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E. Beck, J. Bendix, I. Kottke, F. Makeschin, R. Mosandl (Eds.)

Erwin Beck • Jörg Bendix • Ingrid Kottke
Franz Makeschin • Reinhard Mosandl
Editors

Gradients in a Tropical Mountain Ecosystem of Ecuador

 Springer

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Cover illustration: Change of land use from pristine forest to grassland, abandoned pastures and secondary forest as characterized by the ^{13}C signatures of plant and soil matter. The different types and intensities of land use represent one of the gradients analyzed by the research teams. Another ecological gradient presented here is the altitudinal gradient on the slopes of the Andes of southern Ecuador: see Logo of the Research Group above. TMF: Tropical Mountain Forests.

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Preface

This book reports on a comprehensive study of a neotropical mountain rain forest, a type of an ecosystem that has received much less scientific attention than the rain forests of the tropical lowlands. Since the local pastoral population is crowded together in the limited accessible regions of the mountains, and because of the fragility of these ecosystems, tropical mountain forests are more endangered by human activities than most of the lowland rain forests. This holds in particular for the evergreen mountain rain forests of Ecuador, the smallest of the Andean countries which now, according to the 2006 FAO report, suffers the highest annual rate (1.7%) of deforestation in the whole of South America.

In spite of human impact the Ecuadorian Andes still represent one of the “hottest” biodiversity hotspots worldwide. There are many reasons for the outstanding biodiversity of that area, and those applying to the eastern range of the South-Ecuadorian Andes are discussed in this book: the steep altitudinal gradient over more than 1500 m, the upwind and lee effects, the extraordinary edaphic and microclimatic heterogeneity, the outstanding vegetation dynamics due to an enormous frequency of landslides, the limitation of nutrients and last but not least the eventful landscape history since the Pleistocene. This biodiversity is fostered and maintained by an incredible multitude of organismic interactions which significantly contribute to the stabilization of an otherwise fragile ecosystem.

A hotspot of biodiversity on the one hand and the highest deforestation rate on the other, this conflict is quite obvious in many valleys in the eastern Cordillera of southern Ecuador. One of these is the valley of the Rio San Francisco in the provinces of Loja and Zamora, where a widely undisturbed natural forest covers the orographically right slopes whereas on the left side the forest has been and still is – illegally – cleared by slash and burn for grazing livestock. The replacement of the natural ecosystem “tropical mountain rain forest” by a completely different anthropogenic system (pastures) within the same altitudinal range and geographic situation, separated by a horizontal distance of barely more than one kilometre provides one of the rare opportunities for a comprehensive comparison of two historically related ecosystems. Such a comparison not only helps to unravel functional interrelations of ecosystem compartments but is also extremely useful in examining the suspected loss of ecosystem services following human impact.

The autochthonous ecosystem “neotropical mountain rain forest” and its anthropogenic derivatives “tropical pastures” and “abandoned tropical pastures” have been studied in an interdisciplinary endeavour by temporarily up to 30 German/Ecuadorian research groups. The research station “Estación Científica San Francisco” (ECSF), situated above the banks of the Rio San Francisco at 1850 m a.s.l. and close to the communicating road between the two provincial capitals Loja and Zamora, was and still is the centre of the ecological studies reported here. It is owned and operated by the foundation “Nature and Culture International” (Del Mar, California) through its Ecuadorian branch “Naturaleza y Cultura Internacional” (Loja). The project started in the late 1990s with an inventory of the biotic and abiotic compartments of the mountain rain forest. From the very beginning the investigations of soils, hydrology, climate, vegetation and fauna of the area were staged along an altitudinal gradient of almost 1500 m as the major guideline. In addition, all subprojects were carried out on the same core area of about 1000 ha, the so-called Reserva Biológica San Francisco (RBSF). In good time the results of the inventories could be used to address also processual relations between specific elements and compartments of the ecosystem, subsumed under the term “functionality”. Challenged by the non-sustainable practices of land use by the settlers, applied research projects were incorporated in the study programme. A gradient of land use intensity was identified which could also be considered as a gradient of human impact or disturbance: starting with a soft use of the natural forest and ending with home garden agriculture. However, due to the use of fire as an agricultural tool, the gained areas, mainly pastures, cannot be used sustainably as they are overgrown by persistent weeds like the bracken fern and amply propagating bushes. These form a new type of climax vegetation which forces abandonment of the areas but also prevents a natural recovery of the indigenous forest. This book therefore also reports on socially compatible measures of forest management and reforestation experiments with indigenous tree species at locations of different land use intensities, especially on already abandoned areas.

Ecuador is tied in a particular way to the name of Alexander von Humboldt whose fundamental description of the land, its people and especially its fauna and flora still merits our highest admiration. Even today, 205 years after Humboldt’s expedition to Ecuador, the majority of its biota may still await scientific description; nevertheless, a study of the tropical ecosystem, like that presented in this book, appears as a consequent further development of Humboldt’s idea of an ecological landscape portrait.

A book written by 104 authors requires a lot of endeavour and a sense of solidarity from the authors, the editors and last but not least the publisher. All of them are mutually grateful to one another, but special acknowledgement merits our assistant editor, Dr. Esther Schwarz-Weig, Mistelgau, for her fruitful suggestions and untiring efforts for the completion of the book. The authors would also like to thank the sponsor of the research, the German Research Foundation (Deutsche Forschungsgemeinschaft), the foundation Nature and Culture International for providing the facilities, in particular the famous station ECSF with the research area, and our counterparts from the Ecuadorian Universities, above all from the Universidad Técnica Particular de Loja

and the Universidad Nacional de Loja. In addition to the authors, numerous colleagues and other highly esteemed persons have contributed to the achievements reported in this book, but as the space of a preface is limited, they hopefully can forgive me for not mentioning them here by name.

Bayreuth, October 2007

Erwin Beck

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