

Jitka Klimešová

Plant Bodies

How Plant Structures Contribute
to Our Comprehension
of Their Life-History Strategy



Springer

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Comprehension of Their Life-History
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*I would like to dedicate this book to my
father and first teacher of botany,
Vojtěch Piňos.*

Foreword

Wrapping your mind around the dizzying diversity of plant architecture and growth forms can be a daunting task. At first glance, it seems like a straightforward exercise of simply categorizing species into distinct groups such as trees, shrubs, and herbs. But what about cacti and aquatic plants, how are they to be classified? Many species seem to break the rules. When you commit to deeply exploring this wonderful world of botany in detail, the number of rule breakers appear to multiply exponentially. Because of this, plant growth form classification schemes blossomed into a cottage industry with little consensus, and the secret to understanding the evolutionary basis of plant architecture remained shrouded in mystery. Solving this mystery is the basis of this book.

The author, Jitka Klimešová, learned right away that the mystery could not be solved by simply looking up taxonomic descriptions of species. Such descriptions were not just incomplete, they were contradictory. Even basic theories for explaining the origin of different plant organs had not been fully resolved. Just when we thought that leaves, stems, and roots were distinct organs, botanists discovered too many mischievous species that blended their organs into continuous features. As is often true in dynamic fields of science, our original ideas did not survive scrutiny. Many botanists around the world have worked hard to propose generalizable frameworks to make sense of the diversity of plant forms. Many of these pioneering scientists are characters in this story and are memorialized artistically by the author.

Students of botany have lacked a standard reference to start their journey toward understanding the architecture of plants. Thankfully, Jitka Klimešová has synthesized this scattered literature into a framework that can be used by botanists around the world. Importantly, she moves the discussion from descriptive observations toward an enterprise to understand how this diversity of morphology drives variation in function. This book marks the beginning of an important field of research she calls functional morphology, with a call to go belowground and integrate what we have learned aboveground into a comprehensive understanding of the whole plant body.

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27th April 2025

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Preface

When I delved into my self-study of plant morphology, it was with a clear goal to accurately describe the diversity of clonal growth organs among plants of Central Europe. Initially, I imagined that I would simply find descriptions of clonal growth organs for individual species in books and list them in a table. Based on the data from the table, I wanted to calculate the types of morphological categories and the number of species in them. I went through a lot of literature published from the mid-nineteenth century to the present, written in several languages. I started with a Russian-written ecological flora of the Moscow region, then I moved on to English and German literature. The first problem was that species for which I found multiple descriptions often had different descriptions in each source, and the second was that the number of categories was enormous. There are many classifications of morphological categories, and authors apply them more or less carefully to describe species. To cope with these problems, I started collecting plants and tried to understand their morphology on my own. For this purpose, I began drawing plants, especially their belowground organs, which I aimed to understand. Drawing became my passion. I spent every free moment digging up and drawing plants. I was on maternity leave at the time, so in the morning, during walks with the children, I collected plants, and when they napped after lunch, I drew them.

When I returned from maternity leave, I had collected material for our entire flora. In 2003, we were invited with colleagues to participate in building a European database of plant functional traits. Within this project, I collected more data, clarified how to define the traits I wanted to describe on plants, and filled the CLO-PLA database, which is freely accessible on the internet. My interest in plant shapes could have ended there, but I gradually began to realize how little knowledge of plant morphology there is among ecologists and how this lack of knowledge is limiting their ability to understand various problems in plant ecology. This led me to start a course on Plant Architecture. However, only a few students take such a course, and I was not satisfied with that. With colleagues, we established an international week-long course for young scientists, but even that is not enough. I decided to write my course as a book, which I hope will be read not only by students but also by researchers who deal with plant ecology. Hopefully, this book will help them better understand plant shapes, and the dependent ecological functions, and will inspire them in their own research.

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Introduction

Ecologists have a hard time dealing with plants and must be very inventive in their research. Everything in the plant kingdom takes a long time and is often hidden belowground. With plants, we cannot compare strategies by describing what prey they hunt or how much time they spend on various daily activities; we often help ourselves by attributing functions to plant shapes. Surely you agree that a tree, shrub, or herb have different life strategies, or that a leaf, stem, and root have different functions. But what about different types of stem branching? Does it also have any ecological significance?

I want to introduce you to the shape of plants and its significance for plant ecology here, with an emphasis on seed plants and their vegetative organs (flowers, fruits, and seeds will only rarely be mentioned). In the first part, I will focus on the overall appearance of the plant: the growth form. In the second part, I will focus on comparative morphology, that is, on the basic organs, such as the root, stem, and leaf, and their transformations and functions. In the third part, I will discuss recurring motifs in the structure of the plant body: buds, twigs, and shoots, that is, the architecture of the plant. The aim of all this is to show what we already know about the relationship between form and function, to reveal what we do not know, and to suggest how we might further use information about the shape of the plant body in ecology.

The chosen approach has its advantages and disadvantages. As an advantage, I can present ecological questions from an unusual angle, to show connections that remain hidden if you do not know how the plant body is constructed. The disadvantage of this approach is that some topics—ecological functions such as regeneration after disturbance or clonal growth—will be discussed repeatedly. For example, I will mention the reaction of plants to disturbance in my discussion of growth forms because their definition is partly based on how plants react to disturbance. I will return to this topic in the chapter on morphology, because some belowground plant organs serve for regeneration after plant injury. Finally, I will mention disturbance in the chapter on architecture because the supply of buds from which the plant regenerates is largely determined by its architecture. I believe that these repeated returns to a certain topic will help present the ecological function each time in a new light and will not be too disruptive.

The path to understanding plant shapes and their function relates to the turning points in the lives of researchers, and these are often influenced by historical events. Therefore, I have taken the liberty to supplement the text with brief profiles and illustrations about the lives of some researchers who have studied the shapes of the plant body.

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