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PROBABLE DEFICIT OF EPIPHYTIC ORCHID SPECIES ON THE ORGAN MOUNTAIN ANTICLINE (BRAZIL)

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ABSTRACT. The authors have collected data on remaining orchid populations from both scarp (steep slopes facing the sea) and anticline (landward side) regions of the Organ Mountain Range in Rio de Janeiro State in Brazil. The locations and habitats have been recorded, and the numbers of species, their altitude, flowering times, and frequency have been documented. The loss of species from the decimated anticline also has been estimated. A pilot, model scheme is proposed for forest regeneration and the study of orchid recolonization, which would involve educational programs with local schools.

Key words: Organ Mountains, species loss, orchid survey

INTRODUCTION

The authors have been working for the past 30 years on the private Miller's Reserve in Macaé de Cima in the Organ Mountains of Rio de Janeiro State in Brazil to conserve tracts of original montane forest and to document orchid populations in both their original habitats and their movement into regrowth forest at various stages of development. We have described the habitats involved in the work and have listed, described, and illustrated more than 270 orchid species found above 1000 m elevation (Miller & Warren 1996). Since then, we have extended our research to cover much of the Organ Mountain Range at all elevations and are preparing for publication a book on the orchids of the Organ Mountain Range. This work covers the geography, history, and explorers of the Range, the causes of destruction of the area, and the orchid species we have been able to find and describe.

The Organ Mountain chain forms the backbone of Rio de Janeiro State. The steep slopes facing the sea, known as the scarp, receive more than 3 m of rain per year. Although the scarp slopes are badly deforested, the remaining forested areas are the richest in orchid species to be found in the State. It is here that the Miller's Reserve is located. The landward side or anticline, which receives ca. 2 m of rain per year, is more seriously deforested with virtually no original forest remaining except in remote areas free from farming and grazing animals.

A study of the forest cover as it was 200 years ago shows practically 100% forest extending throughout the state of Rio. Estimates made in 1994 show that most forest fragments and remaining forest pockets are located on the scarp slopes. For the Atlantic forest as a whole, estimates suggest that only 4% of the original forest remains and that Rio de Janeiro State is among the best endowed. The causes of deforestation are well documented. First, during the 18th century, the gold and diamond mines in the inland state of Minas Gerais demanded ca. 20,000 mules for transport, and forest was cleared to grow crops to feed the animals. The decline in mining coincided with the rapid growth of coffee farming in 1780–1790. Little was farmed on the scarp slopes both because of the physical problems of their steepness and the high rainfall, which prevented the beans from drying. As a result, the gentler, dryer slopes of the anticline became the coffee farms. Following the coffee came the railroads in the 1830s, which snaked up most valleys where coffee was farmed. Each train station employed 40 woodcutters to provide hardwood for crossties and wood for fuel. Sparks from the wood-burning engines caused forest fires during the dry winters.

METHODS AND MATERIALS

Having explored the scarp slopes, we spent the past 5 years or so widening our approach to the whole Organ Mountain Range. In planning this orchid fieldwork, we traced four hypothetical transects through the Organ Range and set out to look as thoroughly as possible for forest fragments on both scarp and anticline (FIGURE 1). In preparing our current book, we compiled the following data: orchid species, using numbers projected by Pabst and Dungs (1977); orchid habit (epiphyte, terrestrial, and lithophyte); and orchid frequency (common, occasional, and rare). We also compiled data on the sections in the Organ Mountains where orchid plants were found (Anticline: S1, S3, S5, S7. Scarp: S2, S4,

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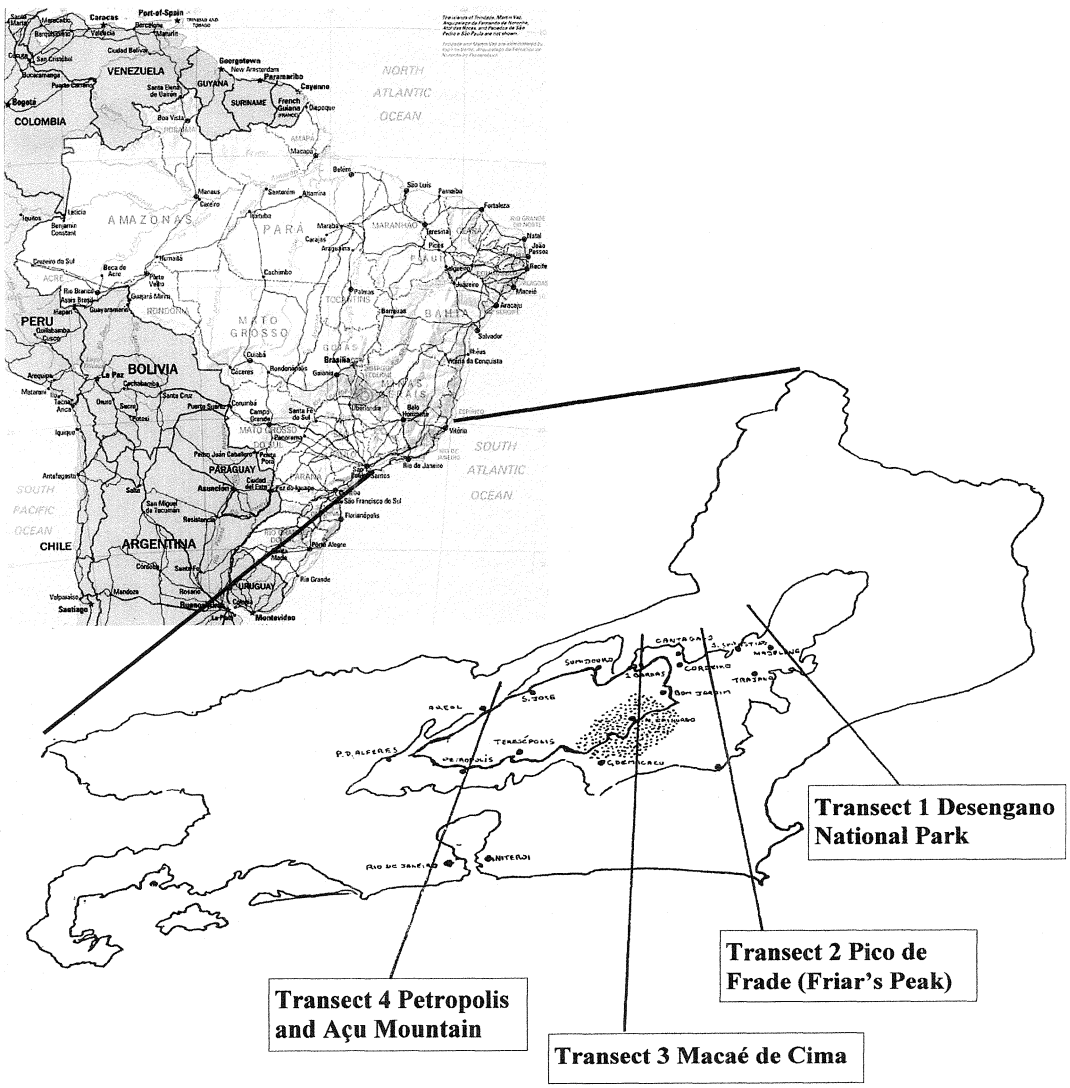

FIGURE 1. Location of Rio de Janeiro State in Brazil (upper left) and enlarged (lower drawing), showing the four research transects established by the authors through the Organ Mountain anticline in their study of orchid species.

S6, S8). Data also was recorded on the elevations at which orchid plants were found and on the flowering periods of the plants.

RESULTS

This report concentrates on the findings of the more devastated anticline areas. Although the anticline has large tracts of poor and useless pasture, valuable orchid habitats are still to be found.

Large relict trees. Such trees are replete with bromeliads and orchids such as *Maxillaria chrysantha, Brassavola* species, *Oncidium robustissimum, Schomburgkia* species, and *Catasetum* species. Plenty of plants are found in the relict trees, but with no trees around, there is nowhere for the orchid seed to go. Such a habitat is referred to as a fragmented canopy (Guevara et al. 1998).

Steep ravines. With a modicum of forest cover on almost inaccessible sides, these ravines are impossible for farming and too dangerous for grazing. Here we have found many orchid species common to the scarp slopes but also plants typical of drier climates. Among the more

TABLE 1. The frequency of orchid species found in the Organ Mountain anticline.

Frequency	Orchid species found	
	No.	%
Common	230	38
Occasional	224	37
Rare	151	25
Total	605	100

spectacular are *Laelia pumila, L. perrinii, Cattleya bicolor,* and *Stanhopea guttulata.*

Oases on the anticline. These areas, often sandwiched between two sugarloaf mountains, collect water and organic runoff and may be very fertile. They also are rich in bromeliads and *Vellozia* species, which help to maintain the humidity in dry periods. Inaccessible to starving animals, they are among the richest orchid habitats on the anticline. Here we have found more than a dozen *Maxillaria* species, *Sophronitis cernua,* species of *Notylia, Cochleanthes candida, Ponera striata, Epidendrum paniculatum, Lanium avicula,* and many others.

Islands of forest. In an area surrounded by occasional raging torrents, we found a 2-ha forest remnant on the banks of a large river. With no bridge, the forest was hazardous to reach, and thus it and probably other similar sites have remained undisturbed. Here we found an abundance of large colonies of *Oncidium baueri* and *Cattleya guttata* with vast colonies of bromeliads, cacti, and curious pleurothallids.

Roadside banks. If steep enough to exclude grazing, roadside banks can be fruitful in our quest for orchids. Among the terrestrial species we have found are *Prescottia nivalis, Habenaria petalodes,* some *Epidendrum* species, and surprisingly *Phragmipedium vittatum* growing with *Bletia catenulata*—an association also recorded by Fowlie (1976).

Treeless rock faces. Angled at ca. 30–40°, these slopes are too dangerous for animals (as evidenced by the skeletons often found at their bases). Fissures in the granite are colonized by grasses and sedges, and among these are found bromeliads, *Vellozia* bushes, and many orchids. The most common being *Pseudolaelia corcovadensis,* which has a symbiotic relationship with *Vellozia, Epidendrum robustum, Cyrtopodium glutiniferum, Oncidium batemannianum, Zygopetalum reginae, Bifrenaria harrisoniae, Laelia cinnabarina, Epidendrum setiferum,* and the curious xerophytic *Pleurothallis teres.*

Collating these data, we recorded the following findings.

TABLE 2. The number of orchid species found in the various sections of the study.

Section	Orchid species found	
	No.	%
I	45	4
II	47	5
III	52	5
IV	98	9
V	158	14
VI	481	44
VII	48	5
VIII	163	14

In our estimation, three quarters of the orchid species found are common or occasional, with the remaining quarter considered rare (TABLE 1).

To an extent, the number of species found in sections V and Vl reflects the fact that we have lived and worked in this region for 30 years or so. Without a doubt, however, section VI has the largest extent of original forest, much of it the least disturbed in the Organ Mountains (TABLE 2). It is also true that section V is the anticline region least propitious for pasture and agriculture because of the steepness of the majority of the valleys.

Not surprisingly, the majority of species are found at 400–1600 m elevation with a peak at 800–1200 m, the lower slopes being almost completely deforested and the higher altitudes being above the tree line (TABLE 3).

Our experiences looking at forest fragments on the anticline have provided an idea of the original landscape. Originally both sides of the range were covered by moist forest, and the orchid content of both would have been similar. The rainfall patterns would have been similar, but with rather less rain on the anticline, and the interior forest humidity also would have been similar. Rivers and streams would have been full, unlike the flush toilets they resemble today. The epiphytic cover of bromeliads—still evident on relict trees and in ravines—would have cre-

TABLE 3. Elevations where orchid species were found.

Elevation m	Orchid species found	
	No.	%
0–400	44	6
400–800	157	20
800–1200	351	44
1200–1600	232	29
1600–2000	11	1
Total	795	100

TABLE 4. Probable deficit of epiphytic orchid species on the Organ Mountain anticline.

Region	Non-pleuro-thallids no.	Pleuro-thallids no.	Total no.
Scarp and anticline	286	216	502
Anticline only	(97)	(45)	(142)
Scarp only	(35)	—	35
Deficit	(154)	171	(325)

ated a suspended but shallow aerial lake that acted as a humidity buffer during the dry season.

Assuming all of the above, we have estimated that ca. 325 species are now very rare or extinct on the anticline (TABLE 4).

DISCUSSION: FUTURE PROSPECTS

Without a doubt, forest regrowth is the most pressing environmental problem in these mountains, particularly on the anticline. We have had considerable experience in monitoring forest regrowth and recolonization by orchids, both natural and introduced, during a 40-year period (Miller & Warren 1995). Based on this experience, we propose an inexpensive model study with both educational and practical benefits.

The area around Nova Friburgo (Section V) is the richest in orchid species on the anticline. The first of these projects involves a school that is adjacent to a piece of worthless pasture but near to a tract of original forest and its seed bank. The scheme involves purchasing or leasing the pasture from the farmer, fencing it off, and monitoring the natural colonization, growth, and humus regeneration over a period of years. We envision the involvement of a local agronomist, who can teach the teachers and schoolchildren the necessary sampling techniques. The results of such a project will show that natural regeneration of native forests is inexpensive and viable and serves the dual purpose of creating forest while educating the next generations about the vital importance of forests. If successful, the model scheme easily could be copied by other schools. In addition, of course, such schemes eventually could provide habitats into which the orchid populations from the fragments of original forest could spread.

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