

Along the coast of Brazil, 8 percent of a once flourishing forest is left to house a diverse family of bromeliads. A group of biologists scale cliffs and trees to collect these rare beauties

by Gustavo Martinelli
Photographs by Ricardo Azoury

The coast of Brazil was once thick rain forest, a tangle of vegetation that covered 1.4 million square kilometers and rivaled the Amazon in its biodiversity. Only slivers and fragments of this Mata Atlantica, or Atlantic Forest, are left today. A mere 8 percent of the original forest has survived the machetes of sugarcane and coffee growers and the axes of loggers, and it remains scattered along the heavily populated eastern seaboard, some of it protected in reserves, some on private land, some in unlikely stands in and around major cities. These tiny bits of Mata Atlantica make up the most endangered ecosystem in Brazil and are the last refuge for many members of an unusual family of plants, the Bromeliaceae.

Bromeliads—the best known of which are probably the pineapple and Spanish moss—are often beautifully colored flowering plants that are stunning in their diversity. Of the 3,146 species and subspecies in 56 genera, more than half are epiphytes: that is, their roots can attach to tree trunks, rocks or other substrates, and they gather moisture from the air or dew rather than from the ground. Some of these epiphytes hold water in the rosette formed by their leaves and can sustain entire microenvironments. For example, one enormous species that lives in a mountainous, grassy part of the southeastern Mata Atlantica, *Alcantarea imperialis*, can hold 30 liters of water. Researchers have discovered more than 900 organisms—most of them insects, but also frogs, crabs, worms and microorganisms—living in these leafy cisterns. The small creatures and their watery domain, in turn, provide sustenance for other animals, including many birds and some primates, such as the endangered golden lion tamarin.

In certain cases, bromeliads and their inhabitants seem to have co-evolved. One frog, *Hyla venulosa*, hibernates through the dry season of northern Brazil inside *Billbergia zebrina*. By backing into the cavity of the bromeliad and turning its flat broad head at a right angle to its

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BROMELIAD from São Paulo State in the south of Brazil, *Nidularium innocentii*, is, like many members of this family, an epiphyte: it can grow on the trunks of trees or on rocks, among other places. Its roots do not need to be in soil but can absorb moisture from the air.

The Bromeliads OF THE ATLANTIC FOREST







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FRAGMENTS of the Brazilian Atlantic Forest are often found around densely populated areas on the coast. This *Alcantarea glaziouana* (1), for instance, was discovered above the city of Niterói, which is just east of Rio de Janeiro. Retrieving the specimens is not always so easy, however. Often biologists have to climb high trees or scale steep inclines, as Thelma Barbará did when she tried to collect *Dyckia encholirioides* (2). But sometimes the brilliant hues of a bromeliad in bloom help the researchers locate them: *Neoregelia carolinae* (3), *Aechmea nudicaulis* (4), *A. ornata* (5), *Bromelia plumieri* (6) and *Canistrum aurantiacum* (7).



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MANY BROMELIADS, such as *Neoregelia marmorata* (1), create small watering holes that support diverse species, some of which have evolved in conjunction with the bromeliads themselves. Investigators have discovered about 900 organisms living in the cisterns of this family of plants—including insects such as this poisonous spider, which depends on *Hohenbergia* sp. (3) for shelter. Hummingbirds are among the main pollinators of bromeliads; this one is visiting *Vriesea neoglutinosa* (5) in search of food. The other bromeliads shown here are *Bromelia antiacantha* (2), *V. rodigasiana* (4) and *Nidularium* sp. (6).



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body, the frog effectively seals the water inside—thereby ensuring itself and the bromeliad a source of hydration. This frog and others in its genus may have played an important selective role in the evolution of the narrow tubular tank of certain *Billbergia* species.

Almost all bromeliads, epiphytes and soil dwellers alike, grow in the New World. They are found between the northern limit of Virginia in the U.S. and Patagonia in southern Argentina and between eastern Brazil and Juan Fernández Islands, about 300 miles off the coast of Chile. Only one species is found elsewhere: for some unknown reason, *Pitcairnia feliciana* occurs in Guinea in West Africa.

The bromeliads of the Mata Atlantica have not been well characterized—many disappeared without a trace centuries ago—and yet they are considered very important because of the high level of endemism in these areas: in some places, more than 53 percent of the trees, 37 percent of the nontree species and 74 percent of the bromeliads occur only in these fragments of forest. Indeed, some scientists argue that the term “Mata Atlantica” is a bit of a misnomer because it conveys the impression that this is uniform forest, when it actually includes seasonal forest, gallery forest and rain forest. In any case, because bromeliads are important to many other species, they offer a window onto these threatened ecosystems.

To record and study the bromeliads of the Mata Atlantica, my colleagues and I set out two years ago to visit as many remnants of original coastal forest as we could. Over a period of 14 months, we made seven expeditions and traveled some 82,400 kilometers. Of the 1,056 species and subspecies we located in our forays, 66 percent are endemic to the Mata Atlantica; eight genera exist nowhere else. We discovered several species that live only on the peak of a single mountain; we found many others that thrive solely within an area of 20 hectares; and we were lucky enough to witness the three-meter-tall flower of a plant that blooms once in 40 years. Although we are still in the process of describing our inventory and will not know for some time exactly what we have found, we estimate that about 119 of the species we collected are endangered, 188 are vulnerable and 58 are near extinction.

This new collection will help us conserve these bromeliads—and just in time. Conservationists estimate that pressure for development along the coast will soon cost Brazil another 70,000 kilometers or so of Mata Atlantica and that only 2 to 3 percent of the original forest will survive in a few protected areas. Accordingly, we have put the 1,842 specimens we gathered in two specially built greenhouses in the Rio de Janeiro Botanical Garden Research Institute. By maintaining the germplasm, we hope to be able to reintroduce certain species if necessary.

At the same time, we hope to discover more





GIANT BROMELIAD, *Alcantarae imperialis* (1), takes 40 years to reach maturity and then produces flowers that stand three meters high. After flowering, the plant dies, without leaving any offshoots. The team was lucky enough to find this plant in bloom in the state of Minas Gerais. Most other bromeliads bloom every year or every several years, producing seeds or offshoots. Most other bromeliads are also more modest in size than *A. imperialis*, including *Vriesea incurvata* (2), *Quesnelia edmundoi* (3) and *Q. lateralis* (5). The process of identifying the bromeliads the author and his team collected is time-consuming, and they tried to get a head start on the road; this specimen turned out to be *Aechmea castelnavii* (4).



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about the basic biology of this diverse family of plants. Although bromeliads are used extensively by horticulturists as ornamental plants—because of their beautiful rosettes and flowers, which bloom purple, white, red, blue, yellow, orange and even brown—surprisingly little is understood about their reproductive strategies. We know that hummingbirds and bats appear to be the major pollinators of bromeliads in the Mata Atlantica, but only in the past several years have my colleagues and I determined that most of them are capable of self-pollination as well. If we are to save bromeliads—and the many species that depend on them—in the face of ongoing and severe habitat loss, we will need to know much more about how to get them to reproduce successfully.

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The Author and the Photographer

GUSTAVO MARTINELLI and RICARDO AZOURY have collaborated on the bromeliad project since 1997, traveling to as many fragments of the Mata Atlantica as possible to collect and photograph this unusual family of plants. Martinelli (*above*) has worked as a botanist at the Rio de Janeiro Botanic Garden Research Institute since 1972. He received his doctorate in ecology at the University of St. Andrews in Scotland and returned to his native Brazil to study the Atlantic Forest. Azoury, a photographer with Saba Press, specializes in environmental topics. He has worked extensively in the Amazon rain forest and travels widely for his stories: from South Africa to photograph sharks to the Hudson River to photograph Atlantic sturgeon.

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Further Information

THE POTENTIAL ROLE OF THE RIO DE JANEIRO BOTANICAL GARDEN IN CONSERVING THE ATLANTIC FOREST OF BRAZIL. G. Martinelli in *Tropical Botanic Gardens: Their Role in Conservation and Development*. Edited by V. H. Heywood et al. Academic Press, 1991.

REPRODUCTIVE BIOLOGY OF BROMELIACEAE OF THE ATLANTIC RAINFOREST. In *Floristic and Ecologic Aspects of Macaé de Cima Ecological Reserve*. Edited by H. C. Lima and R. G. Bruni. Rio de Janeiro Botanic Garden Research Institute, 1997.

REGIONAL FLORISTICS ON INSELBERG VEGETATION: SOUTHEAST BRAZIL. H. D. Safford and G. Martinelli in *Inselbergs: Biotic Diversity of Isolated Rock Outcrops in Tropical and Temperate Regions*. Edited by S. Porombski and W. Barthlott. Springer Verlag (in press).

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