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Book Reviews

Jindřich Chrtek · Jan Pergl

Tom A. Ranker & Christopher H. Haufler (eds.): BIOLOGY AND EVOLUTION OF FERNS AND LYCOPHYTES; *Cambridge University Press, Cambridge, 2008, 480 pp. Price GBP 35.99, USD 59.-, EUR 41.-, ISBN 978-0-521-69689-0*

During the past decades, several books have synthesized ideas on particular areas of basic pteridophyte (ferns and lycophytes) research, helping to maintain and advance the level of knowledge and communication about progress in this field, and not only for scientists dealing with ferns. For example, the last and successful synthesized fern books are *The experimental biology of ferns* (Dyer 1979), *Biology of pteridophytes* (Dyer and Page 1985) or *Pteridology in Perspective* (Camus et al. 1996). After more than ten years, another book has come into being. Presenting a broad perspective, it has assembled contemporary knowledge on the biology and evolution of ferns and lycophytes.

The book's name uses the modern term for the ferns (sensu monilophytes) and lycophytes (*Lycopodiaceae*, *Selaginellaceae* and *Isoëtaceae*) instead of using the classic term "pteridophytes". The authors have used these terms because the preponderance of current evidence indicates that "pteridophytes" have not shared a common ancestor.

The book consists of four parts (Development and morphogenesis, Genetics and reproduction, Ecology, Systematics and evolutionary biology) and altogether 16 authorized chapters by 28 reputable contributors notably from the USA. Chapters are unified in structure and have been written to be readable and interesting. Each chapter has an introduction to the problems followed by a short review of past works. A part on current questions and suggestions for productive directions for continued discoveries and challenges is then included. The texts are enhanced with broad perspective tables, diagrams, photos or line drawings. A summary, future prospects or directions, and references are given on the last pages of each chapter. The text includes

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only a small number of typing errors. There are only small formal lapses, e.g., wrong name in Index (p. 472) "*Dryopteris dilitata*" instead *D. dilatata*.

Some chapters (e.g., Alternation of generations by E. Sheffield, Antheridiogens by J.J. Schneller, Species and speciation by C.H. Haufler and Diversity, biogeography, and floristics by R.C. Moran) present progress and new concepts in traditional pteridological topics, whereas other chapters introduce and summarize new directions and attitudes to research using modern molecular methods, e.g., Structure and evolution of fern plastid genomes (Wolf et al.), Evolution of the nuclear genome of ferns and lycophytes (Nakazato et al.) or Fern phylogeny (Schuettpelz and Pryer) and Fern classification (Smith et al.).

Most studies presented and discussed in this book are based on research by transatlantic authors, whose studies are mainly focused on the species of the American continent. Study results from authors from other parts of world are limited. For example, the omission of recent important advances and wide potential of methods of flow cytometry in relation to plant systematics and evolution biology (e.g., Suda et al. 2007) is obvious. However, the book as a whole is certainly an excellent summary of recent knowledge and advances in research of ferns and lycophytes. This book fills a major gap in the literature of the past decade and provides a modern overview of the biology and evolution of these fascinating plants.

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Suda J, Kron P, Husband BC, Trávníček P (2007) Flow cytometry and ploidy: Applications in plant systematics, ecology and evolutionary biology. In Doležel J, Greilhuber J, Suda J (eds) *Flow cytometry with plant cells. Analysis of genes, chromosomes and genomes*. Willey, Weinheim, pp 103–130

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Jean-Nicolas Volff: PLANT GENOMES; *S. Karger, Basel, 2008, 152 pp. Price GBP 164.-, USD 266.-, EUR 185.-, ISBN 978-3-8055-8491-3*

"Plant Genomes", edited by Jean-Nicolas Volff, is the fourth volume from the series "Genome Dynamics". The book covers the major aspects of plant genome dynamics with an obvious emphasis on the evolutionary impact of genome duplications and transposable elements. In 2000, sequencing of the entire genome of *Arabidopsis thaliana* was completed and since then genome sequences of additional important plants including rice (*Oryza sativa*), grapewine (*Vitis vinifera*) and poplar (*Populus*

trichocarpa) have been obtained. Significant information has been obtained for many other taxa. All these projects made comparative genomics possible and have led to the significant progress in understanding the structure and evolution of plant genomes as well as the processes driving their dynamics. By reflecting recent progress in this field, the book represents an excellent overview of current knowledge of all major aspects of plant genome dynamics and thus I would warmly recommend it to all scientists interested in these topics. The book consists of eleven self-contained review papers, each having different contributors. All papers have classical format, including abstracts and comprehensive list of references, and were reviewed according to classical standards. The content of the book can be summarized as follows:

In the first paper, a general overview of palaeopolyploidy is given. Partial or complete genome duplication is presented as a "punctuational event in the evolutionary history of a lineage". Not surprisingly, most of higher organisms pass through different ploidy levels at different stages of development. Intriguingly, the extreme rarity of genome duplications in the evolutionary history of extant lineages with one event per (sometimes hundreds) millions of years shows that most genome duplication events quickly go extinct. Because retention/loss of duplicated gene copies is non-random, in some groups of organisms duplicated gene copies are lost more frequently than in others. Mechanisms that are beyond such a pattern are described in the second and third paper. These analyses are mostly based on the sequencing of the entire genomes of *Arabidopsis*, *Oryza* and *Populus*, which not only helps in understanding the sizes and diversity of gene families, but also their localization. Colinearity between two genomes can then be used to identify orthologous and paralogous genes with more confidence. Conservation of synteny allows reconstruction of ancestral genomic segments in the common ancestor as well as duplication events that led to the present-day situation. This segmental phylogeny can then clarify the pattern and timing of individual gene duplications. This approach, called "position-based phylogeny", can be used to complement or even correct sequence-based phylogenetic trees.

The third paper presents three possible hypotheses as to why duplicate genes are retained more often than expected: Gain-of-function hypothesis, Balanced gene-drive hypothesis, and the subfunctionalization hypothesis. Subfunctionalization is now the most widely accepted theory. In principal, the theory is based on the assumption that following gene duplication, complementary mutations in each duplicate occur, and these mutations are in different, dispensable regions of the gene. The ancestral function of the gene is then spread between two subfunctionalized genes, which must both be retained to maintain the ancestral function of the gene.

The fourth paper, Grass Genome Structure and Evolution, briefly reports interesting features concerning grass genome structure and dynamics, mostly based on comparison of orthologous loci of maize, sorghum and rice. The key terms orthologous and paralogous are explained, and how to identify each of them is described. Transposable elements, which constitute most repeated sequences in the genome, are presented as major mechanisms by which the dynamics of chromosome structure is driven.

The fifth paper reviews pace and pattern of plant genome size evolution in a phylogenetic context. The authors review current understanding of genome size

variation in plants and present the spectrum of mechanisms responsible for the variation. Plant genomes may contract as well as expand and the variation in genome size among land plants exceeds 2300- fold. Interestingly, genome size can vary even among closely related species. Polyploidy and transposable element proliferation are supposed to be the major mechanisms responsible for increase of genome size. On the contrary, mechanisms of DNA loss, such as intra-strand homologous recombination (recombination between directly repeated sequences) and illegitimate recombination, are described, though they are much less well understood.

The sixth paper reviews plant transposable elements (TEs) as a major mechanism contributing to plant genome dynamics. TEs make up nearly half of the total amount of DNA in many plant species and are defined as DNA sequences able to move from one genomic position to another in a replicative or non-replicative process. The authors provide an overview of different types of TEs as well as their effect on proliferated genomes. TEs can be very deleterious for the host plant, but they can be beneficial because new genetic structure and regulation may favor better adaptation to environmental conditions. TEs can also stimulate genome reorganization, reprogram gene expression, and thus influence genome dynamics.

The seventh paper is dedicated to plant sex chromosomes. The term is used for a largely non-recombining chromosome pair carrying sex-determining genes and differing in size or shape in the two sexes. Heteromorphic sex chromosomes are present in some dioecious plants, however, no plant sex-determining locus has yet been identified. Nevertheless, in several dioecious plants, sex-determining regions have been identified in genetic maps using anonymous markers. Understanding plant sex chromosomes is at an early stage and much more is known for example in animals. The author points out specific topics on which researchers should concentrate to answer challenging questions concerning this relatively new field.

The eighth paper brings recent developments in research on plant centromeres. Centromeres are portions of the chromosomes composed of repeat arrays and playing specific roles in both mitosis and meiosis. Specific topics, like chromatin structure of the centromere, epigenetic determination of centromere identity, and the role of centromere repeats in determining centromere identity, as well as the function of neocentromeres and de novo centromeres, are given in the review paper.

The ninth paper deals with two major types of small RNAs: microRNAs (miRNAs) and short-interfering RNAs (siRNAs). These molecules are potent and specific regulators (of length between 21–24 nucleotides) of gene expression in a wide variety of eukaryotic organisms. They have an important role in plant development, stress responses and epigenetic regulation primarily through their role in transcriptional and post-transcriptional silencing of specific target genes and other loci. As pointed out by the authors, research in this field is very young – the first small RNAs were discovered in 1993 – and became of general significance about ten years ago. RNAs are now considered to be a major gene regulatory force in multicellular organisms.

The last two papers are dedicated to two agronomically important crops: maize and rice. Maize has been known as one of the most diverse species at both the phenotypic and genotypic level. Surprisingly, “intraspecific DNA sequence diversity of maize is up to 10× higher than that of humans, and variation within genes can approach the levels of divergence found between humans and chimpanzees”. The

paper reviews studies of genic and intergenic diversity of maize, as well as briefly reports sources and significance of sequence diversity in different regions of the genome, i.e., genes, retroelements, transposons and tandem repeats. Rice is the first cultivated plant species to be completely sequenced. The major features of the rice genome are listed: genome size is 389Mb, the genome consists of more than 37,000 genes, of which 29% are duplicated (segmental duplication), chloroplast and mitochondrial insertions each contribute about 0.2% of the nuclear genome, and class I and class II elements occupy 13% and 19.4% of the rice genome, respectively. Apart from these statistics, transposable elements and polyploidy in *Oryza* species are reviewed.

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Shripad N. Agashe & Eric Caulton: POLLEN AND SPORES. APPLICATION WITH SPECIAL EMPHASIS ON AEROBIOLOGY AND ALLERGY; *Science Publishers, Enfield, Jersey, Plymouth, 2009, 412 pp. Price GBP 77.-, USD 127.-, EUR 89.-, ISBN 978-1-57808-532-3*

Recent actual research on aeropalynology combined with allergology fill most chapters. However, many other aspects of palynology are mentioned in the publication. The description of a pollen grain as a reproductive cell begins with cytology, microgenesis, pollination/ artificial pollination, germination, pollen viability and storage of native pollen (Pollen Cryobank India). Pollen morphology is a key for pollen determination. However, the classical palynological publications (Iversen and Troels-Smith 1950; Faegri and Iversen 1989) are more or less inaccessible in the scientific libraries. Thus this volume pays considerable attention to pollen morphology and presents updated figures. Pollen morphology of temperate angiosperms is enriched to include tropic species of India (Mimosoides). Pollen morphology of gymnosperms, especially of conifers, is very well arranged to comprise the genesis of Cordaitales of Paleozoic forests as well. Special emphasis is put on palynological and floristic taxa of India. Two chapters present non-pollen groups, such as Algae, Fungi, Bryophytes and other microfossils. The descriptions are enhanced with many illustrative tables, lists, microphotographs (colored/ black and white) and SEM photographs that palynologists have required. The publication, however, concentrates less on “fossil” palynology. The methods of preparation and extraction of pollen grains of both organic and anorganic materials are described.

Aeropalynology as a focus of the publication begins with melisso/melittopalynology. Pollen grains concentrated in honey have their origin in entomophilous taxa according to which categorization of honey is implemented by quality and origin. Melissopalynology has been mainly developed in India, Brazil and Ghana. The history of aeropalynology is not well known. The publication provides an overview that links historical remarks with respiratory diseases (asthma, anaphylaxis shock or hay fever) and an overview of the most important aeropalynologists.

Aeropalynology uses many different devices for air sampling, e.g., a Burkard seven-day recording volumetric spore trap. Such pollen traps are installed in

different areas of the world for allergen pollen monitoring, resulting in a pollination month calendar for a specific area throughout the world with correlation of climatic factors and predominated pollen trees and herbs. In Europe Siwert Nilsson (Sweden) initiated a research program in 1973 on aerobiology, monitoring allergic pollen in the air. Aeropalynology helps with allergy tests that are described in a practical way. On a global perspective the most dangerous allergens are *Ambrosia* (ragweed), grasses and *Betula* (birch).

According to the authors not only higher plant pollen but also fungi are significant allergens, and e.g. *Ascospora, Basidiospora, Clodosporium* can be well determined by palynologists. The authors emphasize that pollen calendar, which differs according to the vegetation zones, is important for diagnosis and treatment of allergies. Highly allergic or least allergic taxa are estimated in blossom time during the vegetation season. The pollen calendar is provided separately for the world continents: Asia, Europe, Australia, and especially for India, Turkey, and Mexico. Aeropalynology is newly used in forensic palynology where pollen evidence is used in detecting crimes.

The authors have put together an international publication, providing rich information in clear and logical framework. The publication achieves a synthesis of classic and traditional areas of palynology and aerobiology with newly developed applications. The publication is relevant to scientific specialists of aerobiology and allergologists, to university teachers of botany, palynology, micropaleobotany, taxonomy or plant evolution and to their students.

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J.P. Poland & E.J. Clement: THE VEGETATIVE KEY TO THE BRITISH FLORA; John Poland, Southampton, Bern, 526 pp. Price GBP 24.99, USD 41.-, EUR 29.-, ISBN 978-0-9560144-0-5

This relatively small book (A5 size, ca. 550 g) attempts a challenging goal: to provide a field guide to all native and common alien species of British flora (except for some apomictic genera) based solely on vegetative characters. In addition, no special equipment except a good botanical loupe is required. If the book had been successful in its aims, it would really cover a need every field botanist occasionally has.

The book is designed mainly as a text determination key supplemented with only a few line-drawings of important determination characters and 24 colour plates illustrating the most typical shapes of leaves, leaf margins, buds of woody plants and, surprisingly cross-sections of leaves of *Carex* species and some other *Cyperaceae*. A brief but

useful glossary of morphological terminology and notes to selected determination characters appends the keys. However, although the Vegetative key is intended and presented as a key fully allowing determination based on vegetative parts, the authors themselves have had to admit that the task is impossible. In some groups, floral or fruiting characters had to be included (e.g., *Melilotus*, *Callitriche*, or some Poaceae) and sometimes the problem is circumvented – for example when the group of indistinguishable species is treated as an "aggregate" ("*Arctium minus* agg." = the genus *Arctium*).

The keys bring species together according to vegetative morphology instead of following hierarchical taxonomic classification. It is an important virtue of the book – it joins similar species from different families that will never come together in traditional keys. The overall structure of the keys is another positive. In general the keys are dichotomic but when reasonable, the authors used polytomy, therefore avoiding impractical use of the phrase "the characters not as above", which occasionally appears in traditional dichotomic keys. The species are grouped into 21 divisions and every division is divided into groups (up to 24, usually less) based on a few more or less obvious characters that allows rapid selection of the group. The detailed keys for every group then involve a few species only and rarely exceed two pages. Several large genera or groups of similar genera (e.g., *Cirsium* + *Carduus*) have their own specialized key that is entered through more pathways from the main keys. This structure makes the determination quite fast and reduces the number of possibilities to check if a decision is not certain at a particular point (e.g., due to absence of particular character on an incomplete individual). Also, it allows for a quick decision between two known species even if they are not in the same group – which is a typical situation in the field when the experienced botanist is usually able to exclude many similar species and has only to decide between either X or Y.

Numerous traditional determination characters are used (composed *vs*. simple leaves, overall shape, leaf margin, presence of hairs, colours, etc.) and some highly valuable but generally overlooked characters are also introduced (e.g., details on nervature). However, some determination characters are also the principal weakness of the Vegetative key. Characters such as "latex [present but] sparse" or "at least some hairs present" are very difficult to score correctly – under these definitions species are included that will usually be seen as (virtually) latex-free or glabrous. Unfortunately, these characters sometimes occur quite early in the key hierarchy, even between main "groups" within a "division", where any mistake is awkward. One other character deserves special comment: stomata. Their presence/absence on the upper-side of leaves is often used to distinguish similar taxa (e.g., *Lamium maculatum vs. L. galeobdolon* s.l.) and would be an excellent character if it could be recognized easily. However, I completely failed to see them with an ordinary 20× loupe, though according to the authors' comments it should be possible. I think a photograph in the glossary to illustrate exactly for what I should be looking would be very helpful.

Although the book does not fully satisfy the aims stated in the introduction, I regard the Vegetative key as a very useful book and I can recommend it to all plant students. I had just little opportunity to test it in the last season, and I am looking forward to using it in the next one. I also wonder about the next revised editions. I join the wish the authors give to the users: Good hunting!

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Short reviews

Charles Vincent, Mark S. Goettel & George Lazarovits (eds.): Biological Control. A Global Perspective; *CABI Publishing, Wallingford, 2007, 440 pp. Price GBP 90.-, USD 130.-, EUR 92.-, ISBN 978-1-84593-265-7*

Using the editors' words from the introductory chapter, biological control as a possible way to manage pests deliberately using living organisms sounds simple but is accompanied by many environmental constraints, and is sometimes accompanied by controversy, which holds true especially for managing biological invasions in Europe. The book provides readers with forty-four examples of biological control case studies from all over the world and all types of target organisms and environments. The trait-off between the level of detail of individual chapters and their number was shifted towards showing as many various examples as possible. Thus individual chapters are short with brief introductions and lists of references, but still with a sufficient level of detail. The biological control topics covered range from control of agricultural to environmental pests, and weeds and invasive organisms. Some examples describe recent stories, however, the older biocontrol programmes contain recent evaluation of their output. The book provides enough space to enable presentation of personal views and experience of authors of individual chapters and it gives them the opportunity to show long-term observations, which cannot be easily presented as classical papers or because the details and context would be lost when published in general compendia or textbooks. The extra value of this book is undoubtedly the wide range of examples that it covers. The set of papers enables the reader to see the whole scope of the biological control field and the topics in a broader context. Even specialists who focus at one taxon group or the environment will never only look at the paper from his/her subject; this book will surely broaden their horizons and allow them to get new ideas. This book is valuable for scientists and people already familiar with biological control, but also (and maybe primarily) for new potential users of biological control from agriculture and biodiversity conservation. Therefore this book presents not only a supplement of general biological control textbooks bringing case studies, but it bridges the gap between science and application in an accessible way. *(Jan Pergl)*

Nnadozie C. Oraguzie, Erik H.A. Rikkerink, Susan E. Gardiner & H. Nihal de Silva (eds.): Association Mapping in Plants; *Springer-Verlag, New York, 2007, 277 pp. Price GBP 94.50, USD 136.-, EUR 102.-, ISBN 978-0-387-35844-4*

For those that are not familiar with the term "Association mapping", this title covers topics linked to the search of phenotypic differences in traits in relation with sequence polymorphism and identification and selection of genotypes. The book gives a broad overview of the topic with a general introduction followed by several chapters devoted to details of the used concepts, methodology, application and examples. Researchers working on phenotypic plasticity and mapping the

genes are facing rapid progress in availability of genetic methods and specific needs from applied sphere of agriculture or forestry. Using methods based on association genetics provides a way to deal with such challenges and this book may be a useful guide. Through practical examples, the book provides geneticists and plant breeders with detailed descriptions of the theory. This book can be also recommended to plant ecologists working in the field of molecular or evolutionary ecology. *(Jan Pergl)*

William E. Grant & Todd M. Swannack: Ecological Modeling. A Common–Sense Approach to Theory and Practice; *Blackwell Publishing Ltd., Oxford, 2007, 180 pp. Price GBP 19.99, USD 33.-, EUR 23.-, ISBN 978-1-4051-6168-8*

This tiny book is oriented to students and their teachers that have to cope with simulation models in ecology. The increase of computer capacity over the last decade led to enormous interest and spread of intensive computer methods in many fields of research activities including ecology. Such methods open new niches and significantly help to understand biological processes. Although their application seems to be simple, several caveats might emerge. The book is a user friendly textbook for students and beginners. It is clearly visible that the book is based on university courses held over many years; the structure of the book is clear, straightforward, with nicely written language that makes the book accessible also for non-native English speakers. Authors guide readers by using simple examples, and step by step show how to build the model – from theory through model development to model evaluation and application. The text is accompanied by plenty of schemes and figures. As a bonus, there is an appendix showing templates of standard reports for the developed models. Although this book foremost can be recommended to university teachers of population ecology and their students, the advanced users of simulation methods should at least look inside it; I am sure, they will find some interesting and important points that refresh their routinely used methods. *(Jan Pergl)*

Barbara Tokarska-Guzik, John H. Brock, Giuseppe Brundu, Lois Child, Curtis C. Daehler & Petr Pyšek (eds.): Plant Invasions. Human Perception, Ecological Impact and Management; *Backhuys Publishers, Leiden, 2008, 428 pp. Price GBP 144.-, USD 234.-, EUR 162.-, ISBN 978-3-8236-1528-6*

The tradition of Conferences on the Ecology and Management of Alien Plant species began in 1992; since 1995, the conference was held biennially and the proceedings from almost each meeting have been published. These Plant Invasion proceedings published by Backhuys Publishers have found a respected position among invasion literature. The reviewed book is a set of contributions presented at a conference in Katowice, Poland in 2005. Individual papers are divided into four sections devoted to *i*) the human role in invasions, *ii*) biology and ecology of species, *iii*) impact and invasibility of habitats and *iv*) management of invasive species. Most papers in the book are focused on European invasions, probably because of the meeting's location, however North American, Australian or South African papers can also be found. Because several journals that focus on invasions exist nowadays, the

proceedings are slowly losing their position as a source of new and comprehensive information on advances in invasion biology. Nevertheless, the proceedings still present a valuable forum for many good papers, which for several reasons are not well suited for journals. The book contains 27 contributions, ranging from descriptive studies on species biology and ecology with emphasis on important or newly emerging invasive species and their habitats to review papers on historical aspects of introductions (e.g., Daehler, Adamowski) and management and control (e.g., Tanner, Widmer & Rayamajhi). Daehler's paper is one of my favourites in the book because it presents an unusual review of the history of invasions from the human perspective. If you work with invasive species and you do not have this book on your personal bookshelf, you should at least leaf through it. *(Jan Pergl)*

Ravinder Kumar Kohli, Shibu Jose & Harminder Pal Singh (eds.): Invasive Plants and Forest Ecosystems; *CRC Press, Boca Raton, 2008, 480 pp. Price GBP 82.-, USD 117.-, EUR 92.-, ISBN 978-1-4200-4337-2*

Invasion ecology provides a clear link between science and management practice. In Brisbane in 2005, there was a joined meeting of scientists and practitioners that resulted in the presented book. The book is focused on forest ecosystems of various quality and geography: from strongly human-affected urban park forests to natural tropical forests. There are 21 chapters on general aspects of invasions in forest ecosystems, impact, management and socio-economic aspects. Some papers in the book, especially in the sections on ecology and impact, suffer from an unclear "take home message" or universal phrases that should be supported by real data. This is namely the case of several impact studies, where invasion biology suffers from lack of data. Nevertheless, this book provides a useful overview of important invasive species in many exotic areas where invasive alien species are important ecological and economic threats. *(Jan Pergl)*