Long Term Socio-Ecological Research

Human-Environment Interactions

VOLUME 2

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Long Term Socio-Ecological Research

Studies in Society-Nature Interactions Across Spatial and Temporal Scales

Springer

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Foreword

People and their changing environment: how to deal with complexity

The broad field of ecology expanded during the twentieth century as a sub-discipline of biology, in order to combine the fundamental curiosity of scientists who wished to uncover the relationships between organisms and their environment with a growing societal awareness of the fact that we are now changing these relationships, on every single square metre of this planet. Nearly all of this change is to the detriment of the functioning of plants, animals and the communities they live in. As such, ecology can be seen as a success story: environmental legislation, first in the US during the 1960s and later also in Europe, began to be informed by ecological research. Now, ecologists form a large and mature community, drawing students to most universities world-wide. However, the environment keeps changing, and environmental policies very frequently fail to take into account even the simplest concepts of ecology. For example, it seems as though few, if any, nations had established an official assessment of their own natural capital and ecosystem services before Norway recently did so.

Most dramatically, we find ourselves helplessly witnessing the loss of species at an accelerating rate, thereby eradicating the fundamental "software" that might provide essential functions ("services") from our changed environment. In addition, the level of pollutants and other disturbing compounds in the environment is increasing in most places, with improved conditions only where the impacts were seen as "too lethal" (such as in European acidified lakes during the 1980s or for chlorinated hydrocarbons in North America during the 1960s). Finally, we still do not really know where the changes in our environment are affecting people in the most direct way, and which impacts might last longer than others.

Hence, while ecology often portrays itself as being helpful to society and policy makers, most often the link between published scientific findings and societal problems is not made. Instead, many ecologists express their concern to media and policy makers with a single and undifferentiated message: stop changing our

environment, cut greenhouse gas emissions, ban the destruction of the deep sea marine ecosystem, enlarge all protected areas, etc. Nearly all public debate in response to these calls merely succeeds in generating feelings of guilt among some portions of society and opposition in other sectors, while often producing little or no policy action and only temporary reductions in the scale of environmental degradation.

One key reason for this failure is that the root cause analysis of the problem is often incomplete. Frequently, any change of the so-called "natural state" is portrayed as negative by ecologists. But even hunting and gathering of food from ecosystems inevitably has an impact on species and communities. Agriculture, in the sense of either cultivating plant species on cleared land, or herding animals in open landscapes, is more intensive, covering a broad range from low impacts to the much higher ones of agro-industrial complexes. If society is to benefit from enhanced scientific knowledge about such impacts in a useful way, then systems must be analysed from a more comprehensive, interdisciplinary and human perspective – e.g., the perspective of Long-Term Socio-Ecological Research (LTSER). LTSER benefits from the conceptual advances in social ecology, which derive from the full range of interdisciplinary approaches that have developed, and are developing, to address the complexity of systems of nature and society over long periods of time.

From this viewpoint, the aspect of benefits, or "usefulness" (which is often relegated to managers or "applied research") of scientific efforts should be distinguished from pragmatism and advocacy. Aiming to directly address public concerns in the human-environment relationship does not imply asking less profound questions than those in other fields of science. Aiming to arrive at an objective analysis of human land use and the associated changes in the composition of species, as well as their population and community dynamics, demands substantial efforts in terms of conceptual development, multi-scale gathering of data and complex interpretation. Just as putting the "S" for "Society" into "Long-Term Ecological Research" means adding an important layer to an already complex set of studies, it also means that new types of topics enter the scene, such as socioeconomics, security, equity and gender issues. In this sense, while it might be more pragmatic to document a physico-chemical change (for example, the acidification of lakes or oceans) and the associated loss of biological function, extrapolate both into the future, and then complain loudly about society's lack of willingness to "do something", a more challenging in-depth analysis would include the study of the way in which the problem is perceived together with society's willingness to act, as part of the same investigation.

This book performs a remarkable "tour de table" of modern LTSER and related studies. Why the long-term? Clearly, from a human perspective, our agricultural life support system has been attuned to a geological period of particular stability over many millennia. Anthropogenic environmental change must be seen against these rather special conditions which have caused the evolution of highly specific ways of relating to the environment (at least on northern temperate latitudes). To adjust to the dynamics now introduced into the physical and biological environment requires an understanding of systemic behaviour on a range of time-scales, at a minimum of several decades. Gathering knowledge about the longer term situation, and observing

systems over periods that extend beyond the scope of a single PhD thesis or research grant is therefore essential to the analysis of social ecology.

The book also reveals that there is not a single unified theory for LTSER. In some studies, the actual analysis of social dynamics goes much deeper than it does in others. We may view this rather as an asset than as a limitation. If anything, this demonstrates that there is plenty of scope for further research developments and creativity, using the work assembled here as an inspiration rather than a straitjacket.

A key aspect of developing the field of LTSER is cooperation – among disciplines of course, but also among like-minded teams in different locations. In times of limited financial resources, international cooperation in particular may provide ways to enhance the value of the various contributions. The international community presently benefits from several platforms for such cooperation, two of which are directly associated with much of the work presented in this book. At the European level, the Network of Excellence ALTER-Net, funded by the European Unions 6th Framework Programme for the Environment (2004–2009) continues to provide crucial support for the development of the LTSER concept, including the training of a large number of next-generation scientists, many of whom are now familiar with concepts of social ecology. In the United States, the LTER network is becoming more interdisciplinary, adding expertise in demography, economics, geography, political science and sociology. At the global scale, the International Council of Science (ICSU) now builds on the achievements of its Earth System Science Partnership (ESSP) by developing a new Programme on Ecosystem Change and Society (PECS) to create global linkages between scientists addressing the human-environment relationship. We have no doubt that this book will provide substantial inspiration for anyone participating in these programmes – indeed, we hope that the programmes themselves will be enhanced by the material presented here.

Wolfgang Cramer
Stephen R. Carpenter

Foreword

In the pages of this book you will find a collaborative effort uniting many disciplines to understand humanity's long relationship with nature. It is a scientific enterprise in the broadest sense, including experts in social as well as natural fields. We can be hopeful that this effort marks a major turning point in consciousness and applied intelligence.

Ecology stands at the very centre of this book, a science that has grown in scope and importance since it was first named in 1866 by Ernst Haeckel, the leading German disciple of Charles Darwin. Haeckel derived the name from the Greek word *oikos,* or household, so that ecology was meant to be the study of Nature's household, or the natural economy, including the interactions of plants and animals, their relations to the soils and atmosphere. In this book, however, ecology moves decisively beyond the purely natural to encompass human society as well. "Long-Term Socio-Ecological Research" aims to achieve a comprehensive understanding of how humans have lived within and changed ecosystems over time. Why has this new, enlarged ecology become so necessary in our time? Because the changes going on across the earth are so cataclysmic and yet so poorly understood that we ignore them at our peril. Because they require a deep historical understanding of where we have been to know where we are going.

Over the past 500 years, good science has somehow advanced against the most powerful opposition, winning more battles than it has lost. It has driven not one or two but multiple revolutions, and at this moment the interdisciplinary study of ecology may be driving us toward still another intellectual revolution. The outcome will be not merely a better understanding of the interrelationships between society and nature but also a better understanding of where our limits lie.

In their concluding commentary on the book *Limits to Growth,* published in 1972, the executive committee of the Club of Rome wrote: "The concept of a society in a steady state of economic and ecological equilibrium may appear easy to grasp, although the reality is so distant from our experience as to require a Copernican revolution of the mind." That concept of society in a steady state of equilibrium seems implicit in the very notion of LTSER; if so, it will require an intellectual revolution before it is achieved.

The call for a new Copernican revolution appears more than once in recent writing: for example, in a paper that H. J. Schnellnhuber of the Potsdam Institute for Climate Impact Research in Germany published in Nature in December, 1999. Schnellnhuber argues that just as "optical amplification techniques brought about the great Copernican revolution, which finally put the Earth in its correct astrophysical context," so "sophisticated information-compressing techniques including simulation modeling are now ushering in a second 'Copernican' revolution." We are learning to see, for the first time, that the planet is "one single, complex, dissipative, dynamic entity, far from thermodynamic equilibrium—the 'Earth system.'"

So what was the Copernican revolution about, and what might a new Copernican revolution look like? Just 50 years after Columbus's first voyage to the New World, the Polish astronomer Nicholas Copernicus published his last and greatest work, *On the Revolutions of the Heavenly Sphere.* Before Copernicus, the earth had been the fixed centre of the universe, just as Europe had considered itself the fixed centre of human history. A 100 years later, astronomers had finally accepted that the earth was only one of several planets in motion around the sun, and that the universe was far more grand and infinite in its dimensions than anyone had realised. But it was far from easy to make that shift in consciousness, and Copernican ideas would bring fierce controversy in religion, philosophy, economics and politics that would not end for centuries to come. We are still struggling with their implications today.

Can we be sure that another, post-Copernican revolution is in the making? Do we have enough information to judge? The idea of a comprehensive perspective of "socio-ecology" does seem to be emerging, a science to which ecologists, geologists, climatologists, historians, geographers and others are contributing. It promises to provide a new understanding of the natural world and of our place in it. Whether this awareness adds up to a revolutionary change in understanding, to a new human way of thinking that accepts the ecosphere's limits and conserves its systems, we will not know for a long time to come. But such a revolution is possible, and we might even say inevitable. We are being driven by material changes that render old ideas outdated and even dangerous to our survival.

Donald Worster

Acknowledgments

With most creative and intellectual processes, achievements can rarely be credited to the efforts of single authors or editors alone. This volume is no exception. The current work is an outcome of unwavering support from a number of institutions, research networks and individuals who all deserve our heartfelt thanks.

The genesis of this effort can largely be attributed to the ALTER-Net process – A Long-Term Ecosystem and Biodiversity Research network of excellence mobilised and established with generous funding from the European Commission's 6th Framework Programme (2004–2009). Led mainly by natural scientists, integrating the social dimensions in the European Long-Term Ecological Research (LTER) was no easy task. In the years that followed, intense dialogues between the natural and social scientists involved eventually led to promising outcomes thereby enhancing the utility of LTER for society, denoted by the expansion of "ecological" in LTER to "socio-ecological" in LTSER. We would like to thank the ALTER-Net project and network co-ordinators, Terry Parr and Allan Watt, as well as the commission's project evaluator, Martin Sharman, for their support in providing this impetus.

A crucial role in spearheading these early discussions, besides some of the editors, was played by Verena Winiwarter, Sander van der Leeuw, Angheluta Vadineanu and Eeva Furmann, who paved the way for a European LTSER agenda, while conceptual rigour was provided by Marina Fischer-Kowalski and Anette Reenberg. Alongside this, the constant feedback received from the 30 members of the LTER-Europe Expert Panel on LTSER, mainly composed of LTSER Platform managers and primary investigators, cannot be underestimated. They actively tested the LTSER approach across Europe and fed their experiences back into further refining the LTSER concept.

However, it was not only developments in Europe that inspired this work in the first place. The goal of this volume at the outset was to crystallize the state-of-the-art in LTSER research and this would not have been achieved without the support of a number of pioneering colleagues in the US. We particularly want to thank Charles Redman, Nancy Grimm, Morgan Grove and Carole Crumley for their encouragement in the project and/or contributions to this book. The current volume has also greatly benefitted from the knowledge generated in a number of European research projects over the past years. Indeed, several contributions to

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Contents

1 Introduction 1
Simron Jit Singh, Helmut Haberl, Marian Chertow, Michael Mirtl, and Martin Schmid

Part I LTSER Concepts, Methods and Linkages

2 Socioeconomic Metabolism and the Human Appropriation of Net Primary Production: What Promise Do They Hold for LTSER? 29
Helmut Haberl, Karl-Heinz Erb, Veronika Gaube, Simone Gingrich, and Simron Jit Singh

3 Using Integrated Models to Analyse Socio-ecological System Dynamics in Long-Term Socio-ecological Research – Austrian Experiences 53
Veronika Gaube and Helmut Haberl

4 Modelling Transport as a Key Constraint to Urbanisation in Pre-industrial Societies 77
Marina Fischer-Kowalski, Fridolin Krausmann, and Barbara Smetschka

5 The Environmental History of the Danube River Basin as an Issue of Long-Term Socio-ecological Research 103
Verena Winiwarter, Martin Schmid, Severin Hohensinner, and Gertrud Haidvogl

6 Critical Scales for Long-Term Socio-ecological Biodiversity Research 123
Thomas Dirnböck, Peter Bezák, Stefan Dullinger, Helmut Haberl, Hermann Lotze-Campen, Michael Mirtl, Johannes Peterseil, Stephan Redpath, Simron Jit Singh, Justin Travis, and Sander M.J. Wijdeven

7 Human Biohistory 139
Stephen Boyden

8 Geographic Approaches to LTSER: Principal Themes and Concepts with a Case Study of Andes-Amazon Watersheds 163
Karl S. Zimmerer

9 The Contribution of Anthropology to Concepts Guiding LTSER Research 189
Ted L. Gragson

Part II LTSER Applications Across Ecosystems, Time and Space

10 Viewing the Urban Socio-ecological System Through a Sustainability Lens: Lessons and Prospects from the Central Arizona–Phoenix LTER Programme 217
Nancy B. Grimm, Charles L. Redman, Christopher G. Boone, Daniel L. Childers, Sharon L. Harlan, and B.L. Turner II

11 A City and Its Hinterland: Vienna's Energy Metabolism 1800–2006 247
Fridolin Krausmann

12 Sustaining Agricultural Systems in the Old and New Worlds: A Long-Term Socio-Ecological Comparison 269
Geoff Cunfer and Fridolin Krausmann

13 How Material and Energy Flows Change Socio-natural Arrangements: The Transformation of Agriculture in the Eisenwurzen Region, 1860–2000 297
Simone Gingrich, Martin Schmid, Markus Gradwohl, and Fridolin Krausmann

14 The Intimacy of Human-Nature Interactions on Islands 315
Marian Chertow, Ezekiel Fugate, and Weslynne Ashton

15 Global Socio-metabolic Transitions 339
Fridolin Krausmann and Marina Fischer-Kowalski

Part III LTSER Formations and the Transdisciplinary Challenge

16 Building an Urban LTSER: The Case of the Baltimore Ecosystem Study and the D.C./B.C. ULTRA-Ex Project 369
J. Morgan Grove, Steward T.A. Pickett, Ali Whitmer, and Mary L. Cadenasso

17 Development of LTSER Platforms in LTER-Europe: Challenges and Experiences in Implementing Place-Based Long-Term Socio-ecological Research in Selected Regions 409
Michael Mirtl, Daniel E. Orenstein, Martin Wildenberg, Johannes Peterseil, and Mark Frenzel

18 Developing Socio-ecological Research in Finland: Challenges and Progress Towards a Thriving LTSER Network 443
Eeva Furman and Taru Peltola

19 The Eisenwurzen LTSER Platform (Austria) – Implementation and Services 461
Johannes Peterseil, Angelika Neuner, Andrea Stocker-Kiss, Veronika Gaube, and Michael Mirtl

20 Fostering Research into Coupled Long-Term Dynamics of Climate, Land Use, Ecosystems and Ecosystem Services in the Central French Alps 485
Sandra Lavorel, Thomas Spiegelberger, Isabelle Mauz, Sylvain Bigot, Céline Granjou, Laurent Dobremez, Baptiste Nettier, Wilfried Thuiller, Jean-Jacques Brun, and Philippe Cozic

21 Long-Term Socio-ecological Research in Mountain Regions: Perspectives from the Tyrolean Alps 505
Ulrike Tappeiner, Axel Borsdorf, and Michael Bahn

22 Integrated Monitoring and Sustainability Assessment in the Tyrolean Alps: Experiences in Transdisciplinarity 527
Willi Haas, Simron Jit Singh, Brigitta Erschbamer, Karl Reiter, and Ariane Walz

23 Conclusions 555
Marian Chertow, Simron Jit Singh, Helmut Haberl, Michael Mirtl, and Martin Schmid

About the Contributors 563

Index 579

Acronyms

ALTER-Net	A Long-Term Biodiversity, Ecosystem and Awareness Research Network
BEC	Baltimore Ecosystem Study
CBD	Convention on Biodiversity
CBNA	Alpine National Botanical Conservatory
CEM	Commission on Ecosystem Management
CZO	Critical Zone Observatory
DEHI	Danube Environmental History Initiative
DIVERSITAS	An international Programme on Biodiversity science
DPSIR	Driver-Pressure-Impact-State-Response
EBONE	European Biodiversity Observation Network
EEA	European Environment Agency
e-MORIS	Electronic-Monitoring and Research Information System
EnvEurope	Environmental quality and pressures assessment across Europe
ERA	European Research Area
ESEE	European Society for Ecological Economics
ESI	Ecosystem Service Initiative
ESSP	Earth System Science Partnership
EVALUWET	European Valuation and Assessment Tools Supporting Wetland Ecosystem
EXPEER	Experimentation in Ecosystem Research
ExtremAqua	Influences of Extreme Weather Conditions on Aquatic Ecosystems
FCM	Fuzzy Cognitive Maps
FP	Framework Programme
GEA	Global Energy Assessment
GISP	Global Invasive Species Programme
GLEON	Global Lake Ecological Observatory Network
GLORIA	Global Observation Research Initiative in Alpine Environments
GLP	Global Land Project
GMBA	Global Mountain Biodiversity Assessment
HEF	Human Ecosystem Framework

IBP	International Biological Programme
ICP	International Cooperative Programme
ICPDR	International Commission for the Protection of the Danube River
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Programme
ILTER	International Long-Term Ecological Research Network
INSPIRE	Infrastructure for Spatial Information in the European Community
IPBES	International Platform on Biodiversity and Ecosystem Service
IPCB	International Press Centre for Biodiversity
IPCC	Intergovernmental Panel on Climate Change
ISEE	International Society for Ecological Economics
ISSE	Integrative Science for Society and the Environment
IUCN	International Union for Conservation of Nature
JPI	Joint Programming Initiative
LECA	Laboratory of Alpine Ecology
LIFE+	The Financial Instrument for the Environment
LTER	Long-Term Ecosystem Research or Long-Term Ecological Research
LTER-Europe	Long-Term Ecosystem Research Network Europe
LTER Site	Long-Term Ecosystem Research Site
LTSER	Long-Term Socio-Ecological Research
LTSER Platform	Long-Term Socio-Ecological Research Platform
MAB	Man and the Biosphere Programme
MEA	Millennium Ecosystem Assessment
MoU	Memorandum of Understanding
MSP	Math-Science Partnership
NCEAS	US National Center for Ecological Analysis and Synthesis
OOI	Oceans Observatory Institute
NAS	National Academy of Sciences
Natura2000	An ecological network of protected areas within the European Union
NCA	National Climate Assessment
NEHN	Nordic Environmental History Network
NEON	National Ecological Observatory Network
NESS	Nordic Environmental Social Science
NoE	Network of Excellence
NSF	National Science Foundation
PAME	Participatory Assessment, Monitoring and Evaluation
PECS	Programme on Ecosystem Change and Society
PPD	Press-Pulse Dynamics Framework
PTA	Participatory Technology Assessments
PVA	Population Viability Analysis
RCN	Research Coordination Network
SCOPE	Scientific Committee on Problems of the Environment
SEBI	Streamlining European Biodiversity Indicator

SEIS	Shared Environmental Information System
SERD	Simulation of Ecological Compatibility of Regional Development
SMCE	Social Multi-Criteria Evaluation
TEEB	The Economics of Ecosystems and Biodiversity
TERENO	Terrestrial Environmental Observatories
TFRN	Task Force on Reactive Nitrogen
ULTRA-Ex	Urban Long-Term Research Areas Exploratory Projects
UNECE	United Nations Economic Commission for Europe
UNEP	United National Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
URGE	Urban Rural Gradient Ecology project
UTC	Urban Tree Canopy
WFD	EU Water Framework Directive
WSSD	World Summit on Sustainable Development

List of Boxes

Box 1.1 The International Long-Term Ecological Research (ILTER) Network 7

Box 7.1 Human Health Needs 158

Box 7.2 The Health Needs of Ecosystems 158

Box 20.1 Structure and Governance of the Central French Alps LTSER Platform 488

Box 22.1 Challenges of Transdisciplinary Research 549

List of Figures

Fig. 1.1 Intellectual genealogies of LTSER 3
Fig. 1.2 Case studies in this volume across time and space 15

Fig. 2.1 Basic approaches to analyse socioeconomic metabolism. (a) Systemic approaches account for all physical flows (materials, energy, substances) required for reproduction and functioning of socioeconomic stocks. (b) Life-cycle analysis accounts for resource requirements or emissions from one unit of product or service throughout its entire life cycle ('cradle to grave') 32
Fig. 2.2 Scheme of economy-wide (national-level) material and energy flow (MEFA) accounts 34
Fig. 2.3 Definition of HANPP – see text for explanation 38
Fig. 2.4 Stocks and flows of carbon in Austria 1830–2000. (a) Socioeconomic carbon flows per year. (b) Carbon stocks in biota and soils in billion tonnes of carbon. (c) Net carbon exchange between atmosphere and biota/soils. (d) Net carbon emissions considering the terrestrial carbon sink 42
Fig. 2.5 Preliminary causal loop model of the land use model for Austria 1830–2000 – see text for explanation 44

Fig. 3.1 Generic heuristic model of socio-ecological systems at the interface of natural and cultural spheres of causation [Reprinted from Haberl et al. (2004). With permission from Elsevier] 54
Fig. 3.2 Sustainability triangle of farmsteads simulated by SERD 61
Fig. 3.3 Decision tree for the 'farm' agent type. *Round light grey boxes*: status of a farm calculated by an automatically induced yearly evaluation of the relation between income and workload. Depending on the status, each farm decides

with certain probabilities to take one of the defined actions or to stay passive (that is mostly the case). *Angled boxes*: Options for decisions available in each state. A decision for one of the options changes income, work load, land use, substance flows, etc 63
Fig. 3.4 Interface of the Reichraming model simulating the development of different parameters (socioeconomic and ecological) under different framework conditions (changeable as sliders – *grey boxes* at the *bottom*) 67

Fig. 4.1 Territory and transport in hunting and gathering societies 81
Fig. 4.2 Territory and transport in agrarian societies, village level 84
Fig. 4.3 Territory and transport in agrarian civilisations, by spatial scale 85
Fig. 4.4 The overall structure of the model 86
Fig. 4.5 Detailed model structure of the rural subsystem 89
Fig. 4.6 Urban subsystem details 92
Fig. 4.7 Per capita material use (*DMC*), and per capita transport effort (*ML, MM*) for hunters & gatherers and for agrarian societies by size of urban centre to be sustained (standard productivity assumptions) 96
Fig. 4.8 The share of urban (in contrast to rural, agricultural) population in the total system, and the share of the urban population required for transportation, in relation to size of urban centre (standard productivity assumptions) 96
Fig. 4.9 The relation between agricultural productivity and human transport effort, by size of urban centre. Results from the standard, a low and a high productivity scenario. In the low productivity scenario we assumed a 40% lower area and 15% lower labour productivity as compared to the standard scenario (see Table 4.2). In the high productivity scenario we assumed corresponding increases in area and labour productivity 97

Fig. 5.1 Location of the Danube sections Machland and Struden, Lower and Upper Austria (Map modified from Hohensinner et al. 2011) 109
Fig. 5.2 (a–f) Historical development of the Danube in the Machland floodplain 1715–2006: (a) and (b) prior to channelisation in 1715 and 1812, respectively, (c) at the beginning of the channelisation programme in 1829 (*red circle*: first major river engineering measure). (d) excavation of the cut-off channel 1832, (e) at the end of the channelisation programme in 1859, (f) after channelisation and hydropower plant construction in 2006 (Hohensinner 2008) 110

Fig. 5.3 The flood in Regensburg in 1784 (Angerer 2008) (© Museen der Stadt Regensburg – Historisches Museum) 111
Fig. 5.4 Arrangement for catching the Beluga sturgeon (*Huso huso*) at the Iron Gate. 115

Fig. 7.1 Biohistorical pyramid 141
Fig. 7.2 Biohistorical conceptual framework 142
Fig. 7.3 Biosensitivity triangle 153
Fig. 7.4 The transition framework 157

Fig. 8.1 Visualisation of the principal intellectual spaces of Nature-Society Geography 165

Fig. 9.1 Model of "circumstances remote in time and of a general order" from de Toqueville's analysis of the French Revolution – factors not in parenthesis are features identified by de Toqueville; those in parenthesis are psychological assumptions or assertions (After Smelser 1976) 201
Fig. 9.2 Coweeta LTER project area scales and research activities. (a) SE U.S. showing relation of project areas. (b) Coweeta LTER Project area in relation to state boundaries and intensive research sites. (c) Macon County NC with research watersheds by development type. Insets show watersheds classified by land ownership persistence (*LOPI*) – darker values indicate greater persistence. (d) Example of land required for architecture, agriculture, firewood, and mast harvest in proximity to a group of Cherokee villages based on "best" assumptions of per capita requirements (After Bolstad and Gragson 2008) 204

Fig. 10.1 Conceptual framework for an urban socio-ecological system (*SES*) that can be used to visualize human-environment interactions at multiple scales. These interactions operate continuously in this multiscalar space, as shown by the *faint, gray, elliptical arrows* (Modified for the urban SES based the framework presented in Collins et al. 2011) 221
Fig. 10.2 Map of Arizona, USA, showing extent of the Sun Corridor Megapolitan (*blue shading*) and the CAP study area within it (*red shading*). *Gray lines* are county boundaries 222
Fig. 10.3 Analysis of land transitions in central Arizona between 1970 and 2000 (After Keys et al. (2007) based on a graphic designed by B. Trapido-Lurie; used with permission from Taylor & Francis) 226

Fig. 10.4 Spatial distribution of heat intensity in Phoenix, AZ, in July 2005. (a) Hours in a 4-day period that temperature exceeded 110 °F (43 °C), (b) demographic characteristics of the population in low-, medium- and high-exposure areas, and (c) a graphic representation of the heat exposure "riskscape" for the region (Map in (a) and data in (b) used with permission from Ruddell et al. 2010) 229
Fig. 10.5 Maps of the urbanised central Arizona, USA region, showing the spatial distribution of plant phenological variables, start of growth, rate of greenup, end of growth, and rate of senescence. The *thick black lines* are the area freeways, which approximately enclose the urbanised/suburbanised portion of the region, comprising ~24 municipalities of the Phoenix metropolitan area. The large area that is differentiated from the surrounding desert to the north and south of the east-west freeway extending to west from the metropolitan area is an agricultural region that has yet to become urbanised. Seasonal parameters for the initial (spring) growth period were extracted from 2004 to 2005 normalised difference vegetation index (NDVI) data that were filtered with a Savitsky-Golay technique. NDVI data provide an index of greenness from remote imagery that can be correlated with vegetation biomass; changes in NDVI with time reflect growth (*increasing greenness*) or senescence (*decreasing greenness*). Dates are displayed as day of year (year 2005 days are shown in *parentheses*). Rates are calculated as tangent of slope between 20 and 80% levels of NDVI (Data and figures from Buyantuyev 2009)..... 230
Fig. 10.6 Paired aerial photographs showing the change in land cover and use in Indian Bend Wash, Scottsdale and Tempe, Arizona between 1949 (*top*) and 2003 (*bottom*). The 1949 image shows a landscape dominated by farm fields, with country roads (part of the characteristic grid pattern of metropolitan Phoenix) evident as *light gray lines*. These same roads can be seen in the 2003 image, but farm fields have been replaced by housing developments and commercial (*right side of image*) and institutional (*upper left part of image*) land uses. The ephemeral stream (1949) and designed lake chain (2003) can be seen bisecting the images from *top to bottom*. Note the wide, shrub and tree-covered channel in the *upper image*; although by 2003 it was replaced by parks, lakes, and streams, the relatively wide channel still contains flash floods (see text for further description) 232
Fig. 10.7 Model showing major compartments of the biogeochemical cycles (Reprinted from Kaye et al. 2006, with permission from Elsevier)..... 234

Fig. 10.8 Lead concentration (μg/kg) measured in 2005 in the surface soil (1–10 cm) across the CAP LTER study area. *Brown lines* show major freeways; the urbanised region is encircled by these roads (Reproduced with permission from Zhuo 2010) 235
Fig. 10.9 Spatial distributions of (a) (*top*) criteria air pollutants and (b) percentage of the population that is in the Hispanic ethnic group, in the central Arizona–Phoenix region (Reproduced with permission from Grineski et al. 2007)..... 236

Fig. 11.1 Population development, Vienna 1800–2000. System boundary: 1800–1890 territory of districts 1–9; from 1890 on the respective administrative boundaries, see text 252
Fig. 11.2 Energy consumption (DEC) in the city of Vienna, 1800–2000: DEC in PJ/year (a) and share of energy carriers in DEC (b)..... 254
Fig. 11.3 Vienna's electricity supply by source 1926–2006..... 256
Fig. 11.4 Population and energy consumption 1800–2000. (a) Development of population, domestic energy consumption (DEC) and DEC per capita and year (indexed 1800 = 1); (b) DEC per capita and year by main energy carriers in GJ 256
Fig. 11.5 Actual and virtual forest area required to supply Vienna with wood and coal 261

Fig. 12.1 Austro-Hungarian immigrant farms, including the Thir farm, situated within Finley Township. Small locator maps show the location of Kansas within the United States and of Decatur County and Finley Township within the state of Kansas 272
Fig. 12.2 Theyern land management; (a) Small meadows and orchards clustered closely around residential house lots, while cropland surrounded the village. On the outskirts of the community, woodlands prevailed on poor soils not suitable for cropping; (b) The cropland portion of the agro-ecosystem rotated annually through a three-field sequence. Family farms consisted of scattered plots distributed across all parts of the village, as illustrated here for the Gill family, one of the larger holdings (ca. 13 ha farmland)..... 275
Fig. 12.3 A conceptual model of agriculture as a coupled socioeconomic and natural system (See text for explanation)..... 278
Fig. 12.4 People and space, Theyern, 1829 and Finley Township and Thir farm, 1895–1940; (a) population density; (b) average farm size; (c) land availability..... 284
Fig. 12.5 Annual farm productivity, Theyern 1829 and Finley Township and Thir farm, 1895–1940; (a) grain yield; (b) area productivity; (c) labour productivity; (d) marketable crop production..... 286

Fig. 12.6 Livestock and nutrient management, Theyern, 1829 and Finley Township and Thir farm, 1895–1940; (a) livestock density; (b) nitrogen return 289

Fig. 13.1 Geographic position of the two case study regions 300
Fig. 13.2 Conceptual scheme of the applied system boundaries and the energy flows calculated in this study 302
Fig. 13.3 (a) Land use in Sankt Florian, 1864–2000; (b) Land use in Grünburg, 1864–2000. "Additional forest area" in Grünburg region was modelled based on the differences between cadastral forest records available only in 1995 and the statistical data used in all other points in time 308

Fig. 14.1 Line of sight along the dynamic metabolic interface between natural and human systems where quantitative measurements of socio-ecological variables are made 320
Fig. 14.2 Oahu's dependence on various types of imported goods by percentage (Eckelman and Chertow 2009b) 328
Fig. 14.3 Number of manufacturing enterprises by sector and successional stage in Barceloneta, PR, 1950–2005 (Based on Ashton 2009) 332

Fig. 15.1 The development of coal use (a), pig-iron production (b) and the railway network (c) in selected countries from 1750/1830 to 1910 and coal use in the United Kingdom (UK) as virtual forest area (d) (Datasources: Authors' calculations based on Mitchell 2003; Maddison 2008; Schandl and Krausmann 2007). To convert coal use into virtual forest area (d), it was assumed that a quantity of fuelwood with the equivalent energy content to the coal used can be provided through sustainable forest management (i.e. through the use of annual growth and not standing timber mass). The forest area required to produce this volume of fuelwood is presented as a virtual forest area. Accordingly, by 1900, coal use in the United Kingdom represented a forest area five times the size of the entire country 346
Fig. 15.2 The establishment of new energy sources in the United Kingdom (1750–2000) (a) and worldwide (1850–2005). (b) In this diagram, the share of total primary energy supply represented by the three fractions biomass, coal and oil/natural gas (including other energy forms) is depicted. The biomass fraction includes all biomass used as food for humans and livestock and biomass used for all other purposes, together with fuelwood 351
Fig. 15.3 Motor vehicle stocks (a) and electricity generation (b) in the 20th century (Data sources: Authors' calculations based on Mitchell 2003; Maddison 2008) 353

Fig. 15.4 The development of global energetic and material societal metabolism. (a) Per capita energy consumption in the UK and Austria, (b) Global per capita energy and material consumption, (c) Global primary energy consumption by technology, and (d) Global material consumption 357
Fig. 15.5 CO_2 emissions resulting from combustion of fossil energy sources and cement production in selected countries. Data given in tonnes of carbon (C) per capita and year. (a) Industrialised countries (b) Southern hemisphere countries..... 361

Fig. 16.1 In *Pasteur's Quadrant*, Stokes categorises four different types of research. Most research associated with BES would be located in Pasteur's quadrant: Use-inspired basic research..... 375
Fig. 16.2 The human ecosystem concept, bounded by the *bold line*, showing its expansion from the bioecological concept of the ecosystem as proposed originally by Tansley (1935) in the *dashed line*. The expansion incorporates a social complex, which consists of the social components and a built complex, which includes land modifications, buildings, infrastructure, and other artefacts. Both the biotic and the physical environmental complexes of urban systems are expected to differ from those in non-urban ecosystems (Figure copyright BES LTER and used by permission (Pickett and Grove 2009) 378
Fig. 16.3 The human ecosystem framework. This conceptual framework identifies the components of the resource and human social systems required by inhabited ecosystems. The resource system is comprised of both biophysical and social resources. The human social system includes social institutions, cycles, and the factors that generate social order. This is a framework from which models and testable hypotheses suitable for a particular situation can be developed. It is used to organise thinking and research and is a valuable integrating tool for the BES (Re-drawn from Machlis et al. 1997)..... 380
Fig. 16.4 Press–pulse dynamics framework (PPD). The PPD framework provides a basis for long-term, integrated, socio–ecological research. The *right-hand side* represents the domain of traditional ecological research; the *left-hand side* represents traditional social research associated with environmental change; the two are linked by pulse and press events influenced or caused by human behaviour and by ecosystem services, top and bottom, respectively (Collins et al. 2011). Individual items shown in the diagram are illustrative and not exhaustive..... 381

Fig. 16.5 Framework for complexity of socio-ecological systems. The three dimensions of complexity are spatial heterogeneity, organisational connectivity and temporal contingencies. Components of the framework are arrayed along each axis increasing in complexity. For example, a more complex understanding of spatial heterogeneity is achieved as quantification moves from patch richness, frequency and configuration to patch change and the shift in the patch mosaic. Complexity in organisational connectivity increases from within unit process to the interaction of units and the regulation of that interaction to functional patch dynamics. Finally, historical contingencies increase in complexity from contemporary direct effect through lags and legacies to slowly emerging indirect effects. The *arrows* on the *left* of each illustration of contingency represent time. While not shown in the figure, connectivity can be assessed within and between levels of organisation (Cadenasso et al. 2006) 386
Fig. 16.6 Examples of socio-ecological data types organized by scale and intensity of analysis. Data types marked in *green* are data that LTSER sites must typically acquire, document, and archive. Data types marked in *red* are typically collected by LTSER sites (Zimmerman et al. 2009)..... 388
Fig. 16.7 Example of non-census data sets with spatial reference to Baltimore City, 1800–2000 (Figure developed for Baltimore LTER Figure copyright BES LTER and used by permission from Boone)..... 389
Fig. 16.8 BES has instrumented a set of nested and reference watersheds that vary in current, historical, and future land use and condition (Figure copyright BES LTER and used by permission from O'Neil-Dunne)..... 392
Fig. 16.9 LTSER Platforms are similar to a table with four legs essential to the integrity of the whole: long-term monitoring, experimentation, comparative analyses, and modelling (Figure adapted from Carpenter 1988)..... 393
Fig. 16.10 The LTSER data temple, with specific BES research themes included (Figure copyright BES LTER and used by permission from Grove) 395
Fig. 16.11 Linkages between decision making, science, and monitoring & assessment (Figure copyright BES LTER and used by permission from Grove) 397
Fig. 16.12 An abstracted cycle of interaction between research and management. The cycle begins with the separate disciplines of ecology, economics and social sciences interacting with a management or policy concern. In the past, ecology

has neglected the urban realm as a subject of study, leaving other disciplines to interpret how ecological understanding would apply to an urban setting. A management or policy action ($Action_z$) results. Management monitors the results of the action to determine whether the motivating concern was satisfied. Contemporary urban ecology, which integrates with economics and social sciences, is now available to conduct research that recognises the meshing of natural processes with management and policy actions. Combining this broad, human ecosystem and landscape perspective with the concerns of managers can generate a partnership to enhance the evaluation of management actions. New or alternative management actions can result ($Actions_{z+1}$) (Pickett et al. 2007) 398

Fig. 16.13 An example of the management-research interaction in Baltimore City watersheds. Traditional ecological information indicated that riparian zones are nitrate sinks. The management concern was to decrease nitrate loading into the Chesapeake Bay. In an effort to achieve that goal, an action of planting trees in riparian zones was proposed. Management monitoring indicated that progress toward decreasing Bay nitrate loadings was slow. Results from BES research suggested that stream channel incision in urban areas has resulted in riparian zones functioning as nitrate sources rather than sinks. In partnership with managers and policy makers in Baltimore City and the Maryland Department of Natural Resources, a re-evaluation of strategies to mitigate nitrate loading was conducted. This led to a decision to increase tree canopy throughout the entire Chesapeake Bay watershed. Baltimore City adopted an Urban Tree Canopy goal, recognising both the storm water mitigation and other ecological services such canopy would provide (Pickett et al. 2007) 400

Fig. 17.1 The functional components of LTSER Platforms 416

Fig. 17.2 Infrastructural elements of LTSER Platforms across spatial scales within a LTSER Platform region 417

Fig. 17.3 Hierarchy of research projects in LTSER Platforms 419

Fig. 17.4 Schematic fuzzy cognitive map derived from two interviews in the Eisenwurzen LTSER Platform – Austria 424

Fig. 17.5 Simplified model of the Critical Ecosystem Services of the Eisenwurzen LTSER Platform and their interaction *left*: *green* = positive, *red* = negative) and scenario of their future importance (*right*: light *blue* = historical situation, dark *blue* = current situation) (Austrian contribution to the ILTER Ecosystem Service Initiative) 425

Fig. 17.6 Interactions of key elements and factors in the socio-ecological system across sectors (environment in *greens* and *blue*, economy and society in *white* and *grey*) and scales in the LTSER Eisenwurzen (Austrian contribution to the ILTER Ecosystem Service Initiative) 425
Fig. 17.7 Socio-ecological profile of the LTSER Eisenwurzen Platform according to the ISSE/PPD framework (Collins et al. 2007, 2011): The conceptual elements, described by Grove et al. (Chap. 16 in this volume) are parameterised based on comprehensive analyses combining disciplinary scientific expertise and primary stakeholders perception (Fuzzy Cognitive Mapping) 426
Fig.17.8 Thresholds (T) and their interactions (I) across sectors (environment, economy, society) and scales in the Eisenwurzen LTSER region (Austrian contribution to the ILTER Ecosystem Service Initiative according to Kinzig et al. (2006)) 427
Fig. 17.9 Geopolitical coverage of LTER-Europe (as of 2010; Mirtl et al. 2010) 432
Fig. 17.10 Location of 31 European LTSER Platforms in 2010 (including five preliminary Platforms). The map reflects the 48 socio-ecological systems of Europe (Metzger et al. 2010). Environmental zones are colour-coded. The brightness of each colour varies according to the economic density, varying between < 0.1 Mio €/km^2 (lightest) and > 0.1 Mio €/km^2 (darkest). The Platform labels are the unique LTER-Europe site codes. According to these site codes, details for each Platform can be found in Table 17.1 433
Fig. 17.11 Conflicting priorities in LTSER Platform implementation. *Left side*: Cases requiring complex approaches in creating the framework for socio-ecological research. *Right side*: Less demand for matrix functionalities and supporting services due to simpler settings 435

Fig. 19.1 Overview of the process and development of the Eisenwurzen LTSER Platform 468
Fig. 19.2 The area of the Eisenwurzen LTSER Platform, including infrastructure elements 470
Fig. 19.3 Interlinkage between the elements of the Eisenwurzen LTSER Platform 471
Fig. 19.4 Data management concept for Eisenwurzen LTSER Platform 478

Fig. 20.1 Location map for the Central French Alps LTSER Platform and meteorological stations. The Platform includes areas with strict protection status (*dark grey*): the Vercors High Plateaux Natural Reserve and some of the core area of the Ecrins National Park, as well as inhabited areas managed by agriculture and forestry (*light grey*): the Vercors Natural Regional Park and part of the peripheral area of the Ecrins National Park. Meteorological monitoring stations set up by the LTSER Platform are located using different symbols depending on the equipment in place 490
Fig. 20.2 Conceptual presentation of the Central French Alps LTSER research questions 492
Fig. 20.3 Recent climatic trends over the Vercors High Plateaux. Interannual variability of air temperature (at 850 hPa level; in °C) and water precipitation (in kg/m^2) calculated for the Vercors site on the 1948–2010 period (anomalies were calculated from NCAR-NCEP reanalysis; time-series anomalies are smoothed using a moving average over 12 months) 492
Fig. 20.4 Potential ecosystem service supply and actual provision of agronomic services to farmers of Villar d'Arène (Hautes Alpes). (a) Green biomass (tons/ha) (b) Potential agronomic value (unitless) calculated as a combination of different functions (green biomass, digestibility and phenology), and actual benefits: (c) the number of days of livestock units/ha and (d) hay production (tons/ha). Roads and tracks are added on maps as they are important elements of analysis (Modified from Lamarque et al. 2011) 499

Fig. 21.1 LTER Sites in the Tyrolean Alps LTSER Platform. *Numbers* refer to Table 21.1 508
Fig. 21.2 Climate, land cover and indicators of development in the Tyrolean Alps LTSER Platform (For details see Tappeiner et al. 2008b) 511
Fig. 21.3 Environmental and socioeconomic factors affecting ecosystems in the Tyrolean Alps 513

Fig. 22.1 Integrated monitoring of natural and social spheres as a foundation for negotiating development options (Adapted from Fischer-Kowalski et al. 2008) 534
Fig. 22.2 (a) Development of number of inhabitants, buildings and beds in relation to the index year 1970 (equals 1) up to 2005. (b) Number of overnight stays for summer and winter tourism and the total of both of these in 1,000 stays from 1977 to 2006 538

Fig. 22.3 Settlement area in 1973 and 2003. The *red spots* in the aerial photos are buildings and the *blue line* is the boundary of the settlement area 538
Fig. 22.4 (a) Comparing a photomontage from 1974 projecting the year 2000 (*left*), with (b) an actual photo taken in 2007 (*right*) 539
Fig. 22.5 Comparison of the occurrence of species of two alpine plant communities (snow bed, alpine grassland with Carex curvula) in 1970s and 2006..... 541
Fig. 22.6 Land cover change visible in aerial photos for 1972 and 2003..... 542
Fig. 22.7 Map of stakeholders, grouping persons or groups according to their relation to nature and their predominant scale of action..... 544
Fig. 22.8 Causal model linking influential external and internal variables – 13 in all – with system parameters and ultimately with the outcome dimension of sustainability 546

List of Tables

Table 3.1 Elements of the stakeholder process conducted in Reichraming over a period of 3 years 65
Table 3.2 Storylines of the three scenarios trend, globalisation and local policy described by the stakeholders and calculated by the integrated socio-ecological model..... 66
Table 3.3 Results of the three scenarios in comparison with the initial value (all values are in total for the whole region)..... 68

Table 4.1 Basic model assumptions of the human food calculator..... 87
Table 4.2 Basic model assumptions and characteristic parameters of the biomass production calculator (standard and low productivity scenario), compared with empirical data on nineteenth century Austrian land use systems (three case studies)..... 88
Table 4.3 Basic model assumptions on the relation of food production and agricultural biomass flows (biomass flows per unit of food output) and assumptions on transport stages of different biomass categories 88
Table 4.4 Basic model assumptions to calculate transport indicators..... 91
Table 4.5 Modelling results for material flows and transport in agrarian societies..... 94

Table 6.1 Definition of scale mismatches between biodiversity, biodiversity management, and biodiversity-relevant policy (upper two rows). Definition of scale mismatches of research, monitoring, and evaluation carried out within each of these parts (third row)..... 127

Table 8.1 Core themes of this study and the levels of correspondence to principal areas (Human-environment interactions and nature-society relations) of the geographic sub-field (see also Fig. 8.1)..... 166

Table 8.2 Case study-based illustrations of concepts at the intersection of geography and LTSER 175
Table 8.3 Examples of temporal scaling of human-environment interactions and water-resource/agricultural land use in Bolivia Table (19th and 20th centuries) 176
Table 8.4 Principal characteristics of a spatial network of potential LTSER sites (Central Bolivia) 178

Table 10.1 LTER ecological core areas, proposed LTER social science core areas, and CAP LTER integrated project areas 224

Table 11.1 Phases of the urban energy transition: Average annual growth rates of population and energy consumption (DEC) and the share of biomass and coal in total energy consumption 264

Table 12.1 Population, land use, livestock and crop production in Finley Township, 1895–1940 280
Table 12.2 Population, land use, livestock and crop production on the Thir farm, 1895–1940 280
Table 12.3 Socio-ecological characteristics, Finley Township, 1895–1940 281
Table 12.4 Socio-ecological characteristics, Thir farm, 1895–1940 282
Table 12.5 Population, land use, livestock and crop production in Theyern municipality, 1829 282
Table 12.6 Socio-ecological characteristics, Theyern municipality, 1829 283

Table 13.1 Data sources 302
Table 13.2 Structural parameters characterising the case studies: Number of population, farms, and livestock; land availability and use; average yields and productivity 304
Table 13.3 Biomass flows in the agricultural sector of the studied land use systems: Domestic extraction (DE), Imports (Im), Direct Input (DI), Exports (Ex) and Domestic Consumption (DC) of biomass; per capita (GJ/cap) and per agricultural area (GJ/ha_{agr}) 305

Table 14.1 Characteristics of the selected islands 319
Table 14.2 Puerto Rico's top five export Commodities, USD million 326
Table 14.3 Singapore's top five import commodities, USD million 326
Table 14.4 Singapore's top five export commodities, USD million 327

Table 15.1 Sociometabolic profile of selected countries in 2000 358

Table 17.1 Overview of European LTSER Platforms, status as of 2010. The labels of platforms in Fig. 17.10 refer to the column "Site_Code" in this table 434

Table 18.1 Interdisciplinary thematic research funding programmes of the Academy of Finland 447

Table 19.1 Biophysical characteristics of the Eisenwurzen region 464
Table 19.2 Land-cover characteristics of the Eisenwurzen region 464
Table 19.3 Inhabitants and population density in the Eisenwurzen region 465
Table 19.4 Exemplary list of research projects within the Eisenwurzen LTSER Platform allocated to the three research areas 474

Table 20.1 Partners and their disciplines involved in the Central French Alps LTSER Platform Aps 488

Table 21.1 Location, site characteristics and research focus of current research sites at the Tyrolean Alps LTSER Platform 509

Table 22.1 Variants of "transdisciplinary" ("td") research and main features 530
Table 22.2 Critical indicators investigated in the biosphere reserve Gurgler Kamm 537
Table 22.3 Alpine winter sporting days for village and mountains of Obergurgl for a recent decade and the decade starting in 2041 542
Table 22.4 Sustainability indicators for describing and assessing the scenarios 547
Table 22.5 Initial sustainability assessment of the four scenarios for Gurgl 2020 548