



Belgeo

Revue belge de géographie

2-3 | 2004

Landscape research in Europe

Landscapes and landscape research in Germany

Landschaften und Landschaftsforschung in Deutschland

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Electronic version

URL: <http://journals.openedition.org/belgeo/13688>

DOI: 10.4000/belgeo.13688

ISSN: 2294-9135

Publisher:

National Committee of Geography of Belgium, Société Royale Belge de Géographie

Printed version

Date of publication: 30 September 2004

Number of pages: 265-276

ISSN: 1377-2368

Electronic reference

Marion Potschin and Olaf Bastian, « Landscapes and landscape research in Germany », *Belgeo* [Online], 2-3 | 2004, Online since 14 September 2013, connection on 08 July 2020. URL : <http://journals.openedition.org/belgeo/13688> ; DOI : <https://doi.org/10.4000/belgeo.13688>

This text was automatically generated on 8 July 2020.



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Introduction

- 1 The interaction between people and nature has, over the centuries, resulted in a variety of landscapes in Europe. Hardly any part of the continent has been left untouched, and land has been worked upon, moulded, designed, destroyed and restored time after time. As a consequence, cultural landscapes are dominant throughout, and despite the pressures of «globalisation» there remains an enormous diversity of structures and forms.
- 2 The diversity of European landscapes represents an important resource, and its conservation and management poses considerable challenges. It is generally acknowledged that scientific-based approaches are needed, especially so in the planning context. It is argued, that these must be grounded upon sound landscape research (van Haaren, 2002). However, scientific schools and approaches in Landscape Ecology vary throughout Europe (Potschin, 2003). Even within single national traditions different approaches can be identified. In this paper we focus on approaches in Germany. The aim is to provide an overview of current landscape research and applications. In the first part of our review we summarise some aspects of the development of landscape research and its application in Germany, and highlight some key features of the current research agenda. In the second part of the paper we describe the broad landscape types of Germany and the general trends of landscape development within the country.

The «landscape» concept

- 3 The origin of discussions about landscape is generally attributed to the German geographer and scholar Alexander von Humboldt, who nearly 200 years ago used the idea of the «total character of a region». From the outset landscape was intended as an holistic idea. Thus 1850, Rosenkranz (in Schmithüsen, 1964) defined landscapes in terms of the hierarchically organized local systems made up of all the kingdoms of nature. Such ideas reflected similar ideas being developed across Central and Eastern Europe at this time, and which continue to be expressed by more recent scholars.
- 4 Neef (1967), for example, has characterised landscape as a part of the earth's surface with «a uniform structure and functional pattern», both in its appearance and constituent components. The components or «geofactors» identified were relief, soil, climate, water balance, flora, fauna, people and their artefacts in the landscape. Appearance also included ideas about spatial position. Also (other) contemporary authors have stressed the fact that landscape is not only the sum of separate geofactors, but also represents the integration of factors into a geographical complex or «geosystem» (e.g. Haber, 1995). For them, the landscape ecosystem is defined by the spatial pattern of abiotic, biotic and anthropogenic components which form a unified functional entity and which serves as the environment for people. German geographers have also discussed the idea of landscape in the context of ideas about «Wesenheiten» (intrinsic entities) instead of purpose-based spatial constructs. Thus Paffen (1973) sought to articulate the character of a landscape, or «Wesen der Landschaft», which was to be understood as a real existing organic Gestalt-complex – or an entity which, with the help of the experienced view of the geographer, could be delimited and analysed.
- 5 Traditionally the geographer's approach to landscape can generally be described as «integrative» rather than «sectoral» (see for example, Leser, 1997). This characteristic is however, probably most marked in the holistic view of landscape developed by workers from the former GDR than elsewhere in Germany. Such approaches were stimulated in recent years by work such as that by Haase *et al.* (1991), Mannsfeld & Neumeister (1999), Zepp & Müller (1999) and Krönert *et al.* (2001). This work was pragmatic in its approach, and used the landscape concept in ways that were not comparable to earlier traditions. Older ideas were criticised as being mainly based on a physiognomic approach, which did not easily support the holistic view which these workers proposed. Using Neef's formulation of the landscape concept, involving the integration of nature, humans, and society in a single system, both physical and human geography approaches could be combined. Such a «symbolic view», it was argued provided an «objective methodological approach» (see Mannsfeld, 1995).
- 6 These developments in the former GDR were, however, not typical of those in other parts of the country where reductionist views in the environmental sciences and geography tended to dominate. In Geography the term landscape lost its crucial position in the second half of the last century. In the 1970s Neef (1970) criticized the «trend» of defining geography as a special kind of social science, along with the tendency to separate the physical and human sides of the discipline. Mannsfeld (1995) has also identified the issue of geography developing towards a specified sectoral science at the expense of its more traditional integrative approach.

- 7 Only recently (see Schenk, 2002) has interest in more holistic approaches is being reawakened in geography, planning and ecology, partly as the result of the growth of landscape ecology as a distinct research focus (Antrop, 2000a; Bastian, 2001; Naveh, 2000; Potschin, 2003), and partly because the term «landscape» has been taken up by other disciplines, and particularly by those who propose more transdisciplinary approaches. Such developments are described in more detail below.

Landscape research and landscape ecology

- 8 Although the work of geographers has been important, perhaps the most significant contributions to landscape research have, however, come through the development of the «landscape ecological approach». The focus here has been to look at pattern and processes in the landscape rather than simply to document or classify its structure, and to apply the ideas in a planning context.
- 9 The tradition grew out of the seminal work of Troll (1939) who later defined landscape ecology as follows: «Studium des gesamten, in einem bestimmten Landschaftsausschnitt herrschenden komplexen Wirkungsgefüges zwischen den Lebensgemeinschaften (Biozönosen) und ihren Umweltbedingungen. Dieses äußerst sich räumlich in einem bestimmten Verbreitungsmuster oder eine naturräumlichen Gliederung verschiedener Größenordnungen.» (Troll, 1968), Study of the whole, in a certain landscape unit dominating complex interaction between biocoenoses and their environmental conditions. This interaction is expressed spatially in a certain spatial pattern or natural regional units at different scales).
- 10 Schmithüsen (1942) extended Troll's approach and broadened it to include the idea of «cultural landscapes», while in the 1950s according to Leser (1997) Neef and his scholars further developed the discipline by arguing that it should be based on a natural science approach (for example through «geoecology» and the «theory of geographical dimensions»), and must include the analysis of human impacts on landscape ecosystems. The concept of cultural landscapes has become a particularly important aspect of landscape ecology, taking in the analysis and assessment of historic cultural elements in the landscapes that are of value (Wöbse, 2001). The importance of the study of the dynamics of change within cultural landscape has been emphasised by the work of Trepl (1996), Bork *et al.* (1998), and Burggraaff & Kleefeld (1998).
- 11 One of the most important contemporary approaches developed within the landscape ecological tradition in Germany is the concept of «landscape diagnosis». The term landscape diagnosis was introduced in Germany in the 1950s (Lingner & Carl, 1955) to draw the analogy with medical practice. Landscape diagnosis is based upon the results of landscape analysis which attempts to provide a description of landscape structure in terms of its natural features, its use by people, and its dynamic characteristics. It has as its primary objective to systematically and methodically determine the «capability» of landscapes to meet various social requirements and to define limiting or standard values «for securing the stability of natural conditions and for, if possible, increasing of performance capacities» (Haase, 1990). An important and crucial stage in diagnosis is that of landscape evaluation, which seeks to convert information about the various scientific parameters into socio-political categories as a framework for decision-making and management. This step is described by Neef (1969) as the «transformation problem», and is clearly complex because it involves the relations between the

evaluator an object being evaluated. However, it is generally accepted that the goal of evaluation is objectively to identify the capacity of the landscape to perform its essential functions (i.e. to maintain its «natural balance») (Bastian & Schreiber, 1999).

- 12 The identification of landscape functions is an important element in any landscape evaluation (e.g. de Groot, 1992; Marks *et al.*, 1989). The term function is not only used to flag landscape or ecosystem properties such as the various fluxes of energy, mineral nutrients and or the distribution and movement of species between landscape elements, but also in their direct relation to human society. Thus the identification of «natural potentials» in the context of landscape functions has been applied in landscape ecology and planning for many years (see Bastian & Steinhardt, 2003 for historical account of concept). The goal here has been to evaluate landscapes with in terms of, say their usability or carrying capacity, in the context of managing such problems as soil erosion, water retention, groundwater recharge, groundwater protection, habitat function, landscape potential for recreation.
- 13 The description of the landscape is not sufficient for most planning and management purposes. Thus we have seen in recent landscape research, attempts to develop the more purposeful and integrated processing of the data that involves combining «...the results of scientific exploration and measurements with technical and economic parameters and, finally, the transformation of geosynergetic and ecological parameters into economic and social indices » (cf. Bastian, 1998).
- 14 In Germany and other countries landscape planning in its more analytic or scientific style developed in the 1950s, but the concept of landscape planning was only formally introduced at federal level in 1976. It drew upon concepts from horticulture and the design of gardens and public spaces, landscape management and nature and countryside conservation. Landscape planning has now exists as a discipline in its own right (for more information on landscape planning in Germany see van Haaren, 2002). Table 1 gives an overview of institutions and research topics within German landscape Research that can be identified (Table 1).

Table 1. German institutions organisations undertaking landscape research, esp. landscape ecology (see homepages for detail).

Organisation	Homepage	Research topic
IAF (Institute for Applied Research, University of Nürtingen)	www.iaf.fh-nuertingen.de/	Landscape ecology (GIS, data) Landscape planning Sustainable plant production? Environmental economy/management Protection of nature/environment
Institute of Physical Geography, Landscape Ecology (Hannover)	hgeo02.geog.uni-hannover.de/phygeo/index.html	Soil erosion and protection Landscape processes (esp. nutrients) Landscape ecology in general
IÖR, Institute of Ecological and Regional Development (Dresden)	www.ioer.de	Resource-efficient land-settlement development Participatory processes Sustainable spatial development
Center for Ecology, University of Kiel	www.pz-oekosys.uni-kiel.de/ www.ecology.uni-kiel.de/	Ecosystem-theory, self-organisation of ecosystems, ecological integrity, ecosystem-indicators, holistic approach to ecosystems
Landscape Ecology, TU Munich	www.loek.agrar.tu-muenchen.de	Landscape ecology and landscape planning
Landscape Ecology Group (University of Oldenburg)	www.uni-oldenburg.de/fs/loek/	Predication and understanding of species response to abiotic factors and changes in landscape use Generation and evaluation of scenarios for nature conservation
TU Dresden Institute of Landscape Research and Geoecology	www.tu-dresden.de/fghgig/lehrstuhl/landoeko/index.htm	Landscape balance GIS modelling of nutrient fluxes in catchment areas
SAW, Saxon Academy of Sciences and Humanities, Working Group «Natural Balance and Regional Characteristics»	www.ag-naturhaushalt.de	Long-term investigation of landscape changes Development and testing of analysis and evaluation methods Functionality and carrying capacity of landscapes at different scales
UFZ-Umweltforschungszentrum Leipzig-Halle GmbH Center for Environmental Research	www.ufz.de/(en)/spb/aloe/	strategies for sustainable landscape development. This requires the investigation of landscape structures or pattern, landscape balance and landscape functions on different spatio-temporal scales
ZALF Münchenberg Centre for Agricultural Landscape and Urban Use Research	www.zalf.de/	analyse, evaluate and predict processes (including their interactions) in agricultural landscapes of the NE-Germany lowlands

Landscape types and landscape development in Germany

- 15 Figure 1 shows one representation of the major landscape types found in Germany. It was developed out of a major research initiative (Meynen & Schmithüsen, 1953-1962), and adopted by government at a national level in 1996 (BfN, 1996). Five broad zones (core units) with 68 sub-divisions are identified using information on geology, glacial impacts, relief, the river network, temperature and precipitation as well as diverse land-use. The broad zones are: the north German plain (Norddeutsches Tiefland), the central European highlands (Zentraleuropäische Mittelgebirge und -vorland), which are transitional for the higher areas such as the south west German highland/plateau area (Südwestdeutsches Mittelgebirgs-/Stufenland), and the pre-Alps (Alpenvorland) and Alps (Alpen). These broad zones generally link to the major landscape zones identified in the neighbouring countries of central Europe.
- 16 Although the classification shown in Fig. 1 is most widely accepted within Germany, other national schemes exist such as GEO (1992). There have also been attempts to place the landscapes of the country in the wider European context (Bunce, 2001). Although these other systems reflect the core areas identified in Fig. 1, they differ in detail and level of thematic and spatial resolution from the national scheme.

Figure 1. Major landscape types in Germany (according to the «Naturräumliche Gliederung»).



FROM NORTH TO SOUTH: NORTH GERMAN PLAINS (NORDDEUTSCHES TIEFLAND), CENTRAL EUROPEAN HIGHLANDS (ZENTRALEUPÄISCHES MITTELGEBIRGE) SOUTH WEST GERMAN HIGHLANDS/PLATEAU (SÜDWEITDEUTSCHES MITTELGEBIRGS-/STUFENLAND), PRE-ALPS (ALPENVORLAND), ALPS.

SOURCE: BFN (1996)

- 17 A review of the historical development of landscapes across Central Europe has been given e.g. by Bastian & Bernhardt (1993). The four major stages identified are relevant to Germany (Table 2). They involve increasing intensity and scale of human intervention in the landscape, culminating in the widespread human environmental impacts that characterise the period since the industrial revolution.

Table 2. Stages of landscape development and human impact.

Stage	Time before present	Changing parameters
1 Agricultural acquisition and use	c. 5000-6000 years	Large-scale (medieval) clearing of woods («colonization») between the 7th and 13th centuries, extreme water and wind erosion
2 Integrated development	c. 1000 years	Further use of landscape additional to farming: especially ore-mining areas arose with a network of facilities, use of water for energy production, leading to forest management around the turn from the 18th to the 19th century
3 The industrial revolution	just over 100 years	Agglomeration in the settlement structure, areas for the large-scale exploitation of resources, industrial development, transport routes and mining, beginning reduction in biodiversity
4 The scientific and technological revolution	for the last 50 years	Large machinery systems, chemicals and automation have been used in order to maximize benefits and yields. Large field farming. Mass tourism puts extreme pressure on remaining natural landscapes. Essential losses in biodiversity

- 18 There are many accounts that set out the major threats to landscape are currently faced in Germany. Thus, the diversity of cultural landscapes in the country is decreasing, and Jaeger (2000) considers the impacts of landscape fragmentation. Within the agricultural sector, further landscape threats arise from the effects of the application of fertilisers and biocides. According to the BfU (1998) in Germany natural areas are now only to be found as small-scale habitats or biotopes, such as springs, rock outcrops, moors and bogs, mud flats, some forests, high alpine areas. However, these too are also under threat from high nutrient inputs. It has been calculated that for Germany 26.8 % of all ferns and flowering plants are endangered and 1.6 % are now extinct (BfN, 1996).
- 19 The problem of urbanisation, which is widespread generally across Western Europe (Antrop, 2000b), is also a major issue in Germany. For the year 2000 the Umweltbundesamt (2002) calculated the rate of loss to be about 130 ha/day, which is an area equivalent to 180 football fields. Recent statistics show that the area settlement is increasing, largely at the expense of agricultural land. The area of forest has increased slowly since the early 1990s, although the impacts of atmospheric pollution on its ecological quality continue to be a problem. Similar problems affect aquatic ecosystems, where pollution loads are also increased as a result of leaching from agricultural areas.
- 20 In common with other European countries, there is an intense debate about the future of nature and landscape in Germany. According to Umweltbundes amt (2002), in 1999 about 2.4% of the land area are designated as nature conservation areas, about 2.1 % was covered by national parks, and 4.5 % was designated as biosphere reserves. Landscape conservation areas covered 26.9%, nature parks 18.9 % and areas designated for the conservation of fauna, flora and habitat (FFH) 6.7%. Although the extent of these

designated areas has increased in the 1990s, many scientists consider that more radical solutions are necessary. Thus, nature conservation ideas should be extended to the wider countryside, that is those areas outside the protected areas network. The German federal law of nature conservation (2002) asks for the creation of at least 10% of the national land area should become part of a green «infrastructure» (biotope networks) to connect existing habitat patches.

- 21 In Germany landscape researchers have also identified the importance of working towards the sustainable use of landscapes throughout the wider countryside, that is the «ordinary landscape», outside protected areas. They also argue that a key concept in dealing with such areas is that of «ecosystem goods and services» and the extent to which they can be maintained as one approaches the ecological carrying capacity of systems (e.g. Potschin & Haines-Young, in press).

Discussion and conclusions

- 22 This paper has demonstrated that it is important to connect up scientific knowledge with the needs of society, especially in the planning context. The value of the landscape concept is that it provides a focus where these different spheres and demands can be integrated and considered. In terms of current research agendas, the following issues are particularly relevant:

- Landscape studies have to deepen their knowledge as well providing as a holistic view of problems or issues (see Bastian, 2001; Potschin, 2003).
- The analysis of the aesthetics of landscape must be considered, as well as the idea that landscape as a product of perception (e.g. Pedrolí, 2000; European Landscape Convention).
- An understanding of the way in which different people value landscape functions in different places.
- Transdisciplinary character of Landscape Ecology (e.g. Tress & Tress, 2001).
- Scale-related approaches.

- 23 The importance of understanding the link between the biophysical elements and the social, cultural and economic aspects of landscape is also stressed by the recent discussions of the «Leitbild» concept in the German-speaking literature (for more details on the Leitbild-concept Gaede & Potschin, 2001; Potschin & Haines-Young, 2003). The development of a Leitbild or vision (prognosis or scenario) for a given area, is seen as providing a means whereby stakeholders can more easily choose between different alternatives for the conservation and utilization of both nature and the environment (Bastian, 1998). The development of tools and concepts that can help people to develop such visions represents one of the major challenges facing contemporary trans-disciplinary landscape research in Germany.

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ABSTRACTS

Landscape research has a long tradition in Germany. After Alexander von Humboldt introduced the term «landscape» 200 years ago, as the «total character of a region» (Totalcharakter von Erdgegenden), it became a key focus of study for Geography, stimulated by the work of Troll, Paffen, Schmithüsen, Neef and others. Although such ideas were, for a time, pushed into the background by wider reductionist views in science and Geography, it has recently reemerged as an important research theme. In Germany Landscape Ecology has made a major contribution to contemporary Landscape Research, providing both scientific understanding and the basis of applications in fields such as Landscape Planning. Important methodological developments have included: landscape diagnosis, evaluation, the analysis and evaluation of landscape functions and the development of Leitbilder.

Within Germany the current research agendas focuses on the relation between holism and the sectoral approach, principle of complementarity, relation of physical and perceptual approaches to the landscape concept, the problem of transformation, transdisciplinarity, scale-related issues. In the more applied arena, key issues are the study of environmental impacts/problems on landscapes in Germany arising out of intensive farming, industrialisation and urbanisation. A key task in Germany is to use the outputs from landscape studies to help protect the most valuable landscape and nature areas, as well as to develop strategies for the sustainable management of such areas alongside the more ordinary landscapes that are the home of most of our population.

Die Landschaftsforschung hat eine lange Tradition in Deutschland. Nachdem der Forscher A. von Humboldt bereits vor 200 Jahren den «Totalcharakter von Erdgegenden» beschrieb, hat sich vor allem die Geographie mit Landschaftsforschung gefasst. Die anfänglich u.a. von Troll, Paffen, Schmithüsen und Neef vertretene holistische Sichtweise geriet zwischenzeitlich im Zuge stärker reduktionistischer Tendenzen in der Wissenschaftsentwicklung etwas in den Hintergrund.

Innerhalb der Landschaftsforschung nimmt die Landschaftsökologie einen wichtigen Platz ein, umfasst aber auch Anwendungsaspekte, so z.B. die Landschaftsplanung. Bedeutsame methodische Ansätze der Landschaftsforschung (und -ökologie) sind z.B. die Landschaftsdiagnose, -bewertung, die Bestimmung von Landschaftsfunktionen bzw. Naturraumpotentialen und die Erarbeitung von Leitbildern. Als wichtige Prinzipien werden erachtet: Komplementaritätsprinzip, ausgewogenes Verhältnis zwischen Holismus und analytischer Betrachtung von Einzelaspekten, Einbeziehung physischer und mentaler Aspekte,

Lösung des Transformationsproblems (zwischen naturwissenschaftlich fassbaren Sachverhalten und gesellschaftlichen Entscheidungen), Transdisziplinarität, Dimensionalität (Maßstabsbezug), Berücksichtigung von Raum-Zeit-Aspekten.

Wesentliche Landschaftsbelastungen resultieren in Deutschland aus der intensiven Landwirtschaft, der Industrialisierung und Urbanisierung. Als eine zentrale Aufgabenstellung wird die Sicherung der wertvollsten Teile von Natur und Landschaft innerhalb eines weiter auszubauenden Netzes von Schutzgebieten angesehen.

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Keywords: landscapes, landscape functions, land-use, Germany, Leitbild

Schlüsselwörter: Landschaften, Raumordnung, Landschaftsfunktionen, Deutschland, Leitbild

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