Volcanic Ashes and Landuse in the South of Costa Rica

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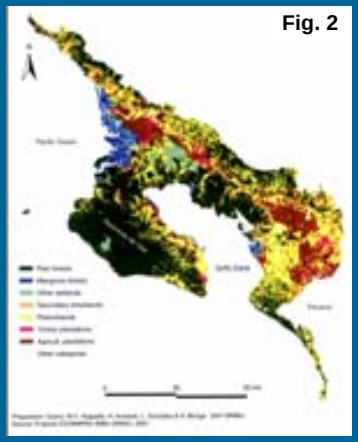
Introduction

The Bosque Esquinas, a tropical lowland rain forest, is part of the Corcovado National Park, situated on the pacific side of the South eastern Costa Rica at the Golfo Dulce (Fig. 1).
In general, more than 60% of Costa Rica are used agriculturally. The most important agricultural crops are bananas, coffee and cocoa (rice, sugar cane, vegetables and various tropical fruits, respectively). In the presented Golfo Dulce area about 45 % is covered by natural forests, which are concentrated in Corcovado and Piedras Blancas National Park (Fig. 2). In total, the given area comprises 38 different ecosystems:
22 different primary vegetation types, 6 secondary forest types and 10 types of cultural ecosystems like pasturelands and plantations. All pastures in the area are located mainly on flat land and are man-made.
The Bosque Esquinas is a tropical lowland rain forest with very high biodiversity. The exceedingly high diversity in trees has been studied in ecologically different plots in the past years by botanists of the Institute of Botany, University of Vienna. Physical and chemical soil properties as well as the mineralogical features of four plots (representative of ridge forest, upper and lower slope forest, and ravine forest) were analyzed in order to find correlations with the distribution of tree species.

Fig. 1

Fig. 2



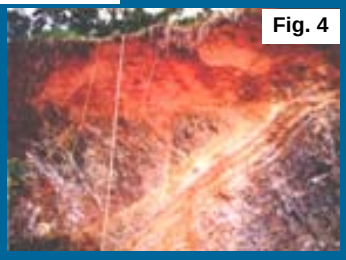
Objectives of the project

- Is the high biodiversity of the Bosque Esquinas based on special soil or rock properties?
- Is the current and future landuse influenced by ash falls?

Investigations so far

Fig. 3

Fig. 4

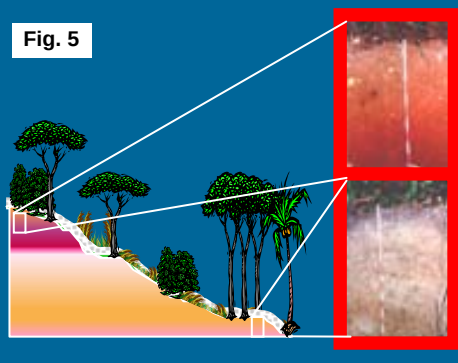


The mineralogical composition of the bulk samples and the clay mineral distribution of the clay fraction were measured by XRD, chemical soil properties were analyzed by ICP OES.
Two different types of parent materials of the soils were found: 1) Tuffites which consist mainly of zeolite minerals and quartz, and 2) basalts with pyroxene und plagioclase as the main components. In addition to different parent material the geomorphologic position of the soils is important. Especially different weathering stages were found. In the ravine profiles (Fig. 3) primary minerals e.g. pyroxenes and plagioclase - originating from the underlying rocks - are present. In the ridge profiles (Fig. 4) only secondary minerals like gibbsite and clay minerals like kaolinite are present. Swellable clay minerals like smectites were found only in the ravine parts.
In the upper part of all soil profiles remarkable amounts of amphibole minerals were detected.

The soils of the sites show significant differences in chemical properties and also display the important influence of topography in this steeply dissected landscape (Fig. 5).
For each plot the soils have been classified according to the international classification system of the "World Reference Base of Soil Resources" and can be characterized as follows:
- Hyperdystric ACRISOL: ridge forest
- Hyperdystric ALISOL: upper slope forest
- Hyperdystric CAMBISOL: slope forest
- Eutric CAMBISOL: ravine forest

Pedological conditions vary within relatively short distances from highly weathered, aluminium saturated clay soils to well structured, nutrient rich soils with high CEC. The differences in the soil properties contribute to the high variability of habitats. The floristic composition, especially the tree species distribution, obviously depends on chemical and mineralogical soil properties.

Fig. 5



Conclusions: The differences in soil properties may provide further explanation for the high tree diversity in the forests. But several questions still remain open, e.g.: Do the amphibole minerals originate from recent volcanic ashes? Due to the absence of amphiboles in the parent material those amphiboles could have only been deposited by aeolian ash transport. If they originate from ashes, where exactly do the ashes come from? How old are these ashes? They might originate from the quite near volcano Baru (Fig. 6). Is current and future landuse influenced by ash falls? If ash falls have occured in the Bosques Esquinas other areas of Southern Costa Rica and adjacent regions must have been influenced as well. The authors plan to investigate these questions. Cooperations with other research groups are very welcome.

Fig. 6