E wie Ethik


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Ethik und Umweltpolitik

Humanökologische Positionen und Perspektiven

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E wie Evaluation

Inter- und transdisziplinäre Forschung ist ein junger und schnell wachsender Zweig in der Wissenschaftslandschaft. Wie sehen die besonderen Herausforderungen aus und wie lässt sich die Qualität ihrer Ergebnisse sichern? Wie sieht das forschungspolitische Umfeld aus? Das Buch beleuchtet alle relevanten Aspekte, die für erfolgreiche fachübergreifende Forschungsprojekte wichtig sind.

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Evaluation inter- und transdisziplinärer Forschung

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N wie Nachhaltigkeitsforschung


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Stand und Visionen am Beispiel nationaler und internationaler Forscherverbünde

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Lines of Tradition and Recent Approaches to Urban Ecology, Focussing on Germany and the USA

Urb an ecology has been and is influenced by many different disciplines and research fields, especially by urban research, urban planning, sociology, and politics. In an article titled Urban Research and Urban Ecology in the Past and in the Present, Sukopp (1994) summarises the variety of urban research in which urban ecology is embedded. As applies also to other research fields, urban ecology is not independent with regard to its genesis, but contributes to the much more comprehensive field of urban research. In order to understand, for instance, developments of urban land use, of the existence and coexistence of species, and of urban temperature (as the environment of organisms), it is necessary to know how urban systems function in terms of matter flows, transport routes, financial aspects of the housing market, globalisation, etc. Today’s urban everyday life and urban form are very different from those of earlier generations. As a consequence, urban ecologists have to take into account progress in other disciplines and refer to it in their research. The basic questions are: Does an epistemological core of urban ecology exist? What are relevant factors influencing urban ecological research? The goal of this text is to point out which self-conceptions the research field of urban ecology has developed over time and what the future challenges of urban ecological research are. These questions have to be answered in a fruitful dialogue with other, e.g., neighbouring, research fields.

Different Lines of Tradition in Urban Ecology

Urban ecology is characterised by a multitude of research approaches. Which lines of tradition can be identified in urban ecology, what are their roots, and how have they evolved and influenced each other? Today, urban ecology has to cope with complexity, change, risks, vulnerability, and other challenges.
Line of Tradition Rooted in Natural History

The beginning of urban ecological research is rooted in 16th-century observations of nature in cities, recorded prior to the officially recognised definition of ecology by Ernst Haeckel. As early as 1597, John Gerard recorded in his publication *The Herball or Generall Historie of Plants*: “(Parietaria judaica) groweth neere to old walls in the moist corners of churches and stone buildings” (quoted from Woodell 1979). Spontaneously growing species in the cities probably drew the attention of botanists to stonewalls, castles, and ruins, which were identified as the first “habitats” in urban areas (Sukopp 2002). Figure 1 shows a photo of *Cymbalaria muralis*, a species typical for walls.

This brings up the question of whether or not such observations can already be labelled as urban ecology, even though the term did not yet exist in the 16th century. Once the occurrence of species was explained with the help of habitat descriptions, it stands to reason that these descriptions can be termed “urban ecology”. This opinion is justifiable because an “all-encompassing understanding” of urban ecology is considered illusory for reasons based on cognition theory (Trepl 1988). Thus all observations of urban nature can be summarised as the ecology of biological species in cities within the line of tradition rooted in natural history.

The societal and scientific context of the early urban ecology records is interesting. The history of ideas addresses in particular the early modern era, the Renaissance and Reformation era. Political reforms and revolutions were formative in Europe. At that time the European city was characterised by a high building density with castles, churches, cathedrals at central urban places within city walls. Extensions of the built-up area, often connected with the demolition of the city walls induced by economic and demographic growth, set up the preconditions for further urban development (Mumford 1963, Lichtenberger 2002).

Personalities such as Alexander von Humboldt made expeditions to foreign countries. Such expeditions were often commissioned by geographical societies and served not only the purpose of securing the “colonial interests” and exploring foreign cultures, but also the study of exotic animal and plant species as well as the discovery and import of new plants with economic potential. Knowledge about the medical use of herbs was widespread. Thus it is not surprising that interest in acquiring knowledge about nature was applied to cities as early as the 16th, 17th, and 18th centuries (Sukopp 2002).

The line of tradition rooted in natural history continues in an altered form. It appears today as a partial aspect of bio-ecological (e.g., Penev et al. 2005) as well as of bio-geographical research approaches (Wania et al. 2006).

Sociological and Human Ecology Tradition

The sociological and human ecology tradition is rooted in Europe as well as in the USA, at least in the middle of the 19th century (Melosi 2000, Winiwarter and Knoll 2007). However, the establishment of the sociology branch of the Chicago School in the 1920s, in which Robert Ezra Park played an important role (Park et al. 1925), had a major influence on the development of urban ecology. In the 1920s, Chicago was in the heyday of industrialisation and was characterised by radical social and economic upheavals. Within few decades the city, which had been surrounded by huge agricultural fields, was transformed from a provincial town into an industrial city, while increasing tenfold the number of its inhabitants. As a consequence of a laissez-faire policy of urban development, Chicago and other industrial cities were polluted by emissions from heavy industry and overcrowded with industrial workers living in extremely unhealthy conditions. Chicago was a typical example of the unsanitary industrial cities of the 19th and early 20th centuries in North America and Europe with extremely high-density tenements, with deficits in water supply, sewage and waste disposal, with poor air quality and poor lighting conditions. These conditions and their consequences provoked Robert E. Park to commence his socio-ecological studies,

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**TABLE**: Lines of tradition in urban ecology, identified on the basis of the relevant literature.

<table>
<thead>
<tr>
<th>line of tradition</th>
<th>object of investigation</th>
<th>approach</th>
<th>research motives</th>
</tr>
</thead>
<tbody>
<tr>
<td>line of tradition rooted in natural history</td>
<td>non-human organisms, in particular plant and animal species</td>
<td>descriptive; simple habitat characterisation</td>
<td>interest in natural and historical sciences, descriptions of nature, improved use of nature</td>
</tr>
<tr>
<td>(since 16th century)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sociological and human ecology tradition</td>
<td>humans and social groups and their dependence on their built, social, and physical environment</td>
<td>application of ecological concepts and methods to investigate the living conditions of humans and social groups</td>
<td>improving sociological and human-ecological factors for human health</td>
</tr>
<tr>
<td>(since approx. 1920)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bio-ecological tradition</td>
<td>non-human organisms, in particular plant and animal species; urban soils, water bodies, and climate</td>
<td>in parts complex ecological site characteristics, sometimes multi-disciplinary supplements</td>
<td>developing a baseline for nature protection that serves human recreation and recuperation</td>
</tr>
<tr>
<td>(since approx. 1965)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(eco)system-related tradition</td>
<td>urban ecosystems; matter fluxes, energy fluxes; non-human organisms</td>
<td>systems approach; analysis of complex influencing factors</td>
<td>preserving (eco)systems for humans and other species</td>
</tr>
<tr>
<td>(since approx. 1970)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>applied urban ecology as a contribution to sustainable urban development</td>
<td>matter/material fluxes, energy fluxes; all organisms (biodiversity); societal and governance aspects</td>
<td>multi- and transdisciplinary analysis of complex influencing factors, differing from study to study</td>
<td>preserving an environment worth living for human beings now and for future generations, conservation of biodiversity and of non-renewable resources</td>
</tr>
<tr>
<td>(since approx. 1990)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
which were strongly influenced by Georg Simmel and Max Weber, among others.

The Chicago School investigated the interrelations between city and society, in particular the living conditions of the industrial workers. Robert E. Park and Ernest W. Burgess tried to explain the urban development processes of Chicago and their impacts on social groups by means of a human-ecological or “quasi biological” research approach (Feagin 1998, p. 2), using theoretical concepts of animal and plant ecology, e.g., succession, symbiosis, competition, and adaptation (Kurtz 1984, p. 21). They explained phenomena such as migration and segregation phases of different population classes and social minorities with the help of “invasion-succession cycles” and city structure models.

The socio-ecological tradition of urban ecology was continued by a collateral human-ecological perspective (e.g., Winter and Mack 1988, Fellenberg 1991), which shall not be presented here.

Bio-Ecological Tradition
After the climax of the economic boom in the USA and Europe that followed the Second World War, there came the realisation of the finite nature and instability of fossil fuel supply, and urban ecology received much more attention than before. In the 1970s, Herbert Sukopp and a group of colleagues developed a complex bio-ecological approach to urban ecology (e.g., Sukopp 1973 and 2005). In its early years, this so-called Berlin School of Urban Ecology carried out mainly ecological site analyses and field botany research on wasteland that existed in great quantities in Berlin in the years after the Second World War. Its approach, which maintains urban flora, fauna, and habitats as the core of its discourse, can be considered a more versatile strand of the line of tradition rooted in natural history.

Some of the research that was developed within the framework of the Berlin School of Urban Ecology is complex and inte-
Ilirke Weiland, Matthias Richter

In this approach, humans influence and superimpose natural habitat conditions, especially in the form of land use and land use changes. Research is centered on organisms, species, and their habitats; additionally, urban climate, soil, and water bodies are investigated, mainly in urban areas. Humans play a role as a source of disturbance and as users of urban nature, above all for recreational purposes (figure 2). A central and application-oriented motive for research is to transfer nature conservation to cities and urban areas in order to protect urban nature for the human inhabitants. Further research approaches that can be considered to be examples of this line of thought are presented, for example, by Gilbert (1989) and Wittig (1991).

In his complex theoretical framework of basic research questions and hypotheses of urban ecology, Trepl (1994) focuses on biocoenotical aspects of animal and plant species in urban settings, their integration, succession, and ability to invade urban spaces. He argues that thinking about the degree of integration of urban ecosystems leads to reflections on three dualisms: holism versus reductionism, individualistic versus organismic, and ecosystem-oriented versus population biology-oriented concepts. He favors the hypothesis that cities are disintegrated ecosystems and systems of instability compared to most non-urban ecosystems; in the latter, it is much easier for ecologists to make a prognosis about future states of the system. Concerning biocoenotical contexts, cities are more adequately characterized by a low degree of integration and can be better described by individualistic concepts. In this approach as well as in the textbook of Sukopp and Wittig (1993), transitions to research approaches of urban ecology named in the following section are evident.

One of the most important merits of this approach was and is to contribute to an increased consciousness towards nature and nature protection in urban areas.

**[Eco]System-Related Tradition**

During the same time period as the Berlin School of Urban Ecology, an (eco)system-related tradition of urban ecology evolved on an international level. This approach is also built on various other research traditions. It is highly influenced by American and German landscape ecology (Tansley 1935, Troll 1939 and 1968, Schmithüsen 1942, Neef 1967) and systems theory (von Bertalanffy 1953), the systemic approach linking both research directions.

![Figure 2: Modifications of an urban ecosphere – relations between selected land use types and basic urban environmental aspects. Dependencies between species (especially plant species) and site conditions, as well as biocoenotical and population-biological relations, are among the focuses of the so-called Berlin School of Urban Ecology. Figure modified according to Sukopp (1990) and Sukopp and Wittig (1993). For detailed information, see Sukopp (1990).](image-url)
Later influences can be characterised by the keywords “patterns and processes”. Major international research programmes such as UNESCO’s Man and the Biosphere Program (MAB) (Spooner 1986) and the International Biological Program (IBP) initiated large research projects in this area.

The research activities initiated by the MAB programme are quite diverse. They include, for instance, studies about climate and social change, geo-ecology, forests, and mountain ecosystems (Spooner 1986). Some of these studies are integrative and comprehensive, e.g., the Chiba Bay-Coast Cities Project that involves aspects of plant and animal ecology, microbiology, human ecology, psychology, soil science, meteorology, hydrology, environment-

Challenging questions in urban ecology include: How will urban biodiversity develop as a consequence of climate change and other social and technological transformations? How can climate change be mitigated in urban areas, and how can we adapt to it in order to avoid major damage as well as environmental and health risks?

The most important merits of this approach include its contribution to an increased understanding of how (and which) substances accumulate in different ecosystem compartments (e.g., urban soil) and how they can become dangerous for plants, animals, and humans via food chains. Furthermore, the identification and quantification of regional to global material and energy fluxes has increased the understanding of the global interconnectedness of the single city, not only in economic aspects, but also with respect to resource flows and environmental pollution.

Applied Urban Ecology as a Contribution to Sustainable Urban Development

Today, urbanisation, the formation of metropolises, and mega-urbanisation are predominant trends in many parts of the world. The 21st century is termed the “urban century”: 80 percent of Europeans and over 50 percent of the world’s population are urban dwellers today; the latter share is expected to exceed 60 percent by 2030 and 70 percent by 2050, with the urban population going to be concentrated in Asia (54 percent) and Africa (19 percent) (ESA 2008).

Cities and urban regions are considered to be systems in a permanent state of change, which are subject to large-scale influencing factors such as economic, technological, demographic, and ecological development, i.e., global, demographic, and climate change. We cannot give a comprehensive overview of the variety of urban development processes, but will focus on the most characteristic features relevant for the discourse of urban ecology.

The concentration of economic activities and traffic in cities causes a high resource use, leads to environmental pollution far beyond urban borders, and contributes to global warming (Hall and Pfeiffer 2000). Suburbanisation and “urban sprawl” due to
changes in lifestyles, household structures, and production are characteristic for most European and North American cities and urban regions. The emerging new types of urban settlements have been referred to as “inter-city” (“Zwischenstadt”; see Sievert 1998) or “network city” (“Netzstadt”; see Baccini and Oswald 1998). From an environmental point of view, suburbanisation, i.e., the networking of cities, causes a fragmentation of nature and landscapes, the transformation of habitats, and the loss of natural areas. Dynamically growing agglomerations contrast with economically weak and stagnating cities, growth and shrinkage processes usually occurring simultaneously within cities.

The United Nations Conference on the Human Environment in Stockholm 1972 served as a cornerstone for the urban ecology line of research aiming at environmental protection. Twenty years later, at the United Nations Conference on Environment and Development in Rio de Janeiro 1992, cities were addressed as both the producers and victims of pollution; improving the urban environment within the broad concept of sustainable urban development gained high significance in the final documents (e.g., Agenda 21, Rio Declaration on Environment and Development, Convention on Biological Diversity, Convention on Climate Change).

Global urbanisation and its unintended negative consequences for the urban environment and urban dwellers necessitates sustainable urban development on a global scale. Sustainable development is a goal of political negotiation with no foreseeable end point. Considering the differences between cities and the variety of urban development processes, every city has to find its own way of striving for sustainability. As a consequence, many differing understandings of sustainable urban development exist; the complexity of the integrated model and its need for interpretation are both its characteristic and its problem. In Europe important objectives are, for example, mixed urban development and the “city of short distances” (“Stadt der kurzen Wege”) in order to avoid further urban sprawl (Oswald and Baccini 2003). The large amount of public awareness that the sustainability discussion enjoyed at the beginning of the 1990s diminished in the following years. Sustainable urban development has, nevertheless, never disappeared from the political agenda; mainly international organisations work on its implementation and the scientific discussion has never broken off (e.g., Atkinson et al. 2007, Elliott 2006, Girard et al. 2005, Girardet 2007).

Parallel to the sustainability discourse, but only partly linked to it and only indirectly referring to urban ecology, the discourse on “new urbanity” has spread among architects and planners in North America and Europe since the 1980s (e.g., Häußermann and Siebel 1995, Swyngedouw et al. 2002, Oswald 2003). “New urbanity” is understood as “the way of living of the majority of people in developed countries” that “is based on modern technical, social and organisational preconditions” (Oswald and Baccini 2003, p. 291). It is an alternative draft to the decline of heavy industry as well as river- and seaports, to suburbanisation and urban sprawl. The concept of new urbanity is multifaceted: Urban reconstruction, revitalisation of urban brownfields, rebuilding of historic townscapes, and rediscovery of urban waterfronts characterise the concept. Some examples are the Docklands in London and Dublin, “Kop van Zuid” in Rotterdam, or “Harbour City” in Hamburg.

Both concepts, “sustainable urban development” and “new urbanity”, have an influence on urban development that cannot be measured, are hardly observable and are mostly concentrated in scattered projects. “New urbanity” especially addresses urban ecology in the majority of cases only indirectly.

Nevertheless, ever since that time, urban environmental research has been carried out and discussed more frequently under the aspects of resource protection and diminution of environmental pollution aiming at equal opportunities for future generations, considered constituent parts of the integrative concept of sustainable (urban) development (e.g., Kennedy et al. 2007, Weiland 2006, Mander et al. 2006, Marchettini et al. 2004, IWM EB 2002).

At the International Conference on Urban Ecology in 1997 in Leipzig, a broad scope of issues related to urban ecology, the perception of urban ecological issues by urban citizens, and policy approaches were discussed (Breuste et al. 1998). Furthermore, “redesigning the urban metabolism in view of sustainability goals” is considered a relevant research question for urban ecology (Brunner 2007). These examples show that urban ecology research has both thematically expanded compared to previous decades and shifted towards investigating the applicability of research findings in urban decision making (Baccini 1996, Alberti et al. 2003, Pickett et al. 2004, Müller et al. 2008).

Recent Comprehensive Approaches to Urban Ecology

In recent times, parallel to economic globalisation, we can observe an increasing internationalisation of urban ecological research activities, most of which have hitherto been conducted in Europe and North America (Deeter 2003). A considerable step forward in international cognition of urban ecology can be attributed to the interdisciplinary research teams at the Long Term Ecological Research (LTER)\(^1\) sites in Baltimore and Phoenix in the United States and to cooperating research groups (Alberti 2008, Grimm et al. 2008, Marzluff et al. 2008). The urban ecology research programme\(^2\) in Baltimore, Maryland, seeks to understand an urban region as an ecological system and investigates a) the relations between spatial structures of socio-economic, ecological, and physical features and their changes over time, b) the fluxes of energy and matter as well as human influences on these, and c) options to improve the quality of the urban environment. Field studies are conducted in an urban watershed.

Moreover, it should not be forgotten that the complex urban ecosystem patterns, as well as aspects of social order (status, power, norms, etc.; considering land use decisions, institutions, demographic patterns, and estimation of the ecological footprint of a city. It asks how cities process energy or matter relative to their surroundings. This approach is realised in the above-mentioned LTER studies. “Ecology of cities” is an atypical representative of a classical ecosystem approach. However, it is proclaimed to include the human component more explicitly in the research agenda, for example, by considering land use decisions, institutions, demographic patterns, as well as aspects of social order (status, power, norms, etc.; see Grimm et al. 2000, pp. 575 ff.). This does not mean that limited questions in urban ecology would lose their justification. Moreover, it should not be forgotten that the complex urban ecological research projects at the turn of the 21st century had its comprehensive precedents (e.g., Duvigneaud 1974, Boyden et al. 1981, Numata 1982).

During the first years of the new millennium – although this certainly was prepared by multiple research projects and publications in the years before – a complex systems approach to cities and their ecology has become common within the majority of the scientific community. Today, cities are considered coupled complex human and ecological systems. They are characterised by non-linear development over time with leaps, unforeseen changes, and new emerging properties. Multiple agents, feedback mechanisms, and their variability in time and space imply complexity, heterogeneity, and surprise as inherent characteristics of urban ecosystems. As a consequence, their behaviour is not exactly predictable and prognoses are uncertain (Alberti 2008, pp. 225 ff.). Urban risks as well as vulnerability and resilience of urban systems represent recent research issues.

Conclusions and Outlook

Urban ecology is an interdisciplinary research field at the interface of natural sciences, social sciences, and humanities. Research issues of urban ecology are – comparably to other research fields – influenced by scientific discourses of their time and the respective prevailing urban forms. Today, urban ecological research has to cope with complexity, change, uncertainty, risk, vulnerability and resilience, as well as urban environmental quality and urban quality of life. The recent findings in urban ecology imply a new research agenda trying to address these issues, including the elaboration of a new theory on urban ecology (Alberti 2008, p. 263). Sectoral solutions to pressing problems of the urban environment are increasingly considered inefficient. Instead, integrative problem-solving approaches related to urban decision making and governance are requested.

Interrelations of environment and society are perceived on a global scale. Reports on environmental disasters such as hurricane Katrina are immediately spread and perceived as local con-
plied research irrelevant. Instead, according to Funtowicz and Ravetz (1993), adequate kinds of problem serving strategies have to be chosen for every particular case in question.

While approaching cities as socio-ecological systems and intending to contribute to sustainable urban development, urban ecological research “must embrace change and evolution” (Coelho and Ruth 2006, p. 181). A promising approach for future research is to link to existing and historical research themes, to rise to the challenges of climate change, and to test recent findings in urban agglomerations with different stages, directions, and velocities of urban development (Weiland et al. 2005).

To analyse differences and similarities between urban ecology and urban environmental history (Melosi 2000) in more detail would be an interesting research topic. Some of the primary themes in urban environmental history, which were summarised by Tarr (2001) and taken from Schott (2004, p. 521), exemplify some overlap with urban ecology. Common research issues are, for example, the impact of the built environment and human activities in cities on the natural environment and the relationship between cities and an ever widening hinterland. Urban environmental history has discussed, for example, the effects and changes of urban technical infrastructure and metabolisms (i.e., the sum of all input and output between biosphere/geosphere and society). This concept has similarities when compared to the study from Duvigneaud (1974) and is included under the label urban ecology.

A special chapter of urban environmental history is the sanitation of cities (“Assanierung der Städte”). The German term “Assanierung”, etymologically coming from the French “assainissement”, is discussed by Weyer-von Schoultz (1998). The related problems are enormously important on a global scale today (e.g., Dye 2008, Konteh 2009). Because they have not been in close range of urban ecologists’ self-conception up to now, “Assanierung” and the closely related topics “healthy cities” and “urban sanitation” shall not be gone into here.

Further large challenging questions in urban ecology are: How will urban biodiversity develop as a consequence of climate change and social and technological transformations? How can climate change be mitigated in urban areas, and how can we adapt to it in order to avoid major damage as well as environmental and health risks? How can synergies be found, for example, between nature protection, flood prevention, and recreation in urban areas? Which ecological potentials do shrinking cities offer? A more theoretical question is: How will urban ecology develop further with regard to the depicted traditional lines? Will the different research strands of urban ecology be influenced to a greater extent by the findings of sociological, socio-economic, and political urban research than is the case today? Will scientific exchange between urban and industrial ecology be intensified?

One experience can be drawn from US American and German urban ecology research: Potential is shown not only by integrating different scientific approaches through a synergistic, cross-cutting research concept, but also through interconnecting within and across disciplinary networks.

References


