

# LEAF STRUCTURE: COASTAL VEGETATION AND MANGROVES OF VENEZUELA

by

Professor Dr. INGRID ROTH  
*Freiburg (Breisgau)*

With 1 map, 105 figures and 8 tables in the text

1992

---

GEBRÜDER BORNTRAEGER · BERLIN · STUTTGART

## Contents

|                                                                                                             |    |
|-------------------------------------------------------------------------------------------------------------|----|
| Introduction .....                                                                                          | 1  |
| Leaf morphology and anatomy of 22 species of the Venezuelan littoral (Playa Grande)...                      | 3  |
| Site and climate .....                                                                                      | 3  |
| Material and methods .....                                                                                  | 4  |
| Description of the plants studied .....                                                                     | 4  |
| Asclepiadaceae: <i>Calotropis gigantea</i> .....                                                            | 4  |
| Boraginaceae: <i>Heliotropium angiospermum</i> , <i>H. polyphyllum</i> , <i>Tournefortia scandens</i> ..... | 6  |
| Cactaceae: <i>Pereskia grandifolia</i> .....                                                                | 6  |
| Caesalpiniaceae: <i>Parkinsonia aculeata</i> .....                                                          | 6  |
| Capparidaceae: <i>Capparis odoratissima</i> .....                                                           | 8  |
| Convolvulaceae: <i>Ipomoea pes-caprae</i> .....                                                             | 8  |
| Euphorbiaceae: <i>Croton rhamnifolius</i> , <i>Euphorbia buxifolia</i> , <i>Jatropha gossypifolia</i> ..... | 8  |
| Gramineae: <i>Chloris radiata</i> .....                                                                     | 8  |
| <i>Ch. virgata</i> , <i>Setaria macrostachya</i> , <i>Sporobolus indicus</i> .....                          | 9  |
| Malvaceae: <i>Thespesia populnea</i> .....                                                                  | 9  |
| Malpighiaceae: <i>Malpighia glabra</i> .....                                                                | 10 |
| Mimosaceae: <i>Pithecellobium pittieri</i> , <i>Prosopis juliflora</i> .....                                | 10 |
| Polygonaceae: <i>Coccoloba uvifera</i> .....                                                                | 10 |
| Solanaceae: <i>Lycium tweedianum</i> .....                                                                  | 11 |
| Theophrastaceae: <i>Jacquinia</i> sp. ....                                                                  | 11 |
| Leaf size and shape .....                                                                                   | 11 |
| Distribution and size of stomata .....                                                                      | 14 |
| Stomata density .....                                                                                       | 14 |
| Position of stomata .....                                                                                   | 36 |
| Stomata size .....                                                                                          | 37 |
| Leaf anatomy of the 22 species studied .....                                                                | 39 |
| Three herbaceous species from the beach of Cumaná .....                                                     | 67 |
| Description of the three species .....                                                                      | 67 |
| <i>Sporobolus virginicus</i> .....                                                                          | 67 |
| <i>Cenchrus echinatus</i> .....                                                                             | 67 |
| <i>Tribulus cistoides</i> .....                                                                             | 68 |
| Inner leaf structure of the 3 species studied .....                                                         | 68 |
| Chloroplasts of different sizes and their distribution in the cells .....                                   | 70 |
| The time-table of the chloroplasts .....                                                                    | 71 |
| Leaf reduction and transference of photosynthetic tissues to the stem .....                                 | 74 |
| <i>Cercidium torreyanum</i> .....                                                                           | 74 |

|                                                                                                                                     |     |
|-------------------------------------------------------------------------------------------------------------------------------------|-----|
| <i>Cercidium praecox</i> .....                                                                                                      | 75  |
| <i>Parkinsonia aculeata</i> .....                                                                                                   | 79  |
| <i>Pseudobombax maximum</i> .....                                                                                                   | 82  |
| <i>Pedilanthus tithymaloides</i> .....                                                                                              | 85  |
| Discussion .....                                                                                                                    | 89  |
| Plant communities in question .....                                                                                                 | 89  |
| Size and appearance of the plants .....                                                                                             | 90  |
| Root system .....                                                                                                                   | 93  |
| Phenology .....                                                                                                                     | 94  |
| Dispersal and propagation .....                                                                                                     | 95  |
| Leaf size and shape .....                                                                                                           | 98  |
| Leaf position and equifaciality .....                                                                                               | 98  |
| Leaf movement .....                                                                                                                 | 101 |
| Equifacial or isolateral leaves .....                                                                                               | 102 |
| Occurrence and structure of the palisade parenchyma .....                                                                           | 103 |
| The C <sub>4</sub> syndrome .....                                                                                                   | 105 |
| Chloroplast migration .....                                                                                                         | 108 |
| Salt spray from the ocean .....                                                                                                     | 109 |
| Salt factor and succulence .....                                                                                                    | 110 |
| Tissue succulence in the leaves studied .....                                                                                       | 112 |
| Leaf consistence .....                                                                                                              | 113 |
| Xeromorphic characteristics of the leaves studied .....                                                                             | 114 |
| Density, position and size of stomata .....                                                                                         | 118 |
| Glandular hairs and their possible functions .....                                                                                  | 120 |
| Comparison of the foliar structure of the species studied with that of 17 species<br>of Capparaceae .....                           | 120 |
| Coastal vegetation: Final conclusions .....                                                                                         | 122 |
| Four mangrove species from different habitats .....                                                                                 | 130 |
| <i>Rhizophora mangle</i> .....                                                                                                      | 132 |
| <i>Avicennia germinans</i> .....                                                                                                    | 138 |
| <i>Laguncularia racemosa</i> .....                                                                                                  | 143 |
| <i>Conocarpus erectus</i> .....                                                                                                     | 149 |
| Structural variations in the leaves due to changing environmental conditions .....                                                  | 154 |
| Structural variations in the leaves of <i>Laguncularia racemosa</i> and <i>Rhizophora mangle</i><br>under controlled salinity ..... | 156 |
| Mangroves: Final conclusions .....                                                                                                  | 157 |
| Bibliography .....                                                                                                                  | 162 |
| Subject index .....                                                                                                                 | 168 |
| Author index .....                                                                                                                  | 168 |
| Index of scientific plant names .....                                                                                               | 170 |