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Soundscape Ecology

Principles, Patterns, Methods and
Applications

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ISBN 978-94-007-7373-8 ISBN 978-94-007-7374-5 (eBook)
DOI 10.1007/978-94-007-7374-5
Springer Dordrecht Heidelberg New York London

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Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

The world is full of sounds that are shared by humans and many other organisms, but little is known about the role and importance of the acoustic context to guide evolutionary processes at different aggregation scales.

Recent advances in sound technology offer a friendly use of a broad collection of different devices able to store large digital sound files and to enter into contact with worldwide acoustic libraries from different biogeographic areas.

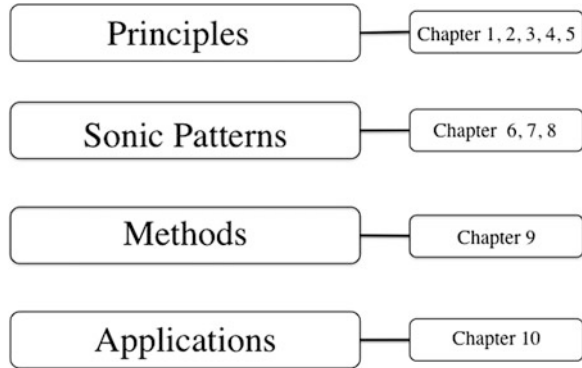
The style of the modern life is characterized by an increasing exposure to technological noise produced by cars, airplanes, trains, ships, and industrial activity, and such exposure, named sonic pollution, is responsible in animal populations and in human societies as well for profound changes in their behavior and in many life traits, creating a growing risk of extinction, especially for marine mammals. In addition, annoyance and relevant pathologies are effects that humans suffer when exposed to massive doses of noise.

The relationships between sounds and organisms have become a matter of interest for ecology and fully justify the creation of a distinct branch of ecological research: soundscape ecology.

This term is not new. Truax used such a term in defining soundscape ecology as the “The study of the systematic relationships between humans and sonic environments” [Truax B (ed) (1999) *Handbook for acoustic ecology*. Cambridge Street Publishing, Toronto]. From that time other scientists and scholars have utilized sound as a proxy to study several processes in animal communication, in community aggregation, in long-term monitoring, etc. We are sure we shall not disturb anyone if we consider soundscape ecology in a broader sense as an ecological discipline that investigates the effects of sounds on the structure and dynamics of animal species at the level of individual populations and community, humans included. The soundscape is an important theme to be developed, especially in urban societies, with reverberations in still-natural environments in remote regions. At the same time, soundscape ecology can approach the effects of landscape structures and biological dynamics on sounds.

The aim of this book is to create a learning tool primarily to teach soundscape ecology in advanced courses of ecology at universities, and at the same time to offer

Fig. 1 Schematic organization of the content



a guide to consultants and practitioners and finally updated reading for experts and amateurs.

Despite being aware of the limitations of this book, which may appear fragmented for the numerous topics discussed, our aim is to create an educational path able to introduce and guide students to the discovery of the soundscape domain and its complexity. To do this, in the text is included all the epistemic and technological information required to achieve the best results.

Definitively, this book is not a review of the state of the art of bioacoustics, ecological acoustics, or psychoacoustics, but a first annotated guide to explore some emergent aspects of the different approaches to sonic phenomena, introducing the “world of the sounds” with the clear and hopeful purpose to integrate the separate aspects of knowledge into a new emergent common disciplinary framework.

Up to the present, the epistemological context of soundscape ecology has not been well delineated, and probably this represents the major difficulty: to prime a new ecological discipline able to face the challenge to consider the acoustics of natural environments and the anthropogenic domain as components of the same phenomenological domain.

The book is organized in four main sections: Principles (Chaps. 1, 2, 3, 4, and 5), Sonic Patterns (Chaps. 6, 7, and 8), Methods (9), and Applications (10) (Fig. 1). In the first section are introduced the main sonic characters of the environment, the theories that actually have been developed to explain acoustic patterns and dynamics in natural and human-influenced landscapes, and all the other epistemic tools necessary for the best understanding of acoustic phenomenon. For this, elements of biosemiotics, cognitive ecology, and landscape ecology are briefly described (Chap. 1, Soundscape and Landscape Ecologies). The relationship between the geographic landscape and the soundscape is discussed, presenting models and conjectures. In particular, the principles that guide landscape ecology are compared with the principles adopted in soundscape ecology, trying to find points of contact and integrations that make sense across appropriate spatial and temporal scales.

The sonic character of the landscape under the constraint of the environmental proxies such as soil morphology, vegetation, and weather conditions is described (Chap. 2, Sonic Characters of Landscapes).

Theories, hypotheses, and models that explain the relationship between animals and soundscape are described and discussed according to the most advanced evolutionary and adaptive visions in terms of bioacoustics theories (Chap. 3, Bioacoustics Theories) and of communication theories (Chap. 4, Communication Theories).

Particular attention has been paid to the description of the acoustic dimension of humans (Chap. 5, Human Dimension of the Soundscape: From Individuals to Society).

In the second section, some sonic patterns such as noise (Chap. 6, Sonic Patterns I: The Noise), choruses (Chap. 7, Sonic Patterns II: The Choruses), and sound and vibrations from the soil (Chap. 8, Sonic Patterns III: Sounds and Vibrations from Soil) are described.

In the third section, acoustic fundamentals, parameters, and methodologies offer a short guide how to handle the sounds, the most updated list of devices, software and metrics used to capture, store, and process sound files (Chap. 9, Methods). Special emphasis is reserved to the metrics that are available to extract information on processes and patterns emerging from the sonic environment.

In the fourth section (Chap. 10, Applications), applications of soundscape ecology procedures are described in detail, with special emphasis on the protection of the sonic context in fragile and valuable landscapes such as natural parks and protected areas. Climatic change monitoring schemes are also considered, as well as all the problems related to acoustic pollution, that in the marine environment affects the large pelagic fishes and marine mammals so seriously, and in terrestrial landscapes the human societies that live in urban contexts.

At the beginning of each chapter a short abstract summarizes the main arguments considered, and full references of the authors cited in the text are also provided.

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