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Book reviews

R. W. Sterner and J. J. Elser. 2002. **Ecological Stoichiometry – the biology of elements from molecules to the biosphere.** Princeton University Press, Princeton, New Jersey, 439 pp. (with 117 figures and tables). ISBN: 0-691-07491-9, paperback, price: USD 29.95, GBP 19.95.

If I will be born again, I will be an „ecological stoichiometrist" – this was my first thought after reading the book. This masterpiece is an example how to do really integrative science, how to jump easily between organisational levels, and how to keep in mind the diverse fields of biology from biochemistry and cell biology to community ecology and global systems ecology. Sometimes with the help of rigorous theorems and axioms, sometimes with convincing graphs and data, and sometimes with stories from the softest ecology. All in all, a hierarchy of topics and styles are suitably presented.

The book is wisely structured. Chapter 1 gives basic definitions like „stoichiometry", „homeostasis" and the „Redfield ratio". The stoichiometric formula of a living human is given ($H_{375000000}O_{132000000}\ldots Fe_{2680} \ldots Mo_3$ Co_1), and it is after this point that it is impossible to stop reading the book. Chapter 2 provides a background in biochemistry, organic chemistry and cell biology, discussing even the elemental composition of the organelles, like the endoplasmic reticulum. Chapters 3 and 4 are thematic units on autotrophs and Metazoans, respectively. Here, both terrestrial and marine data and models are presented, with emphasis on C, N and P, discussing mainly body size and growth physiology. Chapters 5 and 6 take closer to ecology, by discussing the effects of resource chemical composition on consumers, and the effects of consumers on nutrient recycling, respectively. Ingestion, egestion and excretion begin to be key concepts, as well as assimilation efficiency and threshold elements. Examples from diverse habitats and taxonomic groups ensure also the horizontal view in the vertically structured book. Chapter 7 presents stoichiometrical community ecology (some readers probably disagree with the distinction between communities and ecosystems). It is fascinating how chemistry is used to give a new aspect to understanding competitive ability or mutualism. Indirect interactions are also discussed in a highly dynamical context (recalling some excellent experiments of Ulrich Sommer at the Institute for Marine Research, Kiel, Germany), with a special emphasis on the stoichiometrical background of trophic cascades. In this key chapter, we can shortly read also about multiple stable states, chaos, non-linear dynamics and the chemical basis of ecosystem services. Chapter 8 is the arrival to the end of the hierarchy: the stoichiometrical discussion of global ecology with wide spatial and temporal scales, trophochemical diagrams, global change and human impact. Chapter 9 is a robust summary written in strict order, as well as a presentation of perspectives and two highly important figures (surely frequently cited in future).

This book is a mixture of a well-reading encyclopedia and a thoughtful and excellently written basis for future research. About 900 references help orientation and close the prehistoric part of ecological stoichiometry: the Foreword written by Peter Vitousek suggests to divide history into two parts: „BS + E" and „AS + E", where „B", „A" and „S + E" refer to „before", „after" and „Sterner and Elser", respectively. One reason for this strong welcome may be Figure 9.1 showing a „stoichiometric number line" of N:P ratios from polyphosphate to proteins, including bone, ribosome, anthropogenic global fingerprint, average lake seston, chloroplast, and runoff from unfertilized fields (in this order). Another reason can be Figure 9.2 entitled simply „Stoichiometry from genes to ecosystems" giving something very new but not strange anymore.

The book is strongly recommended for readers interested in hierarchical thinking and the most general ecology, as well as readers highly specialised in chemical ecology.

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M. Black and H. W. Pritchard (eds.) 2002. **Desiccation and survival in plants. Drying without dying.** CABI Publishing, Wallingford, x+412 pp. ISBN: 0-85199-534-9, hardback, price: GBP 75.00.

Water is an essential resource for life, thus no organism can exist without it. Yet, there are numerous exceptions from this rule, since certain plants or plant structures can loose almost all their water content for a limited period of time and suspend life until water becomes available again. Before a detailed discussion, it is important to distinguish between drought tolerance and desiccation tolerance. Drought tolerance refers to the plant's capacity of withstanding long periods of water shortage, during which the plant maintains an active - although often heavily suppressed - metabolism. Desiccation tolerance, however, implies the ability of an organism to maintain dry equilibrium with the ambient air, halt metabolism, and to recover and return to normal metabolism upon remoistening.

Life originated in water, and the subsequent colonization of land was a major evolutionary challenge. Terrestrial plants appear to have evolved two solutions to the problem of maintaining an aqueous self in a withering world. The majority solution is never to dry out in the vegetative stage. The minority solution is to dry up but not die - to desiccate during drought and rehydrate and resume growth when drought ends. Desiccation tolerance appears to be a universal evolutionary potential of plant cells which has been little selected for except in resting stages of the life cycle (seeds, spores, pollen or certain other propagules) and in organisms that have not evolved effective ways of avoiding desiccation.

Desiccation tolerance, particularly the so called "resurrection plants", fascinated scientists for centuries, but understanding its biology advanced relatively slowly probably due to a limited array of techniques at the researchers' disposal for studying it. Rapid development in research instrumentation in the last quarter of the previous century brought considerable progress in this field as well, thus the time has arrived to summarize the current state of knowledge on plant desiccation tolerance in a comprehensive volume.

The book contains 13 chapters organized into five parts. The single chapter in Part I provides an intriguing introduction into the field. The brief research history is particularly interesting with accounts from early debates on the question whether life can stand still or not to current knowledge on the biochemistry and ecology of desiccation tolerance.

Part II is devoted to methodology. Traditional methods for studying plant water relations during desiccation as well as the most advanced biochemical and biophysical tools for quantifying desiccation damage and tolerance are equally treated. From chapter 3 it turns out that one should be very careful with experimental conditions when studying desiccation tolerance, since survival of tissues depends on e.g. the rate of desiccation and subsequent rehydration, the time spent in the desiccated state, the method of remoistening, etc. Novel spectroscopic techniques (e.g. electron paramagnetic resonance, nuclear magnetic resonance, laser photoacoustic spectroscopy) allow unprecedented insight into the biochemistry and biophysics of desiccation tolerance and sensitivity.

Part III comes with a detailed account of current understanding of the biology of desiccation. While the tolerance of dehydration is a rule for seeds (although certain species possess desiccation sensitive seeds), it is much more rare for vegetative tissues: still quite widespread among bryophytes and lichens, infrequent among pteridophytes and angiosperms, and completely absent in gymnosperms. These chapters make clear that desiccation tolerance is not a uniform strategy, but a collection of different mechanisms that evolved in different organisms as adaptations to different, specific ecological conditions. For example, homoiochlorophyllous desiccation tolerant plants adapted to frequent desiccation - rehydration cycles preserve their chlorophyll and cellular structure fairly intact in the desiccated state, whereas poikilochlorophyllous organisms break down their photosynthetic apparatus during dehydration and reassamble upon remoistening, the strategy best suiting infrequent lengthy periods in the dry state. Similarly, while the mechanism of desiccation tolerance has mostly constitutive (permanent) components in rapidly desiccating bryophytes, it is mainly built up from inducible constituents (activated during water loss) in the more slowly and less often dehydrating vascular resurrection plants.

Part IV gives insight into the mechanisms of damage and tolerance associated with desiccation, a field with particularly great progress in the last two decades. The main elements of desiccation damage are the disruption of membrane bilayers, structural alteration of macromolecules (proteins, nucleic acids, etc.), and the accumulation of reactive oxygen species, just to name the most important ones. Desiccation tolerant organisms possess special mechanisms that prevent or mitigate the development of these harms and/or repair processes responsible for the reestablishment of proper cellular structure and function. It is widely accepted now that in the prevention of desiccation damage the vitrification ("biological glass formation") in the cell plays a fundamental role: the cytoplasm takes up a solid-like, highly viscous fluid structure (resembling the amorphous structure of glass). A series of protective compounds take also part in cellular defence: sugars (mostly di- and oligosaccharides), proteins (heat shock proteins, late embriogenesis abundant (=LEA) proteins, etc.) and amino acids (e.g. proline), all contributing to the preservation of the structure of biomolecules. Recent research has shown that part of the desiccation damage occurs during rehydration, when the reestablishment of cellular structure cannot keep pace with rapid water entry and cell volume increase. Repair processes (e.g. elimination of active oxygen, breakdown of damaged proteins, etc.) are also activated simultaneously.

Part V comes with a chapter taking a retrospect and prospect. Although an immense progress has been made in the understanding of desiccation tolerance and sensitivity of plants, our knowledge is still inadequate for a new synthesis. Certain topics especially need further research efforts (e.g., the molecular genetics of desiccation tolerance, signal transduction pathway during dehydration, the role of various LEA proteins, etc.).

The book presents a great amount of up-to-date knowledge on the desiccation tolerance of plants in an excellently written and edited, readable format. Each chapter can be read on its own, but this inevitably results in certain redundancy for those reading through the whole book (e.g. desiccation tolerance is defined in at least three chapters). A rich glossary helps the reader not familiar with the terms of the field, and separate taxonomic and subject indices assist in finding specific information. Most chapters are based on an extensive literature. The hardbound volume from CABI Publishing is definitely a milestone publication in plant desiccation tolerance research.

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B. D. Booth, S. D. Murphy and C. J. Swanton. 2003. **Weed ecology in natural and agricultural systems.** CABI Publishing, Wallingford, viii+303 pp. ISBN 0-85199-528-4, paperback, price: GBP 35.00, USD 60.00.

The authors declare in the preface that the book has been designed as a teaching text for undergraduates, such that the material could be covered in a single-term course. Their idea is to achieve two objectives with one book, namely: 1) to introduce students (readers) to the basic principles of ecology in a clear and concise manner (no ecological background is assumed), and 2) to show how and why weeds fit into their environment through examining their ecological behaviour.

To achieve the first objective, the main chapters of the book (preceeded by the prologue-like 1st chapter – ‘Ecology of weeds’) are organised and presented under three major sections, increasing in complexity from the first to the last. The sections and chapters are as follows:

Part I. Population Ecology: 2 - Describing the distribution and abundance of populations; 3 - The structure and dynamics of populations; 4 - Sexual reproduction; 5 - Asexual reproduction; 6 - From seed to seedling; 7 - Growing up, getting old and dying.

Part II. Interactions Between Populations: 8 - Interactions between populations I: Competition and allelopathy; 9 - Interactions between populations II: Herbivory, parasitism and mutualisms; 10 - Studying populations and their interactions.

Part III. Community Ecology: 11 - Basic community concepts and diversity; 12 - Community dynamics: succession and assembly; 13 - Plant invasions; 14 - Studying community structure and dynamics.

Each chapter starts with a brief introductory section listing “concepts” that will be addressed. The bodies of the chapters have an easy to follow style with appropriate organisation by sub-headings. When a concise book is reviewed one may always criticize it about missing facts or phenomena not discussed. For example in chapter 6, it would have been instructive to include data about maximum longevity of weed seeds survival in soil. But instead of listing missing things it will be better to emphasise that each chapter provides a very good selection of topics and includes the latest results of the field. Reflecting immediacy I counted the percentage of cited literature items published in the five years immediately preceeding the publication of the book (i.e., 1998-2002) and expressed it as percent of total cited literature. The result was 29%, a favourable rate compared to the corresponding value of 22% for Begon, Harper and Townsend’s (1986) book.

Altogether 54 tables and 106 figures help the reader to master Weed Ecology, most of them are of excellent quality. However, I found Figure 5.4 over crowded and with text of very small font size, whereas in Figure 5.3 (on the preceeding page) rather little information is transmitted using up to two thirds of the page. Considering that students must often read under suboptimal conditions either late in the evening or whilst travelling, the use of very small font sizes or text printed against gray coloured background boxes is a rather poorly designed aspect of the book given its target audience of undergraduates.

However, most figures and tables show information directly related to weed species or weed communities and in doing so serve the second objective of the book well. At the end of each chapter 3-6 questions are listed and students (readers) are asked to answer them in relation to “their own weed species”, species they are asked to select and to focus on throughout the book. This is a good idea and with exercises such as “Name a plant that you would consider to be a weed but someone else would not" then "Explain how this is possible" study can be made more interesting. For someone who undertakes this task seriously, a brief ecological monograph of his/her target weed species will be almost shaped by the time the course is finished.

From a didactic point of view the inclusion of "General References" should also be mentioned. There are 3-4 key 'general reference' papers given per chapter. These references are closely related to the essence of the associated chapter and listed separately from other references for further reading. The book is completed with a Subject index containing 432 entries and a Species index that lists 314 taxa in alphabetic order of the common names (followed by the Latin names in parentheses).

In conclusion, the authors achieve their aims and provide an excellent book for basic plant ecology with a unique feature that weeds play a prominent role in it. The book will probably be most welcomed at universities providing agricultural, horticultural and silvicultural courses. However, I would also recommend Weed Ecology as highly effective introductory reading for those seeking to grasp the essence of ecology and gather its fundamental knowledge, particularly for those researchers who have arrived in the field of agricultural science from other subjects without prior ecological education. Finally, the reasonable price of the paperback edition should help ensure high sales for the targeted student audience and beyond.

Reference

Begon, M., Harper, J.L. & Townsend, C.R. 1986. *Ecology. Individuals, Populations and Communities*. Blackwell, Oxford, 876 pp.

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