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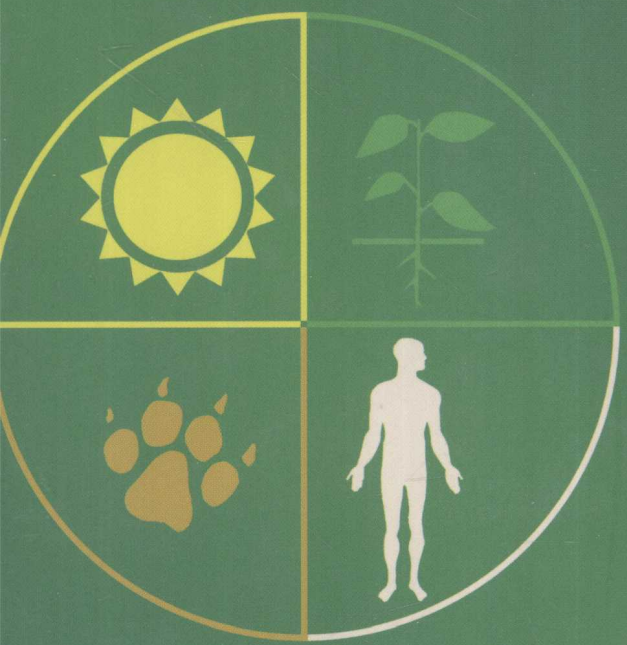
Global Ecology

全球生态学

Sven Erik Jørgensen



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全球生态学

——评《全球生态学》(Global Ecology)

牟溥

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这是继《生态系统生态学》之后，又一本衍生于2008年Elsevier集团出版，由丹麦生态学家Sven Erik Jørgensen主持编撰，达3，800页之巨的《生态学百科全书》的全球生态学分类子集。科学出版社决定将本子集进行导读出版，应有助于我国生态学者学习、探讨和理解全球生态学。与其姊妹子集《生态系统生态学》一样，这本书只是将《生态学百科全书》中有关全球生态学的部分抽出再组成的一本书，但这种处理将关于全球生态学的信息集中、方便使用，在无所不包的大部头中漫游找寻毕竟不如专科工具书来得方便。

与《生态系统生态学》相同，本书每个概念、词条自成一章，由对该领域有专攻的专家撰写而成，内容充分、讨论深入，概念、词条有较为完整、系统的讲解，并给出重要相关文献以备读者查询。本书编著者将收入的信息组合成五部分：第一部分：全球生态学，生物圈及其演化，第二部分：全球循环，平衡及流动，第三部分：全球格局与过程，第四部分：气候变化，和第五部分：生态化学计量学。这种内容组合使得内容系统化，使全书不仅方便作为一本工具书，而且也像是一本教科书。

本书第一部分包括十七章，对全球生态学、生物圈的来龙去脉进行了笼统的介绍：由地及天、由陆及海、由生物及非生物、由物及人、人类活动与智慧，乃至由地球到外星。许多章节着重于具体的大尺度生态学过程，如生物圈内真菌的功能、水圈、土壤圈、捕食者—被捕食者系统的进化等主流全球生态学兴趣所在，同时又分配相当章节介绍相当“深入”的生态学分支，如人类圈、人类知识圈、对生命现象的认识等内容，使人有在读“Deep Ecology”(深生态学——哲学的一个分支)文章的感觉。总之，这一部分有相当浓厚的欧洲学派的味道。本人并非在此对该学派进行褒贬，但的确感觉有些内容在本书开章辟节的讨论有点舍本求末。如这些内容浓缩在一两章内当是最佳。当然在生态学领域美英学派独大的今天，本书提供一些欧洲学派的味道，也有“兼容并蓄”的作用。

本书第二部分同样包括十七章，具体讨论了全球生态系统的能流和生物圈内的各主要元素、物质循环。看到这些章节的名称，读了其中的一部分，个人觉得有些章节如放到本人去年导读的《生态系统生态学》一书中恐更为适当。多数这些章节既讨论了这些元素在生态系统内的生物地球化学循环机制，又谈了全球尺度的机制与格局，具体放到生态系统生态学中还是在全球生态学中是见仁见智之事。这一部分还涉及有关的环境问题及全球变化下的相应变化，内容丰富，适合大学相应生态学课程参考。

本书第三部分和第四部分共包括十四章，其中第三部分九章，第四部分五章。其实这十四章都可以放在“全球格局与过程”这把伞下，为了强调气候变化，将五章特组成一部分。不过细察之，降水格局和温度格局这两章也可以放到第四部分。第三部分值得一提的是“全球尺度监测、观察和遥感”一章，作者用较长篇幅讲解利用遥感技术在全球尺度上对各种陆地生态系统、海洋生态系统的动态进行监测和观察。读者可以对这方面的知识有一个全面的、较深入的了解。另一较长篇幅的章节“物质与金属生态学”则讨论了金属冶炼与制造工业对环境的影响。如果严格从生态学的定义出发，本人觉得金属生态学的称谓有些牵强，至少从该章对其的描述讲解上，更像是在环境科学的范畴。第四部分的五章概括了气候变化的短期、长期及历史的变化以及大气碳的相应变化，气候变化与生物圈的共同进化，和全球变化对生物圈的影响。篇幅都不长，高度概括。

本书第五部分六章对学习生态化学计量学的学者应是很好的入门材料。从其研究对象的较细微时空尺度上，这些论述放到生态系统生态学中更为贴切。虽然许多章在详细讲述后另辟一节讲大尺度应用，但这些讲解似乎只是把研究对象放大。我很想看到在大尺度上应用生态化学计量学时如何评估、处理误差，但是很遗憾，我没发现这类讨论。

总而言之，这本来自百科全书的专集对所选内容论述具体、全面、充分，图文表并茂，信息量很大，是一本不错的专业参考书。本人前面的有些评价可能有所苛求，而且只代表个人，读者可用之为引玉之砖。我感觉科学出版社将本书导读出版将惠及广大的生态科学工作者们，丰富大家的知识，启迪大家的智慧与科学创新。

本书可作为研究生生态课程的参考书，对于从事生态学教学和研究的教学和科研人员、生态学者有非常高的参考价值。

前　言

全球生态学焦距在生物圈或称生态圈，并将其看成一个有大量共同影响的、统一的互作系统。这些互作及其影响可以解释生物圈里独特的性质。

本书第一部分展示了生物圈的这些独特性质。它们能够解释生物圈的生命维持功能。生物圈与所有其他圈互相开放，从而确定其组成。本部分还展示了这些其他圈的组成。

生物圈支持对生命至关重要的那些元素的全球循环。本书第二部分除了展示生物圈中重要的能流、物流和信息流外，还定量地展示了能量与物质的全球平衡。

本书第三部分展示全球循环、流动的结果，以及生物圈的特性：形成气候因子与洋流的格局。

气候对地球上的生物有最为明显的意义，但由于人类活动对生物圈的巨大影响，可以预见全球气候的变化。全球气候变化可能是今天最为热络的环境话题。本书第四部分讨论生物圈－气候相互作用和气候变化，以及它们对地球生命的影响。

本书第五部分涵盖生态化学计量学，并着重于生态化学计量学在量化生物圈内及生态系统内各种生物地球化学循环上的应用。

本书衍生于最近出版的《生态学百科全书》。得益于全球生态学部分的编辑 Yuri M Svirezhev，和生态化学计量学部分的编辑 James Elser 二位卓越的工作，才促成了这本展示全球生态学全面概述和作为可耦合全球与生态过程的生态化学计量学的书籍出版。Yuri Svirezhev 将编辑本书全球生态学部分视为一个巨大的挑战，并以最大的努力全面深入阐述这一深入其心的生态学领域。Yuri 在 2007 年 2 月过世，那时 90%的编辑工作已经完成。我愿以此书献给他，作为对他的怀念。

我还要感谢 James Elser 和所有全球生态学和生态化学计量学各章的作者们。是他们使得这部涵盖广泛，内容新颖的生态毒理学书籍出版成为可能。

Sven Erik Jørgensen

哥本哈根，2009 年 11 月

（牟溥　译）

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PREFACE

The focus of global ecology is the biosphere or the ecosphere conceived as one unified cooperative system with numerous synergistic effects that explain the unique properties of this sphere.

Part A of the book presents these unique properties of the biosphere, which are able to explain its life-bearing role. The biosphere is open to all other spheres, which determine its composition. The compositions of all the spheres are also presented in this part.

The biosphere supports the global cycles of the elements that are crucial for life. A quantitative representation of the global balances of energy and matter is covered in Part B, in addition to the important flows of energy, matter, and information in the biosphere.

Part C presents the results of the global cycles and flows and the biosphere properties: formations of patterns of climatic factors and marine currents.

The climate is of utmost significance for the life on Earth, but due to the huge impact of human activities on the biosphere, changes in the global climate are foreseen. It is probably the hottest environmental issue of today. The biosphere–climate interactions and climatic changes and their consequences for the life on Earth are discussed in Part D.

Part E covers ecological stoichiometry, which focuses on the application of stoichiometry for the quantification of the various biogeochemical cycles in the biospheres and in ecosystems.

The book is a derivative of the recently published *Encyclopedia of Ecology*. Due to an excellent work by the section editor of Global Ecology, Yuri M. Svirezhev, and the section editor of Ecological Stoichiometry, James Elser, it has been possible to present a comprehensive overview of global ecology and ecological stoichiometry as a useful tool to couple the global and ecological processes. Yuri Svirezhev considered his editorial work with the Global Ecology section as a great challenge and did his utmost to achieve a profound and comprehensive coverage of this ecological field, which was very close to his heart. Yuri passed away in February 2007, when about 90% of the work was done. I would therefore like to dedicate this derivative book to his memory.

I would like to thank James Elser and all the authors of the Global Ecology and the Ecological Stoichiometry entries, who made it possible to produce this broad and up-to-date coverage of ecotoxicology.

Sven Erik Jørgensen
Copenhagen, November 2009

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PART A

Global Ecology, The Biosphere and its Evolution

Introduction

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Further Reading

The focus of global ecology is the biosphere or the ecosphere conceived as one unified cooperative system with numerous synergistic effects that explain the unique properties of this sphere.

The biosphere has several unique properties that explain its function and role in supporting life on the Earth. The biosphere is open to the other spheres, and exchanges matter, energy, and information with the other spheres. The compositions of all the spheres are therefore important for life on the Earth.

We also use the term ecosphere for the part of the Earth that is bearing life and which includes both living and nonliving components. The composition of the ecosphere is important for its life-bearing ability and the composition of the ecosphere is dependent on the composition of all the other spheres, with which it exchanges matter, energy, and information.

The biosphere – like ecosystems – cycles the elements that are essential for life. The cycling of matter makes it possible to use again and again the matter to build up new biological components and is therefore a prerequisite for evolution. The global cycles and flows of elements are a result of a number of biological, physical, and chemical processes. It is important that we quantify the cycles and flows of the essential elements, because they determine whether the concentrations of biologically essential elements are in accordance with the functions and roles of the biosphere. They also determine the atmospheric and marine currents, which are decisive for the global pattern of the climate. The life conditions of all parts of the ecosphere are therefore rooted in a proper function and balance of the cycles and flows of the about 20 essential elements. A massive and steadily increasing impact of human activities on the biosphere has, however, reached a level where the global cycles and flows are influenced significantly by human activities. As one of the most important results we can foresee changes of the global climate, which will inevitably cause changes in the life conditions of all organisms on the Earth from microorganisms to humans. Moreover, the climatic changes will change the pattern of species and biodiversity on the Earth, which will influence the life conditions further.

The book Global Ecology presents the latest results of these dramatic global changes. Part A of the book presents the unique properties of the biosphere, which help to explain its life-bearing function and role. The compositions of all the spheres are presented in this part and all the spheres are open and determine the composition of the biosphere. Part A also discusses the crucial question in astrobiology, 'can life be found outside the Earth?', and presents the controversial Gaia hypothesis, which presumes that the ecosphere is working as one cooperative unit with numerous synergistic effects.

The biosphere supports global cycles of the elements that are crucial for life. A quantitative representation of the global balance of energy and matter is covered in Part B, in addition to the important flows of energy, matter, and information in the biosphere. This part reveals the imbalances in the global balance of the biologically essential elements.

The formations of different patterns of climatic factors and marine currents, which are the results of global cycles and flows and the biosphere properties, are presented in Part C. The agricultural pattern, which is a result of the pattern of climatic factors, is included in this part. Furthermore, Part C also covers the processes of global significance.

The climate is of utmost significance for the life on Earth, but due to the massive impact of human activities on the biosphere and as a matter of fact on all the spheres, changes in the global climate are foreseen. The interactions between the biosphere and the climate and the climate change and the consequences for the biosphere are covered in Part D.

Part E covers ecological stoichiometry, which focuses on the application of stoichiometry for the quantification of the various biogeochemical cycles in the biospheres and in ecosystems. The ecological stoichiometry gives the elementary interactions and interdependence of the various global cycles, balances, flows, and processes.