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Why biotope mapping in populated areas?

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The title 'why biotope mapping in populated areas?' is chosen because that is the main question local authorities and other people ask when money should be spent for biotope mapping in towns and cities. In order to answer this question two approaches are used, a theoretical approach, and a practical approach based on experiences in Germany. The theoretical approach is in line with a programme published by a German working group in 1993 and stresses the concept of an integrated nature conservation strategy. In addition, issues are presented such as ecological functions of biotopes, different kinds of nature, and the relationship between man and nature. The practical approach describes that around 200 towns and cities in Germany have carried out urban biotope mappings, and explains the integration of biotope mapping in the planning system. The results of a mail survey are recorded concerning purpose and use of biotope mapping in populated areas. Biotope mapping has proved an important tool for nature conservation strategies because it offers a realistic and comprehensive view of urban nature. It has become an indispensable component of landscape planning and the survey verified that the results of urban biotope mapping are used manifold by local administrations.

Waarom biotoopkartering in bevolkingskernen? - De titel van dit artikel is gekozen omdat dit een door overheden en burgers vaak gestelde vraag is wanneer men geld gaat uitgeven aan het karteren van de stedelijke natuur. Om tot een antwoord te komen, worden twee benaderingswijzen gehanteerd: een theoretische en een praktische. De theoretische benaderingswijze is gebaseerd op een programma dat in 1993 is gepubliceerd door een werkgroep in Duitsland en benadrukt een geïntegreerd beleid voor natuurbescherming in de stedelijke context. Daarbij komen zaken aan de orde zoals de ecologische betekenis van biotopen, de verschillende soorten stadsnatuur, en de relatie tussen de mens en de natuur. De praktische benadering is gebaseerd op de ervaringen van ca. 200 Duitse gemeenten met biotoopkartering en verklaart het gebruik van biotoopkartering in de praktijk van de ruimtelijke planning. De resultaten van een enquête naar het gebruik van biotoopkartering in bevolkingscentra worden gepresenteerd. Biotoopkartering blijkt een belangrijk hulpmiddel bij natuurbeschermingsbeleid omdat het een realistisch en overzichtelijk beeld geeft van de stedelijke natuur. Het is een onmisbaar onderdeel geworden van ruimtelijke planning en uit de enquête blijkt dat de gemeentelijke overheden dikwijls gebruik maken van de uit biotoopkartering naar voren gekomen resultaten.

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INTRODUCTION

The heading 'why biotope mapping in populated areas?', is chosen because that is the main question local authorities and other people ask when money should be spent for biotope mapping in towns and cities. They fear that a lot of data will exist that nobody will know how to use, except for a few scientists who earn their living by this mapping. Moreover, they think that biotopes are only interesting in the countryside and not in towns and cities. Also, the local authorities may be reluctant because they expect new duties and restrictions to further urban development as a result of biotope mapping. In order to answer the question mentioned and in order to clarify the significance of biotope mapping in populated areas for tasks of urban development, two approaches - a theoretical and a practical approach - are made.

In 1993 a completely revised version of a programme for collecting, organizing and analysing data relating to biotopes in populated areas and their peripheres was published in Germany. This programme was the result of discussions and papers of a working group 'Methods of Urban Biotope Mapping' (Schulte *et al*. 1993). Members of the working group were scientists and representatives of nature conservation agencies. The theoretical foundations for urban biotope mapping are well explained in this programme and the first part of the following paragraphs, the theoretical approach, is in line with it. In the mean time we can look back on twenty years of experience with urban biotope mapping in Germany. Some of the experiences are discussed in the second part, the practical approach. In general it is to be noted that the methods applied to biotope mapping in settlement areas can be placed in two categories (Sukopp & Weiler 1988). (1) The first category is called the method of selective biotope mapping. This method considers only biotopes worthy of protection, in some cases also those potentially worthy of protection. This presupposes a framework to evaluate biotopes worthy of protection and thus of mapping. (2) The second category is called the method of comprehensive biotope mapping. This means that biological and ecological features of all actual biotopes are covered. It can either be done as (2a) overall mapping in the entire urban area or as (2b) representative mapping, in which examples of all land use types are mapped and the results are transposed to all other areas of the same type. In this way biologically and ecologically characterised biotope types and biotope type complexes are obtained. The evaluation of biotopes is not coupled to the registration. The representative mapping method is the most widely used form of comprehensive mapping; it is recommended in the programme mentioned above (Schulte *et al*. 1993), because overall mapping of an entire urban area requires a lavish expenditure.

The presented two approaches deal with the following items: (1) the theoretical approach includes (a) nature conservation and environmental protection, (b) biotopes and their ecological functions, (c) four kinds of nature, and (d) man and nature; (2) the practical approach - experiences in Germany - includes (a) urban biotope mappings in the context of the German planning system, (b) using the issues of urban biotope mapping, and (c) involving the public.

THEORETICAL APPROACH

Biotope mapping is to be considered a tool for nature conservation; in the meantime this tool is well established in Germany. For tasks such as area protection or maintenance and management of biotopes a survey is required of the location of biotopes and of their conditions, in other words a biotope mapping. Biotopes are defined as ecotopes in their spatial dimension or as areas in which specific communities of plants and animals live, and which can be marked by biotic and abiotic features (Dahl 1908, Riecken *et al*. 1994, Wittig 1993). As animals and plants live everywhere, this definition of biotope is a

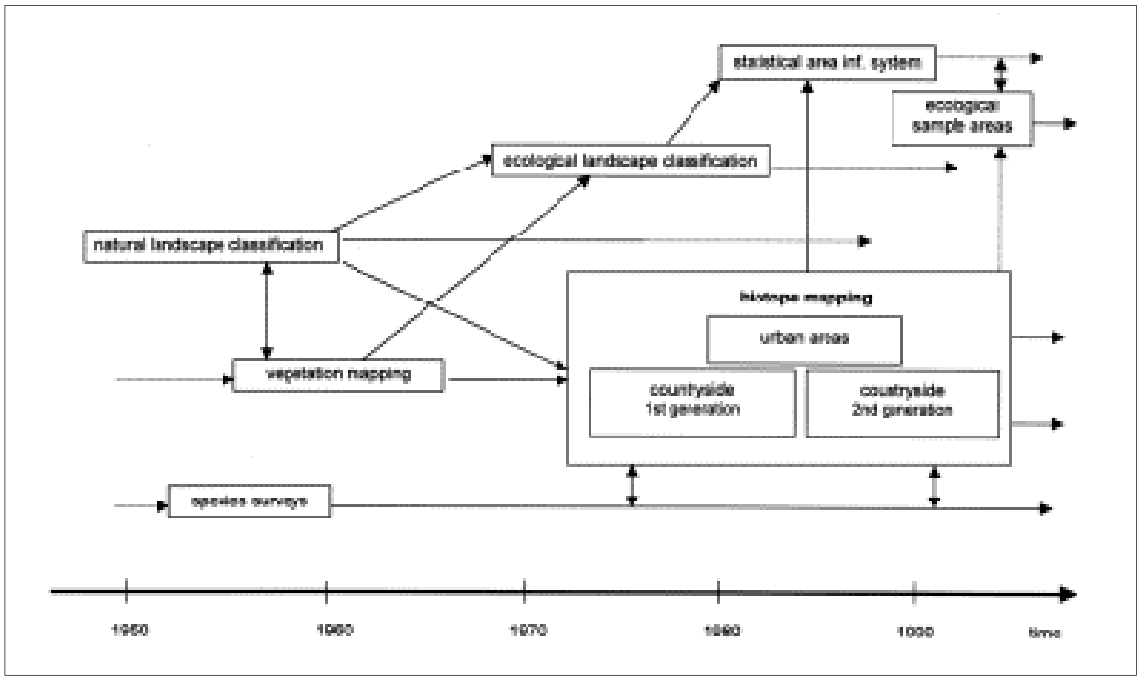

Figure 1 Urban biotope mapping in the context of landscape classification, species surveys and biotope mapping of the countryside in Germany.

'neutral' one including all habitats of animals and plants, valuable or not for conservation, including urban areas as well as the countryside.

Biotope mappings and urban biotope mappings have a twenty-five year old history in Germany. But they are not isolated, they are parts of a system of various surveys and mappings concerning nature conservation and landscape planning. Figure 1 shows that species surveys, vegetation mapping and natural landscape mapping had started in the fifties on both the national level and on the 'Bundesländer' level. Countryside biotope mapping of areas selected for nature protection first began in Bavaria in 1974. These mappings served the purpose to get a quick overview about important biotopes in order to protect them. Neither methods nor the scientific foundation of this first generation of mappings were well developed at the time. That changed when the second generation of biotope mappings was carried out in the middle of the eighties. Scale and methods became more accurate. The first urban biotope mappings in Germany were realised in 1978 and, from this time on, they expanded rapidly and continuously. Especially the method of comprehensive mapping of biotopes - for an explanation of this method see below - was developed and used for urban biotope mappings (Sukopp & Weiler 1988). Complete lists of biotopes, using land use types as basic classification and covering the entire landscape, were first worked out in the context of urban biotope mapping and influenced both biotope mapping of the countryside and surveys of land use types (Bundesministerium für Raumordnung, Bauwesen und Städtebau 1989, AG Naturschutz 1995). Presently, different kinds of surveys and mappings exist next to each other and influence each other, but unfortunately they are not coordinated.

In order to obtain an answer to the question 'why biotope mapping in populated areas?', and while realising that biotope mapping is a useful tool for nature conservation strategies and conservation practice, it is necessary to discuss aims and tasks of nature conservation, both in general and in relation to populated areas. The entire landscape - including landscapes that are extremely influenced by man such as cities and industrial areas - is composed of an overall structure of biotopes in which each biotope, also the seemingly not so valuable biotopes, possesses an ecological function. It is therefore not sufficient to only map and protect some landscape units or elements like isolated islands. Taking into consideration the aim to observe and to improve the ecological value of the entire landscape, you need an integrated view of the whole landscape, i.e. including cities and other settlement areas. Nowadays a complete list of biotope types in Germany exists, which makes it possible to assign each landscape unit to a biotope type (Riecken *et al.* 1994).

The approach to make the entire landscape an object of nature conservation strategies can be called 'integrated nature conservation strategy' in the sense of Erz (1980). The 'Convention on Biological Diversity' that was agreed upon at the Earth Summit of Rio, 1992, recommends that all land use types should be developed sustainably in order to maintain and to encourage biodiversity. Nature conservation has to be fitted into the vision of sustainability, it is an essential part of this vision. For that reason the integrated nature conservation strategy has now to be described as a sustainable nature conservation strategy. Urban areas are an essential part of this strategy.

Nature conservation and environmental protection in urban areas

It is of basic importance to realise that the implementation of the tasks for nature conservation (such as species and habitat protection) cannot be seen detached from the other ecological functions of habitats or biotopes (see next paragraph). Nature conservation and environmental protection are connected. Thus it is obvious that the preservation of wet sites only makes sense if the water regime is not disturbed or the regime can be re-established. Green open spaces protected for nature preservation can be also of value for air ventilation. Especially in urban areas, where serious ecological damages exist, human health and welfare are obviously the centre of interest. Here, the significance of biotopes for environmental protection often plays a major role. It thus comes as no surprise that, in addition to measures for nature conservation, classification systems for land use types that are created for urban biotope mapping are increasingly used for environmental planning in general.

If methods and costs of biotope mappings are discussed, it should be clearly stated that fundamental maps (such as maps demonstrating land-use types or degree of built-up and paved areas) have to be designed as basic information tools for environmental planning and sustainable development. Such maps can be used for calculation of urban run-off, for analysing the urban climate, and so on. Therefore, they should be produced in cooperation with the different planning departments and they should be integrated as basic information for a Geographic Information System (GIS).

Biotopes and their ecological functions

The basic program for urban biotope mapping mentioned above categorises ecological functions of biotopes as follows:

1 Biotopes are significant to protect natural resources
- environmental protection and ecological balance in nature (hydrological cycle, quality of surface water, climate, air

pollution, noise protection)
- species and habitat protection (biotic potential, refuge areas, sites for distribution and dispersal, linking areas)
- monitoring (bioindication) of environmental changes and anthropogenic impacts
- ecological research.

2 Biotopes are significant to experience and enjoy nature as a part of life quality
- leisure
- providing a variety of experiences and knowledge
- education
- gardening.

3 Biotopes are significant for the shaping of town and landscape
- structuring and vitalising the urban scenery
- natural and cultural history
- human identification with the local area ('home-like').

The evaluation of some of these functions cannot be realised by landscape planners or biologists exclusively. A cooperation with other experts is needed. For example, the assessment of the value of a certain biotope for cultural history needs the input of historical knowledge. The effect of biotopes on experiencing nature is a working field for psychologists and sociologists.

Four kinds of nature

The contemporary towns and cities enclose within their spatial boundaries remnant elements of rural landscapes, i.e. fields and pastures, or relics of natural landscapes. Especially in urban agglomerations like the Amsterdam-Den Haag-Rotterdam area the difference between urban and rural landscape is not clearly structured. In addition, new elements of landscape and nature that only exist in towns and cities - like urban wastelands - enrich the urban areas. Moreover, towns and cities are greened not only by leisure grounds, historical parks and public gardens, but also by patches of green spaces inside built-up areas, e.g. green areas between flats or private gardens in residential areas of detached and terraced houses. In many towns and cities such green patches represent the major part of the total green area within the developed areas. For example, the city of Hanau has around 400 ha of parks and public gardens, but private gardens and green spaces between flats represent nearly 800 ha (Werner 1991).

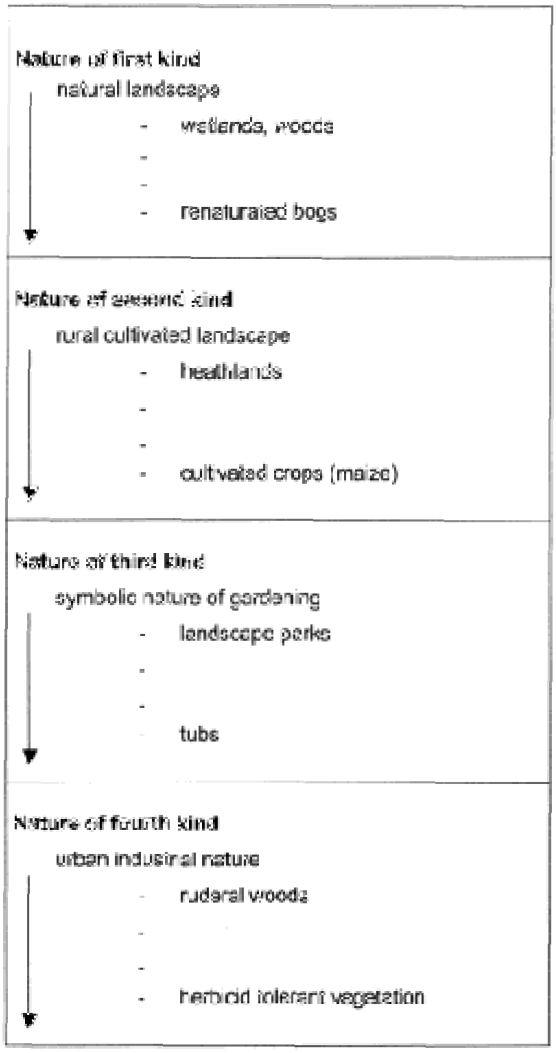

Figure 2 Classification of urban vegetation types into four kinds of nature. The arrows indicate the increasing degree of human impact (after Kowarik 1992).

Figure 3 Landscape structures such as rivers are present in nearly every city; they are an example of nature of the first kind (Hanau, Germany).

Figure 4 Nature of the second kind is mainly located in outskirts; shown here is a field between high-rise flats (Darmstadt, Germany).

Figure 5 Another example of nature of the second kind. New houses placed in a former orchard (Darmstadt, Germany).

Figure 6 An example of the third kind of nature: an intensively designed and managed historical park (Darmstadt, Germany).

Figure 7 Green open spaces between flats: the third kind of nature (Berlin, Germany).

Figure 8 Ruderal sites on wastelands: the fourth kind of nature (Augsburg, Germany).

Figure 9 Foot area of a street tree that is no longer managed: this too is the fourth kind of nature (Darmstadt, Germany).

According to Kowarik (1992) 'urban nature' existing in towns and cities can be divided into four types (see Fig. 2). Those different types of nature have to be taken into consideration if biotope data are gathered, analysed and evaluated (Figs. 3 - 9). Both the cultivated and the spontaneous nature have to be assessed with respect to the ecological functions of biotopes mentioned above. Urban biotope mappings are appropriate to create a realistic and comprehensive picture about the existence and the state of 'nature'.

Man and nature

Man occupies a central position in the urban habitat. Man therefore has to be the central focus of nature conservation strategies in urban areas. An excess of buildings is considered a sterile environment in human opinion. Natural elements compensate for, and contrast with, the artificial urban environment. Spontaneous wildlife even emphasizes this contrast. Nature conservation in urban areas aims at maintaining and encouraging biological diversity as a component of human daily life and experiences. Most people in Europe live in towns and cities. A particular aim of nature conservation is to have them get in touch with nature or to be close to nature, physically and mentally, so that urban dwellers are able to get first hand experiences and become familiar with 'nature'. They should be able to find nature just outside their house door (see also Fig. 15). As a result they can learn to identify the different components of nature, the dynamics of nature, and the different species - in other words, they can learn to 'read' nature. Strategies of nature conservation in urban areas based on fencing out the people are therefore wrong.

The particular task for nature conservation in urban areas is to maintain and to improve habitat and species diversity in a wide range, but, with special respect to common species and common urban wildlife. In addition, the protection of rare and endagered species is a general task of nature conservation.

Conclusions of the theoretical approach

Urban biotope mapping as well as biotope mapping in general are tools for (integrated) nature conservation. Therefore, biotope mapping of populated areas is also a tool to make progress in sustainable urban development. Especially in urban areas nature conservation and environmental protection have to act in the same way. Sukopp & Sukopp (1987) published fourteen major principles of nature conservation in European cities, such as historical continuity, urban ecological zoning, maintenance of local variety and diversity, value of corridors, education to people, and so on. But the particular aim of nature conservation in urban areas is to build a bridge between nature and human life. In order to reach this aim and to fulfill the main prin-

ciples of urban nature conservation, a realistic and comprehensive view of all kinds of nature is needed. The evaluation of urban biotopes has to consider the wide-ranging ecological functions. Urban biotope mapping is a suitable tool to deliver the necessary information.

PRACTICAL APPROACH - EXPERIENCES IN GERMANY

Biotope mappings have been carried out in around 200 towns and cities, for which different methods have been used (Fig. 10). In West Germany in the mid eighties and in East Germany after the reunification in the beginning of the nineties, the number of urban biotope mappings increased rapidly. In West Germany this increase took place particularly in three states that had launched urban biotope mappings by financing programmes. Figure 10 demonstrates the relatively high number of biotope mappings in Schleswig-Holstein, North-Rhine-Westfalia and Bavaria. The State of Schleswig-Holstein supported biotope mapping to 100% if they were carried out in the context of preparations for a landscape plan. The State of Bavaria is more or less still funding urban biotope mapping to an average with 70% percent of the total costs, combined with a professional consultation by the nature conservation agency and with a strong faunistic emphasis. North-Rhine-Westfalia supported mappings also to 100%. However, only selective methods were supported by these programs. The reason is twofold. First, the costs should be kept low so that only the legal minimum was funded. Second, the main tasks for nature conservation at the federal state level are different from those at the local level. At the federal state level, nature conservation practice focusses on valuable biotopes of rare and endangered species.

It is not really clear why so many biotope mappings were carried out in the State of Hesse (Hessen). The high amount of mappings carried out in the South of Hesse could be explained by the issues of the Rhine-Main-Agglomeration and the good financial situation of the municipalities in this region in the eighties. The fact that the comprehensive mapping method was favoured in this region was partly a result of the establishment of a small working group of biologists involved in local biotope mapping projects. Since 1994, local comprehensive biotope mappings are required by law in Hesse as a necessary ecological contribution to the preperation of a landscape plan. The term comprehensive mapping in this law means that only biotope types are to be named and indicated on a map. The execution and consideration of biotope mappings became law in Bavaria and North-Rhine-Westfalia already in the eighties. In the last few years the jurisdiction has also strengthened the obligation to consider species and habitat protection in the sense that the results of biotope mappings are to be demanded for a correct evaluation.

Urban biotope mappings in the context of the German planning system

Meanwhile, local biotope mappings have acquired a firm place in the discussion of local planning issues and tasks, and, as a consequence, a local biotope mapping enclosing the outer landscape and the built-up areas was realized in nearly each large city in Germany. Biotope mapping has become an indispensable component of landscape planning in Germany because it offers precise and multiple usable information about habitats and landscape units. Information provided by a biotope mapping including populated and unpopulated areas is useful for plans, programmes and measures on different levels (Fig. 11). The Federal Building Code decrees that both the preparatory land-use plan and the legally binding land-use plan have to integrate the results of the landscape plan (e.g., indicating areas

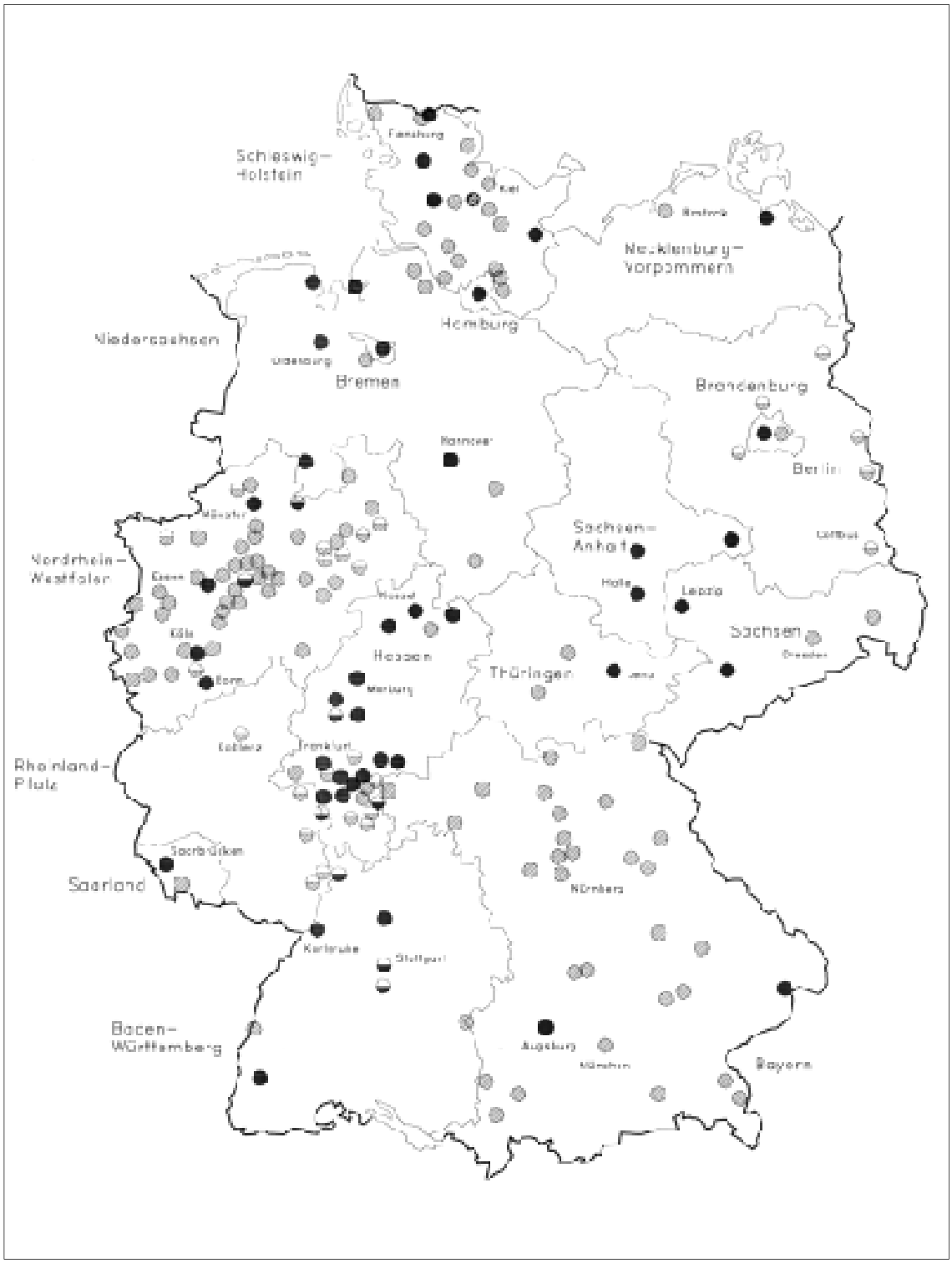

Figure 10 Distribution of urban biotope mapping in Germany. Black circles - the comprehensive/representative method was used and the entire surface of a city was mapped; half filled black circles - the comprehensive/representative method was used, but only parts of the administrative district were mapped; striped circles - the selective method was employed on the entire surface of a city; half filled striped circles - the selective method was used but only parts of the administrative district were mapped.

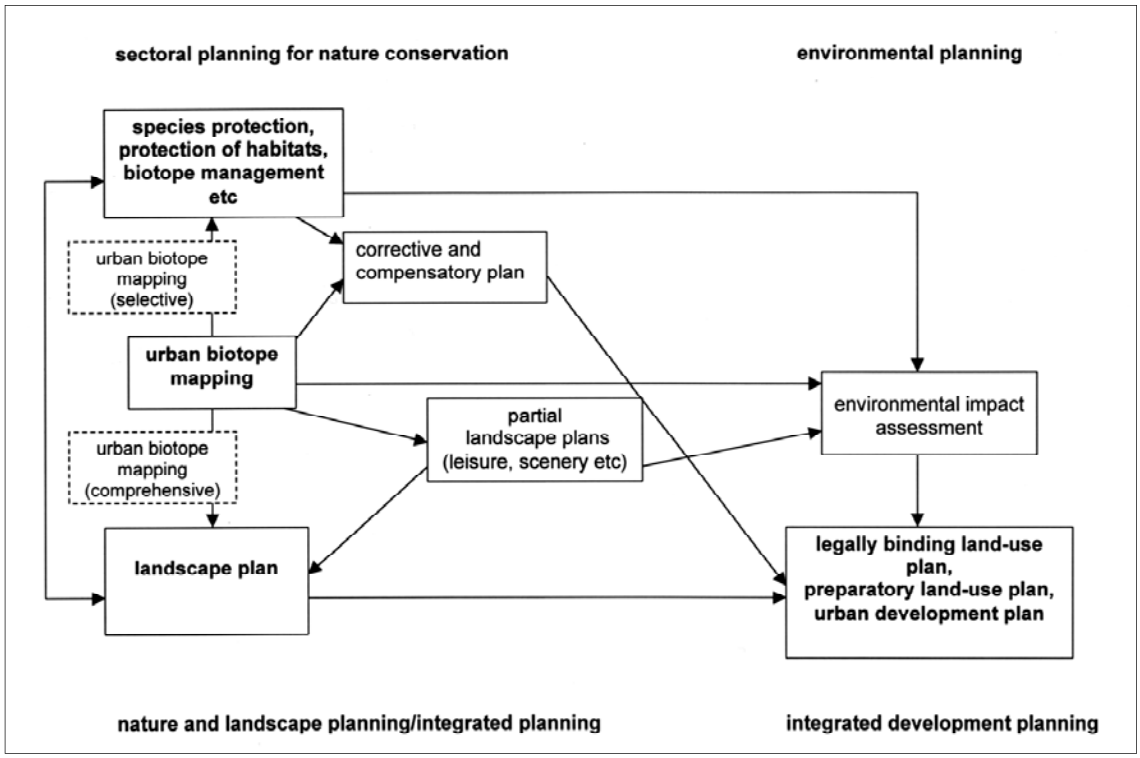

Figure 11 Position and use of biotope mapping in the local planning system in Germany. The boxes surrounded by dashed lines demonstrate that the position of biotope mapping depends on the methods used.

in which land use restrictions have to be executed, making designations regarding the protection of vegetation structures). Biotope mapping delivers basic information for the landscape plan. The landscape plan is the ecological contribution to urban planning in Germany. Also for sectoral plans concerning nature conservation and landscape planning (e.g., planning for biotope network systems, corrective and compensatory plans) quantitative and qualitative information about biotopes are needed. And, finally, biotope mapping is essential for specific local programmes and measures (e.g., local nature conservation programme, biotope management measures, ecological instruction trails).

In the following section some results are presented of a mail survey, carried out by the present author at the beginning of the nineties. The administrations of 120 towns and cities, which had organized or commissioned local biotope mappings, were contacted via a questionnaire. 92 administrations returned the questionnaire. The results presented are enriched by information obtained through systematic interviews with local landscape planners, biologists and urban planners - also mostly realised at the beginning of the nineties - and additionally enriched by practical experiences of the author concerning both urban biotope mapping and urban planning processes and discussions.

Table 1 shows the distribution of answers given to the question about purposes of carrying out biotope mapping. The main answer was 'ecological basis for landscape planning'. This answer usually meant that a legal planning procedure was running, or started to run, with the aim to set up a new landscape plan on the level of the entire administrative

area. In the further planning process the landscape plan will become part of the preparatory land-use plan. As indicated before, in this case several federal states supported, or still support, biotope mapping by means of financial help. Nearly one half of the number of towns and cities that answered that they needed biotope mapping for landscape planning, got financial help by the federal governments. The second frequently named answer was: 'to get basic ecological information for environmental and urban planning'. This meant that local authorities and administrations were generally interested in obtaining well-founded ecological information, sometimes combined with a geographical information system, in order to create a qualified development process. But often also the interest was to know where, in which spaces - spaces determined for further development - problems and conflicts with nature conservation could arise.

This situation will be explained by an example. The administration of a city for which the author had managed a biotope mapping, commissioned the author's institute again some years after the original mapping was finished. The aim was to test the consequences of the mapping results for areas that were possibly destined for further development. The time scale for the development process was 15 to 20 years. The space inside as well as outside of the present built-up area should be considered. Effects on the housing market and on the establishing of business firms had to be analysed and demonstrated in a scenario, in relation to the recommendations of the biotope mapping. It could be demonstrated that (1) a number of conflicts with nature conservation aims will exist if the further development extends into the outside areas, and that (2) conflicts can arise if the use of some inner areas is intensified. But it could be also shown that (3) there are several good possibilities to intensify the use in inner areas without conflicting with nature conservation aims. The aims of the urban development are now being discussed by politicians and citizens knowing the possible conflicts.

The results of the mail survey were surprising in so far, that answers referring to the sectoral and 'traditional' nature conservation work did

Table 1 Reasons for carrying out urban biotope mapping (answers of 80 towns and cities are considered).

answer	1st rating absolute number	2nd rating absolute number	total
ecological basis for landscape planning	41	24	66 %
ecological basis for environmental and urban planning	32	-	27 %
measures for species and habitat protection	5	11	14 %
planning and implementation of biotope networks	2	2	3 %

not play an important role. But this picture is not really correct. Often the answer 'foundation for landscape planning' only meant one task, viz. that the landscape plan needs information about directly protected areas, areas that are managed for nature conservation exclusively. That corresponds with the answers 'measures for species and habitat protection' and 'biotope networks'. The answers to the question 'what were the reasons for biotope mapping?' showed the demands and interests for a systematic and comprehensive survey. Yet however the practice, discussed in the interviews, demonstrates that the information provided by the biotope mapping is often reduced to information concerning valuable habitats for rare and endangered species that should be protected as nature conservation sites. The other biotope functions - illustrated above in the theoretical approach - are often considered in large cities only.

The persons being responsible for, or promoting, biotope mapping at the local administration influence the use of the results. Therefore it was interesting to know who was responsible. Table 2 summarises the answers. Biotope mapping is a tool for nature conservation and this relationship is underlined by the responsibilty (30%). In addition to this it should be kept in mind that in towns and small cities the Nature Conservation Department is frequently a sub-division of a more general department such as Planning and Development, or the like. Legislation with respect to the local planning process only provides for the designation of habitats of rare and endangered species. This notwithstanding the fact that the German nature conservation law orders not only protection but also development of biotopes in general to be a task for nature conservation. German nature conservationists hope that the actual discussion about the implementation of the international 'Convention on Biological Diversity' will provide this task with an impetus like it did in the United Kingdom, where nowadays several local biodiversity action plans exist. The possibilities for nature conservationists to act on the different fields are not equal. For example, the designation of protected areas can be organised directly by departments for nature conservation. Furthermore, the department can create management plans and other measures for protection. It is directly responsible for these activities. If the information of the biotope mapping flows into the planning process, not only the responsibiltiy but also the activities for implementation are given to landscape planners or urban planners. In order to use the results of a biotope mapping in a successful and wide-ranging manner, a working group should be established involving nature conservationists, landscape planners and urban planners. The best way is to do that already in an early phase, when the planning for the biotope mapping is starting.

Table 2 Responsibility in local administrations for carrying out urban biotope mapping (answers of 82 towns and cities are considered).

responsible departments	
Department for Nature Conservation	30 %
Department for Planning and Development	23 %
Department for Environment	18 %
other departments	29 %

Using the issues of urban biotope mapping

The integration in the landscape plan was actually effectuated, as can be deduced from the answers given to the question for the main reasons for carrying out biotope mapping. Table 3 presents the answers to the question 'For what activities were the results really used?' The results demonstrate two points. The first point is, that the results of biotope mappings are used very widely - an average of four kinds of activities is named. This was underlined by the interviews. Local planners and nature conservationists stressed that they were finally able to use a systematic survey covering the entire local area (either totally or all relevant sites of the

area) and as a result of that they had a better foundation for discussions with urban planners. This better foundation also meant that the discussions were more flexible than they would have been without a survey.

Usually a newly planned housing area is discussed seperately. In this case the discussion may be about 'all or nothing'. Normally the following scenario happens: the department for nature conservation starts, or claims, an investigation when the planning process is beginning. If the area under consideration is not cropland, rare and endangered species are surely to be found, especially at the urban fringe. The importance of the investigation's results cannot be really estimated. The urban planners do not believe that the recorded plants or animals are really that important, and the department for nature conservation cannot accept that rare and endangered plant or animal species will disappear. On the other hand, it may happen that the department for nature conservation can only discuss rare and endangered species on a national level, using Red Data Lists, because no regional or local information is given. Yet biotopes may be affected by the planning procedures that represent species or habitats of local value or that possess specific ecological functions. In this case, a comprehensive biotope mapping can present the following data and results for evaluating the affected biotopes: (a) the relative habitat quality of the biotope can be assessed; (b) the local frequencies of the biotope types are recorded; (c) the evaluation of different sites in comparison with one another and considering the connections with surrounding biotope types is possible; (d) the overall view allows nature conservationists and urban planners to discuss several alternatives evaluated on the same level. Table 3 shows that, in addition to measures for species and habitat protection, the influencing

Table 3 Application of the results of urban biotope mapping (answers of 82 towns and cities are considered).

Use	Times mentioned	total in percent	in relation to number of towns and cities (82 towns and cities = 100%)
landscape plan (preparatory land-use plan)	42	14%	51%
green space plan (legally binding land-use plan)	55	19%	67%
measures for habitat protection	60	20%	73%
measures for species protection	39	13%	48%
corrective and compensatory plan	36	12%	44%
designations for legally binding land-use plan	36	12%	44%
Environmental impact assessment	16	5%	20%
Others	9	3%	11%
Sum	293	100%	

of legally binding land-use plans plays a major role. 'Green space plan' and designations for legally binding land-use plans mean nearly the same, the various answers depend on the different planning systems of the different federal states. The difference between a landscape plan and a legally binding land-use plan can be explained by the frequency of these planning procedures. Local authorities prepare a new landscape plan covering the total local area every 15 or 20 years, whereas legally binding land-use plans, which cover only small areas, are made more often. Statements for legally binding land-use plans are common work for departments of nature conservation. As already indicated above, the results of the interviews show that contributions made by the departments for nature conservation to comprehensive landscape plans are too often restricted to s t atements concerning valuable biotopes outside the present built-up area. This certainly applies to small towns and cities. The experiences of some large cities show how biotope mappings can be used for various forms of biotope development that could also be integrated in landscape and green space plans. Examples of this are:

- designing the urban fringe, for example the city of Frankfurt that developed a green belt strategy (in contrast Fig. 12: Darmstadt),
- maintenance or reconstruction of typical historical local sites integrating the historical vegetation structure, for example in Lübeck private gardens and backyards (Figs. 13 and 14), or in a Berlin residential area of the twenties,
- designing new green spaces taking as a model sites of urban biotope types representing processes with spontaneous vegetation (Fig. 15),
- integrating small ruderal patches as parts of inner urban areas (Figs. 16 and 17),
- designation of a protected area representing the fourth kind of nature (Fig. 8, see also Fig. 2).

These concepts could not be realised if only a selective biotope mapping has been carried out.

Figure 12 An urban border without positive ecological functions (Darmstadt, Germany). Biotope mappings can help to find sufficient solutions for designing an urban border.

Figure 13 An old historical site that is a good example of the protection of buildings in combination with corresponding green areas (ensemble protection). Urban biotope mappings should record such sites (Lübeck, Germany).

Figure 14 Another example of ensemble protection (Lübeck, Germany).

Figure 15 A newly designed green area around flats. Typical ruderal sites were used as models or were restored. This is also a good example of possibilities for nature experiences 'at the doorstep' (Berlin, Germany).

Involving the public

Finally, the information and participation of the public will be discussed. In large parts of the built-up areas the influencing of biological diversity, that means habitat and species diversity, depends on citizens, private enterprises or housing associations. It is also a task for nature conservation to communicate with them. Biotope mapping is well suited to inform the public about habitat quality and habitat potential. Brochures and local 'round table' discussions can do a lot! In our mail survey we investigated who was informed about the biotope mapping results, and how this was done. Emphasis was on the other departments of the local adminstration and on the public. Nearly in all towns and cities the results of the urban biotope mapping were distributed to other departments of the local administration. But in only half the number of cases the public was informed. The information was mainly reduced to an article in the local press.

An example. A residential area, developed after 1945, is still characterised by plants and trees of the surrounding forest, because many trees of the original forest were not cut down when the houses were built. The trees, and some herbs with them, were left in the public green spaces or in the private gardens. But eventually, more and more trees become damaged and are now replaced by species bought in

Figure 16 Urban renewal is often combined with replacement of small ruderal sites, stones or concrete that completely cover the open space in front of houses (Ober-Ramstadt, Germany).

Figure 17 This example demonstrates that urban renewal can be carried out in such a way that small ruderal sites are maintained. Biotope mappings can provide information about such sites (Flensburg, Germany).

garden centers. Such trees are mostly exotics and very different from those of the surrounding forest. The results of the biotope mapping shows this change. It is easy to forecast that the character of the area, which is still mainly a forested residential area, will completely change within the next twenty years. The inhabitants can be informed about this change using the results of the biotope mapping, and the potential loss of life quality can be demonstrated.

Conclusions of the practical experiences in Germany

In Germany biotope mappings have become indispensable components of landscape planning because they offer precise and multipurpose information about habitats and landscape units. Information obtained from biotope mappings - and that also applies to urban biotope mappings - can be used for plans, programmes and measures on different levels of space planning and politics and - with special respect to the urban biotope mapping - on local planning and politics. Since biotope mappings have proved their value, several federal states in Germany have implemented laws requiring biotope mappings as an ecological basic survey for environmental, landscape and local planning. In order to make sure that information of urban biotope mapping can be applied to plans and programmes, it is not sufficient to only make lists of habitats or plants and animals or to mark valuable biotopes. Biotope mappings have to include an evaluation for planning aspects. That means to design an independent special planning programme 'biotope protection and development', considering the entire local area. In this programme, the aims for a sustainable development of all biotopes in the local urban area should be described from the point of view of nature conservation.

Urban biotope mapping is a subject area of nature conservation and landscape planning. Taking into consideration the wide-ranging utilisation of the results, it is very useful to incorporate other local departments, especially the department for urban planning. A well carried-out biotope mapping cannot be executed frequently. For that reason, an urban biotope mapping should be based on a well structured fundamental concept, which makes it possible to realise the different demands of use. The fundamental conceptual basis is the comprehensive classification of biotopes, including both the rural and the urban areas. Step by step, specific mappings and plans can be added to this basis, e.g., extensive investigations of plants and animals on specific valuable biotopes, small-scale features, and so on. A minimum standard of information has to be guaranteed in order to allow the filling in of representative data about biotope structure and biotope quality. Biotope mapping is first of all a mapping of habitats, that means a mapping of structures; secondly it is a listing of plant and animal species. The experiences show that the following levels of structural information are needed:

- spatial structure caused by land use (flats with green open space, orchards, etc.);
- ecological site potential (degree of green spaces, intensity of human impact, soil);
- biotic structure (vegetation structure, number and shape of small-scale landscape elements).

The environmental and urban planning is often only interested in structural information. But this information represents only a potential habitat quality, not the reality. It neglects the need for a deeper knowledge, that means, on the one hand, a sufficient description of the historical situation that can be used for comparisons with future situations and, on the other hand, the potential of bioindication (for abiotic situations as well as for biological interactions and networks). That information is necessary in order to realise successful measures for specific nature conservation tasks. Therefore, both a representative survey of plant and animal species aimed at all biotope types receiving an overall view, and an accurate and detailed

Table 4 Groups of plants and animals investigated for urban biotope mapping (answers of 82 towns and cities are considered).

	total	comprehensive lists	selective lists
vascular plants	71 (87%)	55 (67%)	16 (20%)
mosses, lichens, fungi	18 (22%)	3 (4%)	15 (18%)
vegetation communities	51 (62%)	34 (41%)	17 (21%)
birds	57 (70%)	36 (44%)	21 (26%)
amphibians	54 (66%)	34 (41%)	20 (24%)
reptiles	45 (55%)	28 (34%)	17 (21%)
butterflies	45 (55%)	27 (33%)	18 (22%)
dragonflies	44 (54%)	26 (32%)	18 (22%)
mammals (without bats) bats	31 (38%) 15 (18%)	8 (10%) 10 (12%)	23 (28%) 5 (6%)
grasshoppers	23 (28%)	20 (24%)	3 (4%)
beetles (carabids)	13 (16%)	8 (10%)	5 (6%)
other groups of animals (i.e. snails, diptera)	18 (22%)	12 (15%)	6 (7%)

survey of plant and animal species in valuable biotopes are additionally needed. Table 4 demonstrates that most biotope mappings in Germany included a detailed recording of plants and animals.

CONCLUSION

The theoretical and practical approach to answer the question expresssed in the title of this article ('why biotope mapping in populated areas?') stressed the following points:

- biotope mapping in populated areas as well as in the countryside is a tool for (integrated) nature conservation strategies and can offer an important contribution to sustain-

able development;
- the particular aim of nature conservation in urban areas is to bridge nature and human life;
- a realistic and comprehensive view of nature is needed in order to reach this aim;
- urban biotopes possess significance for various ecological functions and the evaluation of urban biotopes has to consider these wide-ranging ecological functions;
- urban biotope mapping has become an indispensable component of landscape planning in Germany because it offers precise and multi-purpose information;
- results of biotope mapping in populated areas can be used to discuss aims and issues of nature conservation with the public.

Theory and practice demonstrate that biotope mapping in populated areas is a suitable and necessary tool for nature conservation strategies in urban areas.

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