

Preface

Over the past century, books on basic research into ferns and lycophytes have largely focused on particular topics, floras, or methods of study. Setting the stage for understanding fern structure and evolution was a three-volume masterpiece by Frederick O. Bower, published between 1923 and 1928 by Cambridge University Press, and titled simply, *The Ferns*. In 1950, Cambridge also published Irene Manton's magnum opus, *Problems of Cytology and Evolution in the Pteridophyta*, establishing a new era of exploring the genetics and evolution of ferns and lycophytes. Books concentrating on laboratory studies have included Adrian Dyer's multi-authored *The Experimental Biology of Ferns* and Valayamghat Raghavan's *Developmental Biology of Fern Gametophytes*. Others, such as the detailed and well illustrated *Ferns and Allied Plants* published in 1982 by Rolla and Alice Tryon, were more systematically focused. Several books have captured the exchange of information at international conferences such as *The Phylogeny and Classification of Ferns* edited by A. C. Jermy, J. A. Crabbe, and B. A. Thomas in 1973, the *Biology of Pteridophytes* edited by A. Dyer and C. Page in 1985, a 1989 volume *Systematic Pteridology* edited by K. H. Shing and K. U. Kramer and based on a Beijing conference, and *Pteridology in Perspective* edited by J. M. Camus, M. Gibby, and R. J. Johns in 1996. These and others have synthesized ideas on particular areas of basic research, and helped to maintain excitement and communication about fern and lycophyte biology.

Distinctive from these books was one edited 70 years ago by Frans Verdoorn entitled *Manual of Pteridology*. This volume brought together authorities including Ingrid Andersson-Kottö, Lenette Atkinson, Carl Christensen, W. Döpp, Eric Holtum, and W. Zimmerman, who provided state-of-the-art summaries of topics ranging from chemistry, morphology, and anatomy, to cytology, genetics, and tropisms, and even synthesizing topics such as ecology, geography, paleobotany, classification, and phylogeny. In the tradition of Verdoorn's broad perspective, we have assembled contemporary scholars to present a broad

perspective on the *Biology and Evolution of Ferns and Lycophytes*. Instead of using the classic name “pteridophyte,” we chose this title because the preponderance of current evidence indicates that “pteridophytes” do not exclusively share a common ancestor. We wanted to incorporate all of the seed-free vascular plants, and we wanted to represent them using labels that captured their diversity without applying overly specialized names. Thus, we consider “ferns” to be equivalent to the “monilophytes” of other authors, and lycophytes to include the extant members of the Lycopodiaceae, Selaginellaceae, and Isoëtaceae.

We have organized our book into major topics that build from the individual and its biochemistry and structure, to genetics and populations, to interactions among individuals and the conservation of species, and conclude with perspectives on evolutionary history and classification. Beginning with a view from the laboratory, M. Wada summarizes decades of studies that have employed fern gametophytes to elucidate basic aspects of plant responses to light, as well as insights on cell structure and function. E. Sheffield shows how ferns can illuminate critical components of phase changes during plant life histories, and reviews the importance of studying species with independent gametophytes and sporophytes. R. Imaichi provides a tour through the anatomy and structure of fern and lycophyte sporophytes, concentrating on the self-perpetuating meristem and its role in establishing plant organization. Moving on to a consideration of genetics and reproduction, T. Ranker and J. Geiger review the dynamics of population biology and show how genetic variation is maintained and partitioned in nature. Integrating physiological responses and genetic consequences, J. Schneller reviews studies of antheridiogen, from both a laboratory and a field perspective. As analysis of entire genomes has become possible, studies of both chloroplast and nuclear DNA sequences have provided remarkable genetic and phylogenetic insights. P. Wolf and J. Roper summarize our current knowledge of the relatively compact chloroplast genome, and T. Nakazato and his colleagues provide new perspectives on the large and complex nuclear genomes of ferns. Shifting to ecology, K. Mehltreter reviews the adaptations of ferns to their environments, and D. Farrar and his co-authors develop provocative insights on the importance of studying gametophytes in their natural habitats. Given the critical topic of the ongoing mass extinction of species, this section concludes with a consideration of conservation, from both field and *ex situ* points of view. In the final section, C. Haufler considers the current status of defining species and discovering their origins, while G. Rothwell and R. Stockey demonstrate the value of fossil plants in considering the evolutionary history of ferns, synthesizing new data from recent discoveries with that from earlier material. R. Moran integrates ecology, population biology, and geology to show how dispersal and vicariance

have contributed to current distributions of species. E. Schuettpelz and K. Pryer discuss recent advances in applying DNA sequences to constructing hypotheses of relationships among the diverse members of the ferns and lycophytes, and finally A. Smith and his colleagues use these phylogenetic trees to construct a revised and updated classification.

We recognize that a single volume cannot summarize all of the ongoing research relating to ferns and lycophytes, but by focusing attention on a diverse array of disciplines and approaches, the goal of capturing exciting, contemporary issues and casting a view to the future of each may spark innovative approaches and yield opportunities for new generations of researchers. With each of the chapters organized to review past work, explore current questions, and suggest productive directions for interested investigators, we hope to have developed a compendium that can serve as a benchmark, and one that can energize prospects for continued discoveries about these fascinating groups of organisms.