

Preface

As plant biologists enter a new era in which comparative genomics promises to address fundamental questions in botany, such as unravelling metabolic and regulatory networks, the inestimable value and usefulness of robust systematic studies quickly become clear. In simplest terms, systematic studies can indicate which genomes in the plant kingdom to search, sample, and study for the answers to questions relating to the evolution of chemical and physical structures and their synthesis or ontogeny. After several model and crop species have been sequenced, the next phase of plant genomics will necessarily build on new phylogenies that are greatly assisted by molecular techniques and whose interpretation and applications will be guided by "traditional" botanical knowledge.

Plant systematics was long considered to be an "artful science," but well before the application of molecular techniques to systematics, semisubjective authority was supplanted by rapidly developing analytical methods and the computers that run them. In the age of genomics, the art of modern plant systematics lies in its applications and its links to other disciplines; conversely, the applications of genomics to an expanding array of plant species will be grounded in plant systematics, itself still based largely on field work and knowing the plants. Much is new—and much is not—for plant systematics in the age of genomics. Molecular techniques have introduced vast and numerous independent data sets, and there are continual advances in preparing DNA, sequencing genes, aligning sequences, and designing software for interpreting the data. As a consequence of this increased accessibility, mainstream plant systematics has been able to incorporate molecular approaches, which no longer occupy a separate domain but rather constitute part of the normal repertoire of skills for systematic botanists. The special usefulness of molecular approaches in analysing phylogenetic relationships at higher ranks has resulted in still unresolved but clearly better and dramatically new classifications, discussed below. These developments, coupled with other advances in phylogenetic analysis, now place systematics in a key position among

other disciplines in biology, with increasingly diverse and powerful applications in investigations of biosynthetic and developmental pathways, natural products, origins and migrations of evolutionary lineages, and conservation. Whether it occupies the hub or spokes, more than ever plant systematics is needed to make the genomics wheel roll. The biggest non-news is that molecular techniques have in fact not revolutionized methodologies in systematics. Instead, molecular data have rather rapidly been accommodated in existing analytical methods whose revolution—cladistics—had come and for some time had been the new order.

Once computers could be harnessed to execute complex pattern analysis and resample data thousands of times for statistical rigor, phylogenetic systematics or cladistics had overruled the authority represented by a few great intellects in favour of greater objectivity and more reproducible results. Systematists were already wrestling with issues about adequate sampling and about merging data sets before DNA sequences began flooding the market. News perhaps for non-systematists, but not for systematists, is a greater need than ever before for traditional botanical knowledge and activities. Field work, collections, diversity surveys, floras, monographs, and conservation efforts still provide the primary means for working with the physical materials needed for investigations in systematics and genomics as well as for formulating hypotheses, interpreting the results, and making useful applications of those results, thereby linking the genes to the whole plants and the world outside them.

This book provides updated information on various aspects of this subject. This book will be invaluable to students dealing with this topic.

—Editor