



# 工程生态学

ENGINEERING ECOLOGY

胡孟春 马荣华 著

——中国环境科学出版社

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胡孟春 马荣华 著

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## 前 言

改革开放以来，我国建设突飞猛进。祖国大地，一座座高楼拔地而起，一条条交通干线蜿蜒伸展，一片片工业园区落地而生，工程建设日新月异。13 亿人民在 960 万  $\text{km}^2$  土地上，大手笔描绘最新最美的图画。

恩格斯在 100 多年前告诫我们：“我们不要过分陶醉于我们对大自然的胜利，对于每次这样的胜利，自然界都报复了我们。”我们为国家建设成就而欣喜、而自豪时，不能忽视工程建设对生态环境的严重破坏，不能不正视大规模建设引起的资源枯竭、环境污染、生物物种锐减等问题。如何在工程建设中消除、减少对生态环境的影响，正确处理人与自然的关系，使工程技术系统与生态环境系统和谐相处，工程生态学是在这样的背景下诞生的一门新学科。

工程生态学是生态学在工程规划、建设、管理领域的具体应用，属于应用生态学的范畴。其主要研究对象是自然—技术系统，研究自然生态系统与工程技术系统的协调性。工程生态学一方面研究工程建设对生态环境的破坏与影响，另一方面研究减少、预防工程建设对生态环境影响的工程技术措施及管理措施，最终建立工程技术系统与生态系统协调关系。

工程生态学是吸收经典学科的知识、理论，吸收自然学科与工程学的知识、理论，所形成的一门新的综合学科。工程生态学的综合性表现在，一方面是自然环境与工程对象的融合，另一方面是相关学科知识系统的融合。

工程生态学研究的主要问题：分析在复杂的工程地质、水文及自然气候环境下，“自然—技术系统”正向与反向变化过程；定量评价自然环境总

的及局域性的损失；研究在“人类—自然体系”、“工业—环境体系”或“人类—技术—自然景观体系”，生态系统平衡的客观标准；在具体的“自然—工程技术体系”中获取生态信息的方法与技术手段；研究清洁生产材料、技术、设备；研究自然保护以及被人类工程破坏景观的恢复措施与方法；研究“自然—工程技术体系”的管理方法。

作者步入环境保护领域 10 多年，承接了一些工程生态研究课题。在课题研究中，深感从理论与工程实践的结合上，在环境保护领域，构建“工程生态学”初步框架的必要性。本书是作者所从事工程生态研究课题的汇总。介绍了工程生态学概念、学科体系、研究对象，介绍了所采用的研究方法，介绍了一些工程生态研究实例。

由于作者专业水平与工程实践的局限性，书中问题不少，谬误难免，敬请读者不吝指正。本书出版的目的是想提起同行专家、工程技术人员与广大读者，对工程生态问题的关注。作者衷心希望与同行专家一起持续努力，构建适合我国实际的“工程生态学”学科体系。

作者非常感谢：教育部国家留学基金委，给予了两次出国进修机会，与国外同行交流、切磋；环境保护部自然生态保护司、科技部国际合作司、江苏省科技厅国际合作处、江苏省交通规划设计院、环境保护部华南环境科学研究所、甘肃省环境保护局、张掖市环境保护处、中国科学院寒区旱区环境与工程研究所，给予了相关课题研究机会；环境保护部南京环境科学研究所，给予了科研环境与保障支撑条件。同时向参考或引用有关资料、数据、图表的参考文献的国内外作者表示敬意。

作 者

2008 年 7 月于南京

## Preface

China's construction has grown by leaps and bounds since the initiation of the policy of reform and opening-up. In every place of our country, people can see a large number of tall buildings, winding and stretching arteries and newly-built industrial parks, as well as rapidly changing project construction. 1.3 billion Chinese people are boldly creating the up-to-date and most beautiful picture on the land of 9.6 million square kilo meters.

As warned by Engels more than 100 years ago, "We should not enjoy our victory over nature, for nature would take revenge for any victory we have made." While we are delighted for and proud of the construction achievements of our country, we shall not neglect the severe damage of project construction to the ecological environment, and the problems such as resource exhaustion, environmental pollution and sharp reduction of biological species caused by large-scale construction. We have to consider how to eliminate and reduce the impact of project construction on the ecological environment, as well as properly deal with the relationship between man and nature so that the engineering system can be in harmony with the ecological environmental system in the process of construction. This is how Engineering Ecology, a new discipline, came into being.

As a branch of applied ecology, engineering ecology is the application of ecology in project planning, construction and management fields. It mainly studies the nature-technology system, probing into the coordination between the natural ecosystem and the engineering system. Engineering ecology explores the damage and impact of project construction on the ecological environment on one hand, and the engineering solutions and management measures for reducing and preventing the impact of project construction on the ecological environment on the other hand, finally establishing the harmonious relationship between the

engineering system and the ecosystem.

Engineering ecology is a comprehensive discipline formed by assimilating the knowledge and theory of classic disciplines, natural science and engineering. The comprehensiveness of engineering ecology is demonstrated by its merging natural environment and engineering objects, as well as knowledge systems of related disciplines.

Engineering ecology mainly researches: analysis of the positive and reverse changes of the “nature-technology system” in complicated engineering geological, hydrological and natural climatic environments; quantitative assessment of overall and regional losses of natural environment; research on the objective criteria of ecosystem balance in the “man-nature system”, the “industry-environment system” or the “man-technology-natural landscape system”; approaches and techniques of obtaining ecological information in the specific “nature-engineering system”; research on clean production materials, technology and equipment; research on measures and ways of protecting nature and recovering landscape damaged by human projects; research on management methods of the “nature-engineering system”.

Being involved in environmental protection for more than 10 years, the author has undertaken certain research topics on engineering ecology. In the research of these topics, the author has deeply felt it necessary to set up the initial framework of the “engineering ecology” system in the environmental protection field through the combination of theory and engineering practice. As a collection of the engineering ecological research topics that the author has been involved in, this book introduces the concept of engineering ecology, the discipline system, research objects, research approaches and cases of engineering ecological research.

As limited by the author’s expertise and engineering practice, there may be some problems and inevitable errors in this book. Please don’t hesitate to point them out. The publication of this book aims to arouse concerns for engineering ecological problems among counterpart professionals, engineering technicians and

a large number of readers. The author sincerely hopes to set up the discipline system of “Engineering Ecology” adapting to the actual conditions of our country by collaborating with counterpart professionals with repeated efforts.

The author is very grateful to: State International Students Scholarship, Ministry of Education, which provided me with two chances to study abroad and exchange and consult with foreign counterparts about engineering ecology; Department of Natural Ecological Protection, Ministry of Environmental Protection, Department of International Collaboration, Ministry of Science and Technology, International Collaboration Office, Jiangsu Provincial Department of Science and Technology, Jiangsu Provincial Communication Planning and Design Institute, South China Institute of Environmental Science, Ministry of Environmental Protection, Gansu Provincial Department of Environmental Protection, Zhangye Municipal Environmental Protection Office, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, which provided me with opportunities to get involved in research on related topics; Nanjing Environmental Science Institute, Ministry of Environmental Protection, which provided me with scientific research environment and security & support. Meanwhile, I also show my respect for authors both at home and abroad for the references and quotations of their related materials, data and diagrams in my book.

The Author  
July, 2008 in Nanjing



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# 第一部分

工程生态学学科体系  
及其研究方法





# 第1章 工程生态学概念及学科体系

## 第1节 工程生态学概念及学科体系

随着社会的发展, 工程建设的规模日益扩大, 工程建设活动与生态环境的矛盾越来越突出。如何解决工程技术系统与生态环境系统的协调性, 是迫切需要解决的问题。工程生态学是在这种强烈的社会、生产需求下, 产生的一门新学科。

工程生态学是生态学在工程规划、建设、管理领域的具体应用, 是属于应用生态学的范畴, 是生态学的一门技术应用学科。研究对象是自然—技术系统, 研究自然生态系统与工程技术系统的协调性。工程生态学一方面研究工程建设对生态环境的破坏与影响, 另一方面研究减少、预防工程建设对生态环境影响的工程技术措施及管理措施。最终是建立工程技术系统与生态系统协调关系。

工程生态学是一门综合性学科, 工程生态学的学科体系构成如图 1-1 所示。

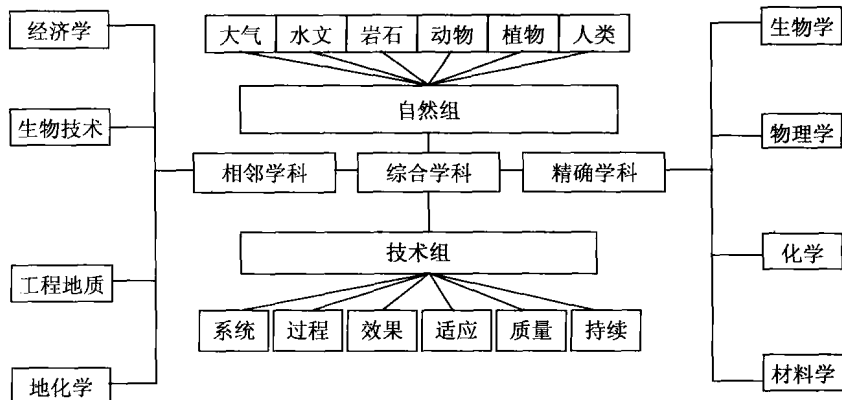


图 1-1 工程生态学的学科体系构成 (引自 И. И. МаЗур)

如图 1-1 所示, 工程生态学是吸收经典学科的知识、理论, 吸收自然学科与工程学的知识、理论, 所形成的一门新的综合学科。工程生态学的综合性表现在, 一方面是自然环境与工程对象的融合, 另一方面是相关学科知识系统的融合。