Ecology and Conservation of Mountaintop Grasslands in Brazil

Geraldo Wilson Fernandes
Editor

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This book is dedicated to my children, Stephannie and Arthur.
I hope that the stories about the exuberant life in the quartzitic and ferrous mountains that I have shared with them in the field has given them an appreciation for this paramount ecosystem. I wish that they emulate those experiences for the next generations to come.

Foreword

This book offers a feast of information on a little-known Brazilian ecosystem. Rupestrian grasslands occur on extremely infertile soils derived from quartzites and ironstones. They are tropical grassy systems embedded in cerrado, the Brazilian savanna, but with some striking affinities to temperate Cape fynbos and Australian heathlands. I first encountered rupestrian grasslands (RG) on a visit to the Sierra de Cipo to view a restoration project. As in South Africa, restoration of the Brazilian montane grasslands had proved inordinately difficult. I had assumed strongly convergent ecologies of the grasslands starting with intense competition from densely rooted grasses. I was completely wrong. The grasses had sparse roots and bare soil patches were ubiquitous. The vegetation, though grassy, had some elements strikingly similar to Cape fynbos. Many shrubs had an ericoid appearance with tiny evergreen leaves but were from tropical families, not temperate ones. Though C4 grasses dominated, many graminoids were from other families in the Poales (Cyperaceae, Eriocaulaceae, Xyridaceae, Bromeliaceae) which, like fynbos Restionaceae, seem to thrive where grasses struggle. As in South Africa, a fire had produced a stunning display of fire-stimulated flowering herbs. But unlike South African grasslands, decades of fire suppression at one site had produced no successional trend to closed forests. Whereas lowland cerrado on oxisols appears to be fire-maintained, the rupestrian grasslands seem to exist because of distinctive soil properties, not fire. It's hard to recall a day with so many preconceptions demolished so quickly.

This book explores these extraordinary grasslands in rich detail. Though embedded in cerrado, they have some striking affinities (and clear differences) with the heathland systems in winter rainfall climates of South Africa and Australia. The similarities are functional, rather than phylogenetic. There are no Proteaceae, Ericaceae, or Restionaceae, just plants that look like them. Like the southern heathlands, the RGs are remarkably rich in plant species accounting for nearly half the diversity of the cerrado, the world's most species—rich savannas. There are also high levels of endemism (30 %) and many species have tiny distribution ranges. RGs resemble heathlands in nutrient acquisition strategies with many species

lacking mycorrhizal associates; yet cluster roots are absent. RGs also resemble heathlands in the preponderance of autochory in striking contrast to the dominance of zoochory in closed forest patches; yet myrmecochory is absent.

The genius of this book is first to recognise the distinct nature of rupestrian grasslands within Brazil, and then to make the links with ecosystems on similar geological substrates elsewhere in the world. The result is a book that deserves a wide readership. Brazil has a venerable ecological tradition starting with Warming and others in the 19th century. Though much research has been published in Portuguese, language is not the only barrier to wider knowledge of these systems. For far too long, grassy biomes have been neglected in favour of tropical forests. This neglect is coming to an end as researchers begin to delve into the lighter side of tropical ecology. Most of the papers cited in this volume are from the 2000s and many from the 2010s. The excitement of discovery is tangible in many of the chapters. New questions are being asked: on the origins, history, affinities, functioning of RGs and their relationships with lowland cerrado and Atlantic forests. What, one wonders, grew on these hostile habitats before the C4 grass revolution of the late Miocene? Several chapters explore predictions of Steve Hopper's OCBIL theory (old climatically buffered infertile landscapes) providing context for novel comparisons with tropical and extra-tropical ecosystems elsewhere in the world. Readers interested in the human ecology of RGs are also well served. There are chapters on the history of land use, traditional and novel uses of the plants from craftwork made with members of the Eriocaulaceae to the potential for novel antibiotics revealed by studies of the rich fungal symbiotic flora.

While RGs have escaped the massive transformation of cerrado to croplands on clay-rich oxisols, their future is far from secure. Besides the general uncertainties of climate change, the extraordinary vegetation of ironstone outcrops is clearly threatened by future mining. On the quartzites, poorly conceived afforestation plans, the spread of alien invasive trees (Pines and eucalypts) and African grasses, and the vexed question of appropriate fire regimes in a legislative environment that has suppressed fires until recently, are discussed as concerns for the future of RGs. As regards the threats posed by increasing tourism, this book will undoubtedly exacerbate the problem. The many photos in the book of the magnificent plants and the habitats in which they grow will surely lead to an influx of yet more visitors keen to explore the rupestrian grasslands for themselves.

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About the Book

This book is a pioneer attempt to bring forward the first synthesis on the rupestrian grassland ecosystem. It brings to light the state of the art information on this ecosystem geological genesis, soil formation, environmental filters, biodiversity, species interactions, and their fine-tuned adaptations to survive and succeed in this harsh environment. The book also brings to light the several human dimensions of the rupestrian grasslands, including the anthropogenic threats that may irreversibly impact this ecosystem and ecosystem services. Whenever possible, the book also addresses several aspects related to conservation of this ecosystem and relates those to human pressure and climate change. While most of the knowledge is concentrated on the quartzitic grasslands of the Espinhaço Mountains, we have witnessed a growing interest and science being produced on the ironstone rupestrian grasslands, which are mostly confined to the Iron Quadrangle and to the Carajás region in northern Brazil. In spite of the exuberance and uniqueness of life found in this ecosystem, the rupestrian grasslands are being converted into novel ecosystems, fragmented and invaded by exotic species at a fast pace. These have resulted in losses of its biodiversity, ecosystem services, and unique identity with still unknown consequences to society. While ecological restoration is still in its infancy and threats augmenting, climate models suggest that threats to the rupestrian grasslands shall worsen in the future. In this way, urgent conservation efforts are needed to save the rupestrian grassland 'nanoforests' and its organisms.