mariana Cabral de Oliveira, an expert on algae and head of the Department of Botany. "The number of species has doubled for some groups of algae, and we've even discovered new genera" she adds. Researchers are using molecular markers that work as barcodes to distinguish species that appear morphologically identical, or to unite others that present morphological variations in different environments. Among other findings, along the Brazilian coast the group discovered a species of algae—only a few millimeters in size—found previously only in coastal Somalia and Kenya by an Italian researcher in the 1970s and 1980s. These algae are already a component of the fossil record and play an important role in explaining the evolution of calcareous algae (*Corallinales*).

Despite novel approaches, surveys of flora continue to form the basis of biodiversity studies. The department has already compiled exhaustive lists of flora from the Serra do Cipó and Serra do Grão Mogol—an area of rupestrian vegetation—both in the Espinhaço range of Minas Gerais State and collaborated on the flora of São Paulo, a project that involves work coordinated by the Botanical Institute of São Paulo. The department also published a study of the flora of benthic marine algae (those that remain at the bottom of the ocean) in Brazil, as well as the algae of Abrolhos Reef, in the state of Bahia. "The survey of flora forms the basis of all research concerning plant evolution, since an understanding of plant morphology is required to establish a connection between the ecological and phylogenetic aspects," explains José Rubens Pirani, a professor at the department, adding that "this also contributes to one's academic training, as each student can focus on a particular family or group as he begins his studies."

Surveys have also played an important role in promoting conservation. The flora of the Serra do Cipó and Serra do Grão Mogol served as decisive arguments to convince government authorities to establish parks in these areas. Also, Eurico Cabral de Oliveira's algae studies contributed to the creation of the Marinho de Abrolhos National Park as well as the Atol das Rocas Biological Marine Reserve.

Astolpho de Souza Grotta examines a dehydrated plant in a herbarium in the 1970s

PHOTOS 1 DEPARTMENT OF BOTANY ARCHIVES 2 EURICO C. DE OLIVEIRA / IB-USP

Marine algae diversity remains underestimated despite the tradition of research by the department

The new holistic approach follows along the lines of the tradition of conservation and research into flora

TRADITION

The focus on native biodiversity can be traced back to the work of plant anatomist Nanuza Luiza de Menezes, the first to study a family known only to Brazil—the *Velloziaceae*—of the *Vellozia squamata* group, popularly known as "canela-de-ema", typical of rupestrian vegetation. Menezes, who turned 80 along with USP, studied under Aylthon Brandão Joly, who instituted the department's biodiversity studies in 1940. At Joly's insistence, Menezes abandoned her avocado research (at the time it was common practice to focus on exotic species) and focus exclusively on plants that were native to Brazil. She then became the first researcher to visit the rupestrian areas. "I fell in love with the landscape and the *Velloziaceae*, and focused my research there," she explains. Today Menezes' anatomical studies are one of the pieces of the puzzle that contribute to understanding the evolutionary history of the plants.

The new holistic approach follows along the lines of this tradition of conservation and research into flora. "With the knowledge that we're acquiring, conservation goes from being merely a topic for discussion to having a solid scientific basis," says Lohmann, adding that "it will be possible to pinpoint priority areas and species for purposes of conservation." The project Lohmann coordinates involves a partnership between USP and the American Museum of Natural History in New York, along with 17 other institutions in Brazil, the United States, Argentina, England and Canada. Now in its third year, the thematic project promises the introduction of a new methodology to serve as a standard for studying other Brazilian biomes. ■