REVIEWS

JOHN C. AVISE: **Molecular markers, natural history, and evolution**. 2nd Edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, 2004. 541 pp., illus. ISBN 0-87893-041-8. Price: USD 59.95.

Molecular markers have opened new ways to get information on biodiversity. This treatment addresses the many applications for genetic markers (from polymorphic proteins and DNA) from the perspectives of population biology, ecology, speciation, and phylogeny.

The first four chapters (1. Introduction; 2. The history of interest in genetic variation; 3. Molecular techniques; 4. Philosophies and methods of data analysis) review the history and purview of molecular approaches, compare and contrast various laboratory techniques for revealing molecular markers, and trace relevant empirical and conceptual roots. Each of the subsequent five chapters (5. Individuality and parentage; 6. Kinship and intraspecific genealogy; 7. Speciation and hybridization; 8. Species phylogenies and macroevolution; 9. Molucular markers in conservation genetics) is devoted to a theme, starting at the individual level, via the level of kinship relations and speciation, up to the level of (deep) phylogeny and of conservation. In each chapter a huge number of examples of pioneering and recent molecular studies (well balanced over animals, but also plants and microbes) are described which have or may shed new light on the respective themes. Although not always easy reading, the book is appropriate for advanced undergraduates, graduate students, and scientists in such disciplines as ecology, genetics, population biology, ethnology, molecular biology, systematics, conservation biology, and anyone interested in the application of molecular markers to organisms in the wild. My opinion of this book is very positive and I can only endorse the many positive reviews published so far. I recommend it especially for every biologist who looks for a reference text on a great variety of successful applications of molecular markers.

However, the book is not infallible and I am also critical because as a systematist I found it a bit disappointing as well. The book is written with some sympathy for, but hardly any affinity with, systematics (e.g. the unwarranted remark on the obsession of systematists to get phylogenetic understanding of their favourite taxon, p. 431). The presentation of numerous examples makes the book a biased, rather uncritical compilation of success stories and I really miss some fundamental discussions on remaining problems, e.g. gene trees as single characters, total evidence analyses of morphological and molecular data, phylogenetic methods to deal with homoplasy and incongruent sequence patterns, practical delimitation of species, etc. A typical example can be found on p. 128, where it is stated that "biogeographic evidence can also be difficult to interpret" whereas what is actually difficult to interpret are the molecular patterns in the example given as the biogeographic evidence is clear-cut.

I do not understand the author's criticism on Wiley's statement (p. 118), because parsimony was the rule and 'volumes of other information' always outruled a single argument. Wiley made the point that observations had to be evaluated very thoroughly in order to end up with good, informative characters. It is interesting to see his remark (p. 119) that synapomorphies are the basis for clade delineation is now universally accepted. In contrast, in no molecular consensus tree is ever indicated which molecular character change takes place on which node, and thus synapomorphies seem of no concern whatsoever in this respect. This I find a real problem, as it makes the process

of phylogeny reconstruction a black box without any biological notion. I can see the distinction between gene trees (transformation series) and organismal (species) trees (p. 118), but cannot follow the statement that the two are equally 'real' phenomena, merely reflecting different aspects of the same phylogenetic process (p. 157). The point is that any character phylogeny can only be based on an *a priori* hypothesized phylogeny. That is something quite different to me.

The description of the genealogical concordance (p. 301 and following, fig. 6.13) makes me question what news it brings, having in mind concepts like character compatibility and generalized area-cladograms.

The discussion of species concepts in Chapter 7 raises quite some questions for me. I really miss any attention for the common systematic practice of morphological arguments to delimit species. Although I strongly endorse the statement that 'no arbitrary magnitude of molecular genetic divergence can provide an infallible metric to establish specific status' it needs more elaboration, especially because on p. 333/334 and p. 357 (fig wasps) genetic differences are used to indicate specific status. The discussion is so focused on the biological species concept and its underlying reproductive processes that the patterns on which prime species hypotheses are based are completely ignored. It remains a point what molecular markers can tell in this respect, as the species concepts c.q. names as used in the studies cited are in fact taken for granted. I find therefore conclusions 2 and 3 (p. 399) not really the logical outcome of the argumentation in this chapter.

Regarding Chapter 8, 'Species phylogenies and macroevolution' I was struck by the misunderstanding of the clade of Charophyceae and land plants sharing 2 tRNA introns versus the land plants sharing 3 mtDNA introns (p. 443). This is presented as a contradiction stating that the latter indicated even better candidates for the closest relatives of land plants, whereas the two hypotheses are completely compatible. This chapter is concluded by a proposal which astonished me, i.e. the proposal to standardize taxonomic ranking by using different geological eras to assign taxonomic rank. It is stated that current taxonomic classifications are flawed because they fail to standardize ranking criteria. Taxonomy is about two things: reconstruction of clades (the Tree of Life) and chopping the tree into taxa which get an official name. What we are talking here is chopping the tree and naming groups following the Linnaean hierarchy, and according to theoretical criteria of monophyly and practical criteria of diagnostics, morphological gaps, etc. I cannot see why this is called not-standardized and, furthermore, I really do not see the advantage to use geological age, of which in many cases we do not have the faintest idea. Ranking is no problem at all. No, the real problems of taxonomic classifications are changing views on taxa due to ongoing research (including molecular studies), i.e. changing delimitations of clades and consequently of taxa, name changes, etc. Let us hope that a synthesis of molecular markers together with morphology and other relevant data will eventually lead to more robust phylogenetic hypotheses.

MARCO ROOS

H.C.J. GODFRAY & S. KNAPP (Eds.): **Taxonomy for the twenty-first century**. Philosophical Transactions of the Royal Society of London, series B: Biological Sciences, Vol. 359, Nr 1444, 2004. 182 pp., illus. ISSN 0962-8436. Price: GBP 45.

This is a most interesting volume on topics which concerns us all. It comprises an introduction to the whole volume by the editors Godfray & Knapp followed by 18 papers.

Wheeler, in a provoking essay entitled 'Taxonomic triage and the poverty of phylogeny', rightfully defends the scientific position of descriptive taxonomic studies and states that revisions and monographs are efficient, high-throughput species hypothesis-testing devices. Gotelli ('A taxonomic wish-list for community ecology') recognizes 4 research frontiers in community ecology that are closely tied to systematics and taxonomy: the statistics of species richness estimations, global patterns of biodiversity, the influence of global climate change on community structure, and phylogenetic influence on community structure. In this respect he stresses the need for keys, current nomenclature, species occurrence records, and resolved phylogenies. Finlay explores Protist taxonomy within an ecological perspective, focusing on species delimitation. He sees morphospecies as a first step in erecting a taxonomy of the protists, followed by additional genetic, physiological and ecological studies. He discusses the possibilities of DNA sequence-similarity clusters, suggesting as starting point ecotypes where genotypic and phenotypic clusters correspond. Sandra Knapp et al. on the 'Stability or stasis in the names of organisms: the evolving codes of nomenclature', regard nomenclature today more relevant than ever. Also in genomics the need for systems of nomenclature for communication about organisms is recognized. They discuss a number of challenges like publication (e.g. electronic publishing, registration systems for newly published names), priority (lists of available names, names in current use, new starting dates), typification (digital images, molecular sequences), and flexible rules for changing knowledge (phylocode, ambiregnal organisms). Oren ('Prokaryote diversity and taxonomy: current status and future challenges') states that the present prokaryote taxonomy is based on a combination of genomic and phenotypic properties. The recommended cut-off value of 70% DNA-DNA similarity to delineate species signifies an extremely broad species concept, resulting in only 6200 species currently recognized. A better coverage of the diversity depends on new culture methods, enabling the isolation and cultivation of more organisms. Forey et al. treat the palaeontological views in this respect ('Taxonomy and fossils: a critical appraisal'). They recommend abandoning some of the palaeontological species concepts (e.g. chronospecies, stratospecies) and advocate species recognition on the basis of unique combinations of characters. Furthermore, they suggest generic lists as an attainable goal (rather than species lists). Like many others in this volume they regard web-based taxonomy as the way forward. Gaston & O'Neill look at 'Automated species identification: why not?' and rather optimistically argue that progress in the development of automated species identification is so encouraging that such an approach might enable the reduction of the burden of routine identifications. Blaxter, in another provoking paper on 'The promise of a DNA taxonomy', glorifies vistas of DNA-sequence based delineation of Molecular Operational Taxonomic Units (MOTUs), that have a similar extent to traditional species. He outlines advantages in rapid identifications (DNA-barcodes) and direct investigations of the evolution of patterns of diversity. He puts the MOTU concept parallel to biological and morphological species concepts, with the advantage of clearly defined cut-off levels. However, his ideas are reminiscent of the OUT-discussions decades ago in that he ignores any correspondence of MOTUs with the biological reality. Knapp & Godfray rightfully warn against throwing away 250 years of accumulated taxonomic

knowledge. Lughadha ('Towards a working list of all known plant species') signals that the Global Strategy for Plant Conservation has reinforced the urgent need for a global plant checklist. Soberón & Peterson discuss the ins and outs of 'Biodiversity informatics: managing and applying primary biodiversity data'. They stress the importance of verified identifications and georeferencing for biodiversity assessments based on large-scale quantitative analyses of species presences with GIS. Scoble ('Unitary or unified taxonomy?') argues that unitary taxonomy (i.e. one preferred, consensual classification) is not a necessity which for practical reasons should be pursued. The inevitable and desirable development towards web-based taxonomy allows for retaining multiple concepts of taxa while still facilitating data access. Mace deals with 'The role of taxonomy in species conservation' and also focuses on the species problem. She states that species conservation needs two taxonomic solutions: a set of rules to standardize species units included in lists used for conservation planning, and an approach to the units chosen which recognizes the dynamic nature of natural systems. Samper ('Taxonomy and environmental policy') treats the impact of the Convention on Biological Diversity on taxonomy. One of the results is the rise of the Global Taxonomy Initiative. The interactions and synergies of the GTI with the Global Environmental Facility as well as with other actions are explored. The major challenges ahead are to improve the distribution of taxonomic capacity and information around the globe and to generate new taxonomic information on under-explored parts of the globe as well as of poorly known groups of organisms.

This volume ends with a number of essays by leading biodiversity experts: Raven ('Taxonomy: where are we now?') emphasizes the lack of knowledge of present-day species diversity, the undervaluation of taxonomy in academies, the shortage of taxonomic experts in tropical countries, and the human population rise. He proposes a number of solutions to improve our knowledge basis and makes a plea for field naturalist studies. Janzen ('Now is the time'), from his experience of an all-species inventory in Costa Rica, argues for automated DNA bar-coded palm-computerized identification tools and species delimitations. May ('Tomorrow's taxonomy: collecting new species in the field will remain the rate-limiting step') questions the attainability of a complete catalogue of Life on Earth and the applicability of the taxonomic hierarchies for prokaryotes and lower eukaryotes. Crane ('Documenting plant diversity: unfinished business') elaborates on the Global Strategy for Plant Conservation and how to realize its first and most fundamental objective: to establish a widely accessible working list of plant species. Wilson ('Taxonomy as a fundamental discipline') explains how impressed he is by both the need and feasibility of digital photography, genomic maps and internet publication for an accelerated global effort to classify and name the species on Earth.

All in all a most valuable volume worth studying to develop your own ideas on the demand for and desirability of future developments.

M.C. Roos

Rodolphe-Edouard Spichiger, Vincent Savolainen, Murielle Figeat & Daniel Jeanmonod: **Systematic botany of flowering plants: a new phylogenetic approach to Angiosperms of the temperate and tropical regions.** Science Publishers, Enfield, NH, USA, 2004. 414 pp., illus., 16 colour plates. ISBN 1-57808-373-7. Price: Softcover and CD-ROM set: GBP 31.90, approx. USD 58.

This is a translation of the second edition in French (Botanique systématique des plantes à fleurs – Une approche phylogénétique nouvelle des Angiospermes des régions tempérées et tropicales, 2002). It includes a CD-ROM with 351 colour photographs, summary tables on useful plants and keys to identification. The objective of this book is to describe a range of families of flowering plants in a sequence corresponding to current phylogenetic classification. It covers a large range of families from temperate and tropical flora and each family is richly illustrated. It is a nice European flavoured textbook next to a number of recent American equivalents (Judd et al., 2002; Woodland, 2000; Zomlefer, 1994; etc.).

The book is divided into 6 chapters, of which the last, Chapter 6, forms the bulk of the text with 240 pages and treating 111 families delimited following the APG II. I will not go into detail about the diagnostic information for each family and the pros and cons of the selection of families. What I want to emphasize is that for each family when relevant very to the point the new phylogenetic circumscription is explained and also what the position is in four major traditional classificatory systems (i.e. those of Engler, Cronquist, Thorne and Dahlgren). Also, all families are well illustrated and although a number of the habit drawings are a bit coarse, I enjoyed the many diagnostic SEM-photographs which give the book a special cachet.

Moreover, what I very much like about this book are the first 5 chapters. These give in a nutshell a very concise and quite complete outline of the discipline of classifying plants. In the Introduction a number of disciplinary general terms are explained. The first chapter presents a very fine overview of the history of classification of the plant kingdom and its systematic fundamentals. Chapter 2 is devoted to species and speciation. Some elementary notions of species are discussed, although a little bit more elaboration would have been justified for such a central concept. More attention is given to speciation, especially those aspects of relevance for delineating species as well as models which can be deduced from phylogenetic hypotheses. I only wonder why Grant's 5 taxonomic types get so much attention. Chapter 3 deals very briefly with diversity plant patterns (again, this important topic may deserve some more elaboration; I miss references to literature on e.g. why the tropics are so species rich) followed by a relatively extensive exposé on vegetation types. Chapter 4 on land plants describes the morphological variation and major evolutionary developments both of vegetative as well as of reproductive organs. Finally, in Chapter 5 on seed plants a diagnosis of the evolution and major phylogenetic lines is presented. In both these latter two chapters, attention is paid to paleobotanical aspects.

I recommend this book to everybody interested in a reference book on current ideas on a great variety of aspects of the evolutionary history and taxonomic diversity of land plants. It presents a wealth of to the point information for e.g. preparing for examinations as well as for preparing lectures.

Judd, W.S., C.S. Campbell, E.A. Kellogg & P.F. Stevens. 2002. Plant systematics: A phylogenetic approach, 2nd ed.

Woodland, D.W. 2000. Contemporary plant systematics, 3rd ed.

Zomlefer, W.B. 1994. Guide to flowering plant families.

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