



FEDERAL GREEN INFRASTRUCTURE CONCEPT

NATURE CONSERVATION FOUNDATIONS
FOR PLANS ADOPTED BY THE GERMAN FEDERATION

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FOREWORD

The German Federation's activities in various areas of policy have considerable influence on the state of nature and our landscapes. Examples can be given such as infrastructure projects involving roads, railways and waterways, the expansion of energy grids, federal-level spatial planning, and the Federation's funding instruments in the fields of urban development, energy and land use. All these activities are factors in the large number of species and habitats that are being endangered, the dramatic acceleration in the transformation of Germany's landscapes, and the disadvantageous impacts being suffered by the diverse ecosystem services that are provided by nature and landscapes.

The coalition agreement for the government formed at the beginning of the Bundestag's 18th electoral term states that *'a "Federal Green Infrastructure Concept" [will be] the foundation for decision-making about plans adopted by the German Federation'*. The Federal Concept therefore serves primarily to improve the quality of all spatially relevant plans adopted by the Federation and so ensure they are consonant with nature conservation objectives. This can only be done in a systematic fashion if the issues relating to nature and landscape are analysed cartographically, and the data on these issues are supplied to the Federation's planning authorities.

The term 'green infrastructure' is rooted in the idea that the conservation and improvement of ecosystems and their services as 'green infrastructure' are just as indispensable to a country's development as the maintenance and improvement of 'grey' (technological) infrastructure. For example, intact floodplains make significant contributions to precautionary flood protection, and help to purify water bodies and drinking water. One study commissioned by the Federal Agency for Nature Conservation comes to the conclusion that the floodplains along the major rivers in Germany already provide purification services (nitrogen/phosphorus) worth €500m a year today. This means that investments in society's green infrastructure can deliver services just as important as those delivered by investments in technological infrastructure. That is why, from an economic point of view, there is an urgent need to take nature and landscapes into consideration as well when technological infrastructure such as roads or railways is constructed and/or upgraded.

With the Federal Green Infrastructure Concept, the Federal Agency for Nature Conservation is presenting the foundations on which nature conservation and landscape management authorities will be able to draw up technical papers that can be applied in all spatially relevant areas of the German Federation's policy-making. It bundles the technical nature conservation concepts that are in place at the federal level for these purposes, takes up the European Commission's Green Infrastructure initiative and therefore supplies important environmental information.

Prof Beate Jessel

President of the Federal Agency for Nature Conservation



FUNDAMENTALS

A. FUNDAMENTALS

The Federal Green Infrastructure Concept (BKGI) is integrated into EU-wide processes for the establishment of green infrastructure. Its main aims include the conservation and restoration of ecosystem services, and therefore the protection of natural capital. Ecosystem services are defined as the goods and services provided by nature and landscapes – in other words biological diversity, soil, water, the climate/air and their interactions. They deliver direct or indirect benefits for society and, in this way, contribute to human wellbeing, for instance through the production of foodstuffs and drinking water, flood retention and climate regulation, or even by offering opportunities for recreation and aesthetic experiences (NATURAL CAPITAL GERMANY 2016). The term ‘green infrastructure’ is rooted in the idea that the conservation and improvement of ecosystems, and their services as ‘green infrastructure’ are just as indispensable to a country’s development as the maintenance and improvement of its ‘technological infrastructure’.

This idea is also taken up by the EU Biodiversity Strategy. For the implementation of this strategy, the European Commission has, among other things, issued a communication in which the term is defined as follows:

Green Infrastructure (GI): a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings. (EUROPEAN COMMISSION 2013)

If these services are to be safeguarded and developed on a nationwide scale in Germany, there is a need for a nationwide framework that systematically highlights the spatial requirements for the safeguarding of vulnerable ecosystem services that are worthy of protection, while ensuring particular appreciation of the protection and development of biological diversity. This purpose is to be served by a technical paper drafted by the authorities responsible for nature conservation that highlights the priority areas for nature conservation and landscape management at the federal level, and makes the relevant data available to the Federation’s planning bodies. This paper is given concrete form in the Federal Green Infrastructure Concept. Consequently, the Federal Green Infrastructure Concept imparts important stimuli for sustainable spatial and landscape development. At the same time, the framework of federal law and the aims for action set out in the Federal Nature Conservation Act (BNatSchG) are to be taken into consideration for its integration into existing planning instruments and processes.

The Federal Green Infrastructure Concept is therefore pertinent to the concept of ecosystem services as well. Primarily, however, the statements made here are based on the three dimensions of Germany’s conservation aims mentioned in Article 1 of the Federal Nature Conservation Act (BUNDESTAG PRINTED PAPER 16/12274, P. 50):

- the protection of the diversity of the natural and cultural landscape heritage, in particular biological diversity,
- the protection of material functions and/or natural resources, and
- the protection of the immaterial functions of nature and landscapes.

These three dimensions of the country’s conservation aims are equally pertinent to all the objects of action for nature conservation: biological diversity (plants, animals, biotopes), the natural balance (in particular the web of interactions around soil, including geotopes, water, the climate, air), and landscapes and their aesthetic qualities. They make it clear that the concept of ecosystem services is already implied by the Federal Nature Conservation Act.

The Federal Green Infrastructure Concept serves the implementation of the EU Biodiversity Strategy, and is targeted in particular at the federal level because:

- important plans with spatial impacts that are of significant relevance for nature and landscapes, and therefore for green infrastructure fall within the jurisdiction of the German Federation (Federal Transport Infrastructure Plan, grid expansion, etc.),
- the Federation itself is directly responsible for certain areas of nature conservation (marine conservation, species protection), and also supports nature conservation measures at the Land, regional and municipal levels as a funding provider,
- technical nature conservation concepts with spatial relevance developed at the federal level (e.g. for ecological networks, defragmentation across transport routes, the status of floodplains) are to be coordinated using a uniform national format so that these concepts contribute to planning procedures, and it is ensured they are implemented effectively in relation to federally relevant plans and projects,
- federal technical nature conservation concepts must fit into a Europe-wide approach.

In addition to this, a nationwide approach will support actors at the Land, regional and municipal levels in appropriately categorising and assessing individual sites, elements and functions of Germany’s green infrastructure.



The Federal Concept's functions and/or goals are:

- to implement EU concepts for green infrastructure at the national level,
- to bundle existing nature conservation concepts and models at the federal level, and therefore draw together nationwide information and foundations for assessment,
- to give 'guidance' for plans made by third parties,
- to define the spatially relevant aims set out in the National Strategy on Biological Diversity (NBS) in concrete terms,
- to identify priority functions and areas for nature conservation at the federal level,
- to provide advice concerning the exemplary implementation of nature conservation targets at Federal Government properties,
- to facilitate coordination with neighbouring states.

Within the framework of the distribution of legal and administrative competences for nature conservation in Germany, the Federal Green Infrastructure Concept concentrates on topics that are of federal relevance. At least one of the following criteria must be satisfied for this to be the case:

- A need for nationwide coordination: The target/content is the subject of political/programmatic statements at the federal or EU level (e.g. in the National Strategy on Biodiversity and EU Biodiversity Strategy) and, from a technical point of view, (also) requires cross-Länder and/or nationwide coordination and attention.
- Federal funding for projects: Targets and projects are promoted by diverse forms of financial support from the federal budget (e.g. Federal Biological Diversity Programme, chance.natur).



- Cross-Länder or international interrelationships: Targets and measures relate to spatial and functional interrelationships that extend across Land or state borders, for instance in the context of watercourses, seas or the system of habitat networks and/or biotopes.
- A need for nationwide assessment: Assessment from a nationwide perspective is expedient or required for other assessments, and the derivation of targets and measures at the Land, regional and municipal levels because the significance of the local and regional can only be fully grasped against a nationwide background.
- Nationwide relevance of existing concepts, programmes and targets: Existing nature conservation and landscape management concepts, programmes and targets expressly relate to nationwide qualities and/or assessments (e.g. 'nationally representative', 'nationally significant') and therefore, by definition, can only be put into practice and implemented by taking a nationwide approach.
- National significance: Sites and natural and landscape features are distinguished by their nationwide rarity and characteristics that are qualitatively outstanding from a nationwide perspective, and cannot be created and/or replaced arbitrarily at other locations. This may relate to all protected assets (objects of action/dimensions of conservation aims).
- A need for cross-Länder action if the impacts of nature and landscape-relevant developments are to be managed: The impacts of plans, projects, interventions, and societal and natural developments (e.g. climate change) on nature and landscapes extend across the borders of the individual Länder and require coordinated cross-Länder action if they are to be managed (e.g. in the context of grid expansion or the reduction of greenhouse gas emissions).
- The need for efficiency: For reasons of efficiency (ratio of time, human and financial resources deployed to nature conservation gain), the nationally coordinated concentration of measures is expedient and/or required in order to conserve or develop particular features and qualities in selected spaces.
- Properties owned by the German Federation: Targets and measures relate to sites owned by the German Federation and may be implemented on those sites (federally owned properties).

When the Federal Concept was drafted, recourse was had to available data sets and concepts, which were analysed for that purpose by a concurrent research project (Heiland et al. 2017). No new data were gathered. This is why the maps and graphics show different levels of detail. In addition to this, technical data and concepts that are currently in development will gradually be incorporated into the Federal Green Infrastructure Concept.

In this connection, reference is expressly made to the fact that the strong emphasis on biological diversity compared to other protected assets in this document primarily reflects the data that are currently available. Even though the protection and development of biological diversity are of central significance for nature conservation and the safeguarding of particular ecosystem services, the protection of soil, water, air, the climate, and landscapes and their aesthetic qualities must not be neglected. Against this background, the Federal Green Infrastructure Concept is to be understood as a concept that will be updated further, supplemented and adapted as sufficiently valid data and findings become available.



COMPONENTS AND FUNCTIONS OF GERMANY'S GREEN INFRASTRUCTURE

B. COMPONENTS AND FUNCTIONS OF GERMANY'S GREEN INFRASTRUCTURE

Support for green infrastructure is embedded in the EU's Biodiversity Strategy, and has the goal of improving the protection and conservation of ecosystems and ecosystem services in the period up to 2020 (European Commission 2011). Against this background, although the components of green infrastructure are primarily natural sites (e.g. intact peatlands, lakes) and near-natural sites (e.g. extensively used meadows and pastures), artificially created elements (e.g. greenbridges and ecoducts across motorways, façade and roof greening systems) may also be components of green infrastructure, as long as they perform particular functions and therefore provide ecosystem services.

The geographical scope for the investigation and planning of green infrastructure is initially the whole of Germany, and the approach encompasses all natural goods (animal and plant species, their habitats, soil, water, climate, air and landscapes), as well as their significance for action to safeguard the diversity of nature and landscapes, and their material and immaterial functions in relation to the appreciation of, and engagement with, nature and landscapes. The Federal Green Infrastructure Concept is consequently not limited to either biological diversity or uninhabited spaces, but explicitly extends to all natural goods and settled areas. This means it is also possible to respond to the specifics of different spaces with different requirements concerning green infrastructure and/or the provision of ecosystem services. Likewise, green infrastructure not only encompasses terrestrial ecosystems, but also water bodies and marine ecosystems. Sites and features of nationwide significance for the various assets to be protected under nature conservation policy and/or particular ecosystem services are regarded as being part of the country's green infrastructure. Further sites and features will be added, the choice of which will be informed by Land-wide, regional and municipal perspectives.

As far as the conception of green infrastructure for the protection and development of species and habitats is concerned, it is possible to build to a great extent on concepts adopted at the federal level. By contrast, there are topics such as the identification of nationally significant cultural landscapes or the appreciation of, and engagement with, species and habitats for which concepts that contain statements of comparable precision have not been adopted to date.

The heterogeneity of the concepts in place at the federal level for individual components of the natural balance and/or the functions and ecosystem services connected with them does not permit all the assets protected under nature conservation policy to be examined in the same depth. The Federal Green Infrastructure Concept therefore concentrates particularly on the protection, conservation and development of the diversity of species, habitats and landscapes, selected soil functions and areas that perform particularly numerous or significant functions and ecosystem services, and where there is an accordingly great need for action, subject to consideration of federal competences (settled areas, floodplains, seas).



B1. THE BACKBONE OF GREEN INFRASTRUCTURE: PROTECTED SITES AND ECOLOGICAL NETWORKS

B1.1 PROTECTED AREAS AND GERMANY'S NATIONAL NATURAL HERITAGE

The central components of Germany's green infrastructure are the country's systems of protected areas under Article 20 ff. of the Federal Nature Conservation Act and the European protected areas covered by the Natura 2000 network (under Article 31 ff. of the Federal Nature Conservation Act, i.e. Special Protection Areas (SPAs) under the Birds Directive and Sites of Community Importance (SCIs) under the Habitats Directive). National Natural Heritage sites back up the system of protected areas and are safeguarded for the future for nature conservation purposes.

B1.1.1 PROTECTED AREAS

There is a range of categories of protected areas whose primary protective purpose is the conservation of biological diversity. In this respect, strictly protected areas (national parks, nature conservation areas, Natura 2000 sites), in particular, have proven to be effective at safeguarding biological diversity (cf. Jessel 2011). Even though there will continue to be a need for great efforts with regard to the management of strictly protected areas (Scherföse 2011), the opportunities for their development are, in principle, markedly more favourable than those of normal landscapes.

The following protected areas, whose primary protective purpose is the conservation and development of biological diversity, are components of Germany's green infrastructure:

- Natura 2000 sites,
- national parks,
- biosphere reserves (core and buffer zones),
- nature conservation areas,
- national nature monuments.

Large parts of Germany's biosphere reserves (development zones), but also its nature parks and landscape protection areas primarily serve the safeguarding and development of extensive cultural landscapes, engagement with landscapes and nature, and therefore human recreation. At the same time, they may also be important habitats, buffer sites or sites that belong to ecological networks. They are therefore represented on the map of 'protected areas' for information purposes only in order to guarantee a comprehensive overview of the extensive protected areas located across Germany.

The other protected areas and/or protected area categories, whose primary objective is to conserve biological diversity, form the 'backbone' of Germany's green infrastructure. At the federal level, just as in ecological networks, there is therefore a need for cooperation and coordination across Land borders when it comes to Germany's protected areas – which are administratively designated by the Federation (Exclusive Economic Zone (EEZ)) and the Länder – if justice is to be done to (inter)national requirements concerning their representativeness, the links between them, their good management and their good integration into surrounding landscapes.

Map: Protected areas under the Federal Nature Conservation Act



B.1.1.2 NATIONAL NATURAL HERITAGE

National Natural Heritage (NNE) is an outstanding initiative taken by the German Federation (BMUB 2014). Instead of being privatised, selected valuable natural sites owned by the Federation are dedicated to nature conservation organisations and authorities. They include areas that were previously in military use, sites along the former inner-German border ('Green Belt'), sites that used to be under state ownership in the German Democratic Republic (GDR) and were administered by the Treuhandanstalt privatisation agency after reunification, and former GDR open-cast lignite mines. Across Germany, about 156,000 hectares of federally owned land are safeguarded as National Natural Heritage. For the most part, the Federation has transferred these sites to the German Federal Environmental Foundation (Deutsche Bundesstiftung Umwelt), the Länder, and nature conservation associations and foundations. The Federation itself has assumed responsibility for the nature conservation management and development of about 30,000 hectares of this land. National Natural Heritage sites are cited in the Federal Nature Conservation Act as components of the system of ecological networks and therefore serve *'the enduring conservation of populations of wild fauna and flora, including their habitats, and biotopes and communities, as well as the preservation, restoration and development of functioning ecological interaction relationships'* (Article 21 Federal Nature Conservation Act). The protection of national natural heritage sites makes an essential contribution to the conservation and development of national biological diversity, and constitutes an aim of the National Strategy on Biological Diversity.

The Federal Green Infrastructure Concept places the following aims for Germany's National Natural Heritage sites at the centre of attention:

- safeguarding and developing natural heritage sites, so that the functionality of ecological interrelationships within national nationwide ecological network is ensured and safeguarded over the long term,
- improving the conservation statuses of habitat types and species in the Natura 2000 network by means of the conservation and development of National Natural Heritage sites,
- supporting the two-per-cent target for wilderness areas by means of the appropriate development of suitable National Natural Heritage sites,
- improving the coherence of National Natural Heritage sites as the core sites of the nationwide ecological network.

In order to implement the above aims, the management plans for National Natural Heritage sites are also to be focussed on safeguarding the functionality of individual habitats and their ecological interrelationships over the long term. Cross-Länder aims are to be taken into consideration when management plans are drawn up. In order to avoid conflicts between different aims, plans in neighbouring Länder are to be taken into consideration and/or coordinated as necessary.

The conservation and safeguarding of the 'Green Belt' along the former Iron Curtain as part of Germany's natural heritage and a historical monument is a lighthouse project in this connection. The German Federation is supporting measures intended to achieve the main goal of this project, which is to conserve and develop the former inner-German border strip as a unique national ecological network that extends through nine Länder over a distance of about 1,400 km. In addition to this, its National Natural Heritage sites support the five-per-cent target for natural woodland development and the two-per-cent target for extensive wilderness areas set in the National Strategy on Biological Diversity.

Currently, an areally precise cartographic representation is not yet possible because the detailed inventory of sites is still being prepared at present.



Federal Agency for Nature Conservation

Classification of sites by size
Figures in hectares

- Up to 50
- Up to 100
- Up to 500
- Up to 1,000
- Greater than 1,000

Sources: Federal Agency for Nature Conservation (BfN), 2016
After: Institute for Federal Real Estate (BImA), 2016
Basic Spatial Data: © GeoBasis - DE / BKG 2015

B 1.2 HABITATS AND SPECIES

The protection and development of biological diversity encompass genetic diversity, the diversity of species and the diversity of ecosystems and/or habitats. At the federal level, spatial statements about biological diversity can be made on the basis of habitat, requirement and/or ecosystem types. At the moment, spatial representations of species diversity are based largely on floristic and faunistic mapping data, which were used, for example, to delimit the hotspot regions for the Federal Programme for Biological Diversity.

The following fields of activity are priorities:

- a nationwide concept for ecological networks, the fundamental habitat networks and the derived axes and/or corridors that connect to the European ecological network (BURKHARDT ET AL. 2004; FINCK ET AL. 2005; RECK ET AL. 2005; FUCHS ET AL. 2010; HÄNEL AND RECK 2011),
- action to safeguard bottlenecks in habitat networks (HÄNEL ET AL. 2016),
- 'defragmentation along transport routes', subject to consideration of the Federal Defragmentation Programme (HÄNEL AND RECK 2011; BMU 2012),
- undissected functional areas (Unzerschnittene Funktionsräume) (HÄNEL 2007; RECK ET AL. 2008).

B 1.2.1 ECOLOGICAL NETWORKS, HABITAT NETWORKS, AXES/CORRIDORS

The Federal Green Infrastructure Concept integrates a range of nationwide technical concepts that have prepared the way conceptually for, and support, the statutorily anchored nationwide ecological network. These concepts deal with:

- the fundamental habitat networks with their functional areas,
- nationally significant axes and/or corridors for the nationwide ecological network, including the Green Belt,
- sites for the nationwide ecological network and
- international links.

Habitat networks are systems of similar, spatially neighbouring habitats that are particularly worthy of protection, potentially have close functional connections with one another and therefore represent functional ecological interrelationships. They are based on the sites shown on the biotope maps drawn up by the Länder, as well as supplementary data, and therefore reflect what is known about valuable habitats at the federal level. On this foundation, the sites for the nationwide ecological network were identified in line with the recommendations of the Working Group on a Nationwide Ecological Network (BURKHARDT ET AL. 2004). They represent the most significant sites (or core sites) for ecological networks at the national level and therefore belong to the country's habitat networks. In conjunction with data on their potential for development, these habitat networks continue to form the foundation for the identification of nationally significant axes and/or corridors for the nationwide ecological network. They symbolise the most important functional interrelations within the networks.

When the Federal Nature Conservation Act was re-enacted in 2002, it was set as a goal to create a nationwide ecological network that would occupy at least ten per cent of each Land's territory. The nationwide ecological network is to transcend the borders between the Länder. In addition to this, the realisation of a European and/or international ecological network is included in the National Strategy on Biological Diversity.

Map: Summary map of the nationwide ecological network, habitat networks and axes/corridors



Within the framework laid down by the technical concept drawn up at the federal level for the nationwide ecological network (FUCHS ET AL. 2010), the defragmentation concept (HÄNEL AND RECK 2011) and the Federal Defragmentation Programme (BMU 2012), the Federal Green Infrastructure Concept integrates the targets that have been stated, inventories of sites and recommendations concerning the concepts discussed above. This means that the habitat networks, axes/corridors (including the Green Belt), sites for the nationwide ecological network and international links (FINCK ET AL. 2005) described in the Federal Concept are to be taken into consideration both in all spatially relevant plans and projects at all spatial levels, and also through the landscape planning and/or planning for the ecological network done by the Länder, as well as the regional and municipal plans derived from such planning.

In particular, these axes/corridors also possess a European dimension. Their links to other countries form the foundation for the implementation of the European Commission's strategy (EU BIODIVERSITY STRATEGY TO 2020) or for contributions to initiatives taken by the Council of Europe (e.g. Pan-European Ecological Network (PEEN)), above all by making appropriately concrete spatial inventories available for the implementation of their targets. Furthermore, the axes/corridors contribute to the national implementation of Article 10 of the Habitats Directive, which provides for measures to improve the ecological coherence of the Natura 2000 network. Further to the measures taken in the Natura 2000 network, measures relating to the nationwide ecological network are indispensable for many habitat types and species covered by the Habitats Directive and the Birds Directive in order to safeguard/restore their favourable conservation status.

B1.2.2 SAFEGUARDING BOTTLENECKS IN HABITAT NETWORKS

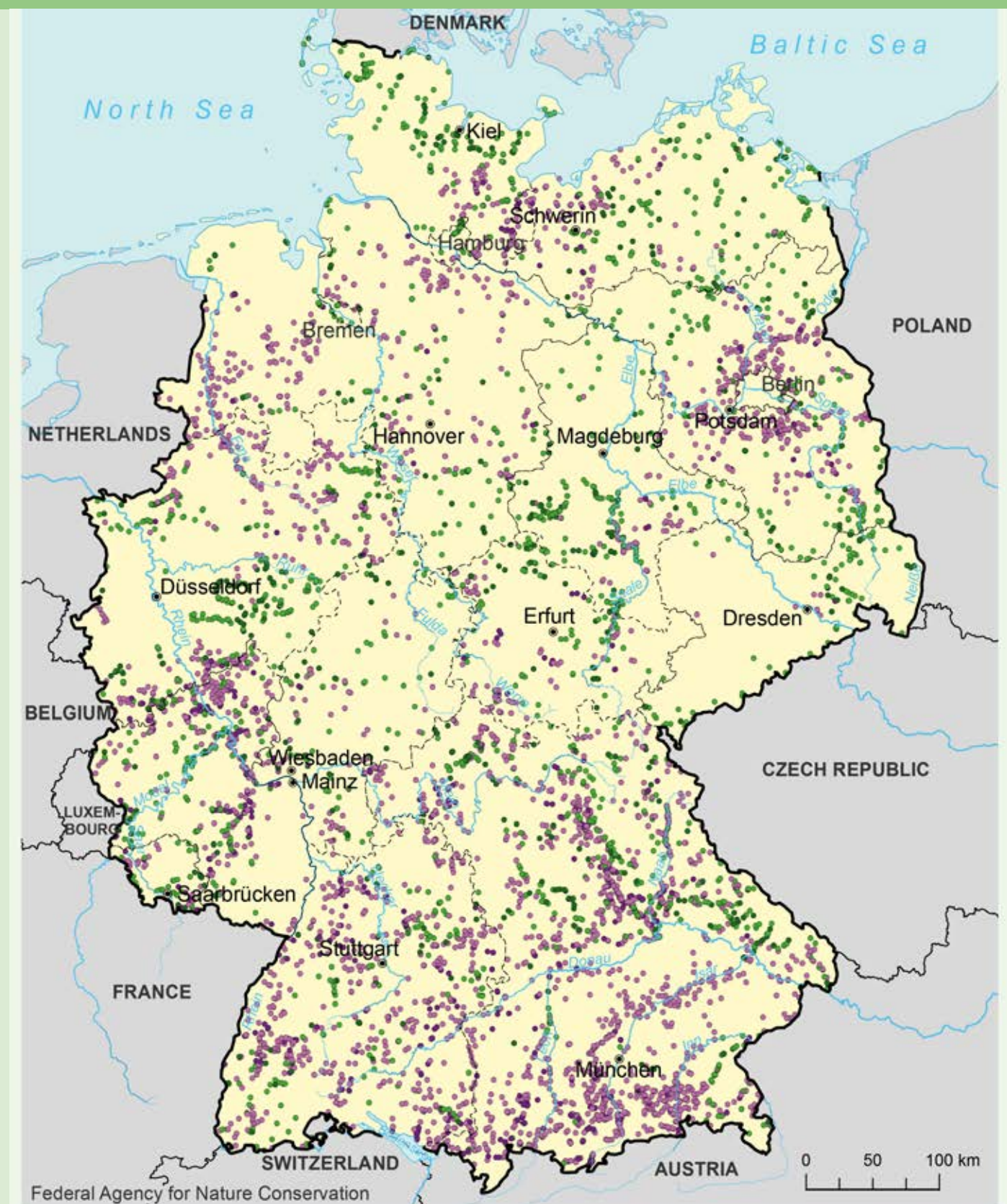
The land take driven by the development of settlements and transport is still at a high level, running at an average of 66 hectares a day (FEDERAL STATISTICAL OFFICE 2016). Apart from the absolute quantitative increases in land take, the spatial locations where land is being taken are also a critical aspect of settlements' sustainable development. Frequently, newly developed sites are linked up to existing settlements and land occupied by transport infrastructure, connecting them or creating ribbon settlements. Above all due to their vertical elements, such as buildings and enclosures, built-up areas represent an insurmountable barrier for many species that are not capable of flying.

Consequently, important connections between habitats and/or whole landscape subunits are not infrequently severed, or 'bottlenecks' arise (HÄNEL ET AL. 2016). It is particularly grave if new structures are erected in areas that are important for the supralocal habitat networks and/or their species. The disruption of important spatial/functional connections may be associated with harm to populations.

Action to keep bottlenecks free is intended to sustainably safeguard the system of interlinked spaces in the habitat networks and axes/corridors. Safeguarding open spaces around bottlenecks in the system of habitat networks is of particular significance in the context of green infrastructure in urban spaces and/or settled areas.

As essential components of the concept for nationwide habitat networks, bottlenecks are important to the nationwide ecological network, and should therefore be incorporated into nature conservation-relevant plans and concepts in future. The Federal Green Infrastructure Concept integrates the concept of bottlenecks as an important contribution to the safeguarding of biodiversity and the conservation of ecosystems' productivity.

Since the size of the bottlenecks does not permit them to be depicted at the scale of the mapping in the Federal Green Infrastructure Concept, they are only symbolically represented to provide an overview of the situation. A detailed account is found in the relevant technical concept (HÄNEL ET AL. 2016; cf. http://www.bfn.de/o3o6_zerschneidung.html).



- Sources: Federal Agency for Nature Conservation (BfN), 2016
Basic Spatial Data: © GeoBasis - DE / BKG 2015
- Bottleneck with very high ecological risk
 - Bottleneck with high ecological risk
 - Bottleneck with very great significance for network
 - Bottleneck with great significance for network

B 1.2.3 RE-LINKING ALONG TRANSPORT ROUTES; FEDERAL DEFRAGMENTATION PROGRAMME

The fragmentation of habitats and habitat networks by linear pieces of technological infrastructure is one of the main factors contributing to the threats faced by species. Firstly, technological structures take up land and, secondly, they form barriers that separate what were previously functionally connected habitats from one another so it is no longer possible for sufficient exchange and resettlement processes to take place between populations of species that have so far been largely isolated from one another.

In the concept *Nationwide Priorities for Re-Linking Ecosystems: Overcoming Road-Related Barriers* (HÄNEL and RECK 2011), priority sections of the road network were therefore identified along which – subject to more detailed analyses on the ground – the construction of wildlife crossings is urgent in order to reduce barrier effects. Consequently a spatial/technical framework is available that, together with the defragmentation concepts of the Länder that are in place or still to be developed, will lay foundations for the systematic remediation of the existing road network with suitable wildlife crossings. This concept formed one of the bases for the **Federal Defragmentation Programme**.

On the foundation of the re-linking concept drawn up at the federal level and the Federal Defragmentation Programme, the Federal Green Infrastructure Concept pursues and/or affirms the following aims:

- the implementation of the Federal Defragmentation Programme by means of the construction of the envisaged wildlife crossings,

- the concrete specification of the priority sections identified under the re-linking concept by means of the drafting of Land-wide defragmentation concepts,
- the construction of further wildlife crossings on the basis of the nationwide re-networking concept and Land concepts in addition to the measures provided for in the Federal Re-networking Programme.

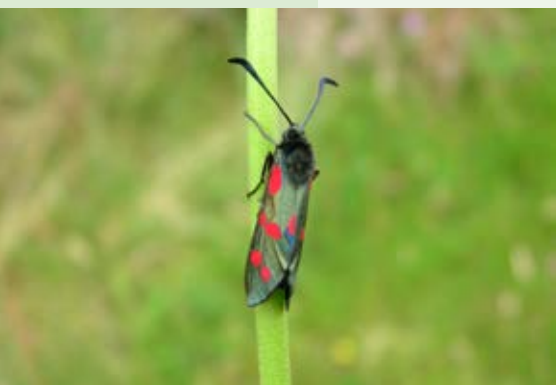
On account of the high spatial resolution required to depict the sections earmarked for re-networking, they are not represented cartographically in the Federal Green Infrastructure Concept; reference is made to the relevant technical concept (Hänel and Reck 2011; cf. the Federal Agency for Nature Conservation website: http://www.bfn.de/o3o6_zerschneidung.html).

B 1.2.4 UNDISSECTED FUNCTIONAL AREAS

Undissected functional areas illustrate the current fragmentation of habitats and the associated spatial-functional relationships on a small scale. They are based on a rough areal representation of the habitat networks and therefore the connectivities between particular habitat groups and/or species' requirement types (HÄNEL 2007; RECK ET AL. 2008).

As 'functional units', undissected functional areas are pertinent to particular, priority habitat systems used by certain species groups. They are indicative of ecological interrelationships at an aggregated level. This means that, on the one hand, undissected functional areas serve the representation of habitat fragmentation and/or the re-linking of habitats as an indicator at the federal level; on the other hand, when plans and projects are exam-





ined they are drawn on at a superordinate, strategic level as sources of environmental information about habitat fragmentation.

When land take is unavoidable in undissected functional areas, spatial/functional relationships are to be upheld by means of appropriate measures (e.g. **wildlife crossings**). The implementation reports on the Federal Defragmentation Programme are to be used to build up the undissected functional areas concept into an indicator that reflects habitat fragmentation and/or the progress of re-linking at the federal level (see **BMU 2012**, section D3, 'Umsetzungsbericht').

B 1.2.5 SPECIES

One essential function of green infrastructure is to support the protection, conservation and development of endangered animal and plant species. At the level of the Federal Green Infrastructure Concept, species are at present still largely represented by some of their habitats, whose nationwide concentrations and connections across Germany have been discussed above. This is true at least for those species that display close ties to particular habitat types, such as species that live in wetland habitats, dryland habitats and near-natural woodlands. Furthermore, large mammals and species that live in watercourses with subhabitats are integrated through specific networks. With the further expansion of the German Federation's databases on the occurrence and distribution of animals, plants and fungi, it will also be possible for spatially localised population survey data on species to be integrated into the Federal Green Infrastructure Concept.

The concepts for **biological diversity hotspots** (ACKERMANN AND SACHTELEBEN 2012), **population vulnerability analysis** for the compilation of Red Lists (LUDWIG ET AL. 2009), **species for which Germany bears national responsibility** (GRUTTKE ET AL. 2004) and the protection of **migratory species** (BfN 2016) that have been adopted at the federal level are relevant with a view to the protection and development of individual species or species groups, and the setting of appropriate priorities.

Biological diversity hotspots are regions with a diversity of species, populations and habitats that is typical of Germany and particularly worthy of conservation. They encompass a concrete spatial inventory; however, on account of the data on which they are based,



which have largely been aggregated, they are only suited to a certain extent for the direct derivation of statements for nationwide plans. Apart from their function as an inventory of sites eligible for funding under the Federal Programme on Biological Diversity, however, they possess a certain indicative evidential value with regard to the clustered occurrence of endangered animal and plant species. Hotspots are therefore represented for information purposes only in the Federal Concept.

Migratory species such as migrating birds cross state borders or even continents on their way between their breeding sites and wintering grounds, and rest, gather or winter in Germany as well. Many marine species like harbour porpoises also migrate in the course of a year. However, distribution data are only available for some of the migratory species and species for which Germany has national responsibility, while no nationwide representations have been generated to date. The Federal Agency for Nature Conservation defined spatial corridors for bird migration over the German North Sea and Baltic Sea that are of particular significance for the migration of birds in the nature conservation planning paper published back in 2006 – but these corridors have not been further defined in concrete terms for specific species to date (BfN 2006).

With regard to the protection of migratory species and the movements of individuals over wide areas, the development of a spatial concept would also be expedient for marine mammals and migratory fish species. Sites expected to have a significant function for particular migrating and resting birds should be identified as resting and wintering grounds on the basis of uniform criteria. Building on this, the development of a spatial concept could be examined. As far as migratory fish (e.g. salmon, eel, river lamprey, common sturgeon) are concerned, significant statements about the passability of Federal waterways can already be made at the federal level thanks to the Federal Institute of Hydrology's concept for the prioritisation of measures to ensure the passability of federal waterways (BfG 2010; BMVBS 2012). At the Land level, concepts for the restoration of watercourse passability in each Land were drawn up when the Water Framework Directive was being implemented. Among other things, priority water bodies have been designated and priorities have been set for the implementation of measures with the purpose of achieving the relevant targets.



B1.3 PROTECTED SITES AND THE NETWORK OF ECOSYSTEMS

All spatially delimitable spaces and sites throughout Germany that display an overwhelmingly natural or near-natural character are brought together on the summary map of protected sites and the network of ecosystems. As the backbone of green infrastructure, they are of outstanding significance for the protection, conservation and development of biological diversity. Consequently, Germany's 'green infrastructure' has not been conclusively spatially recorded, but those areas have initially been captured that, on the basis of the European Commission's communication, are definitely significant components of green infrastructure.

Since it is hardly possible to distinguish individual categories of area any longer on account of the various overlaps between them, a uniform colouring has been chosen for all the areas shown on the summary map so that all relevant spaces are apparent at a glance. For information on the various categories of area, see the individual thematic maps included in the Federal Green Infrastructure Concept.

Following the criteria for priority nature conservation sites formulated from a federal point of view by **SSYMANK (2000)**, the following areas are brought together on the summary map of green infrastructure for the protection, conservation and development of biological diversity:

- Natura 2000 sites (including OSPAR and HELCOM marine protected areas, Ramsar sites),
- nature conservation areas,
- national parks,
- national nature monuments,
- biosphere reserves (core and buffer zones),
- areas eligible for funding (formerly core areas) under large-scale nature conservation projects,
- sites with nationwide significance for the system of ecological networks (open land and woodland),
- core spaces for the habitat networks (dryland, wetland and woodland habitats),
- nationally significant axes/corridors for the nationwide ecological network, Green Belt.

Most protected areas have been included in the map in their entirety. However, the biosphere reserves are represented solely by their core and buffer zones, while large-scale nature conservation projects are represented solely by the areas eligible for funding under them because an overwhelmingly near-natural character is only to be assumed in these zones.

The determined sites for the ecological networks with cross-Länder significance and the core spaces of the habitat networks (cf. **BURKHARDT ET AL. 2004**) are integrated as additional categories for the system of interlinked habitats outside protected areas. The spatial inventory is supplemented by the nationally significant axes/corridors for dryland, wetland and woodland habitats, and large mammals (lynx, wildcat and red deer).

National Natural Heritage sites are not incorporated into the inventory because no areally precise data are yet available on the areas in question. These areas are to be integrated into the inventory of sites for the Federal Green Infrastructure Concept when progress is made on the gathering of this data.

Map: Green infrastructure for the protection, conservation and development of biological diversity



- National parks, Nature conservation areas, Natura 2000 sites, Ramsar sites, Biosphere Reserves (core-/buffer zones), National nature monuments, large-scale nature conservation projects (areas eligible for funding), OSPAR/HELCOM marine protected areas, nationwide ecological networks (open land, woodland), habitat networks (core spaces)
- Biologically diverse hotspots (represented, but not components of Green Infrastructure)
- Outer limit of Exclusive Economic Zone
- - - 12-mile zone including deep-water anchorages
- Nationally significant dryland habitat, wetland habitat, woodland habitat and large mammal axes/corridors, Green Belt

Sources: Federal Agency for Nature Conservation (BfN), 2015, protected areas based on information supplied by the Länder
Basic Spatial Data: © GeoBasis-DE / BKG 2015

* For design reasons, only sites > 200 hectares are depicted.

'Biological diversity hotspots' are not components of green infrastructure either because their spatial boundaries essentially define an extensive inventory of areas eligible for funding. They are represented for information purposes only. Furthermore, distribution data are not available on all species for which Germany has national responsibility that would make it possible to integrate them into the mapping as species prioritised nationwide for protection. Nor are there yet any nationwide or areal representations of the occurrence of migratory species from various species groups at present.

The spatial and site categories discussed above occupy approximately 24 per cent of the territory of the Federal Republic of Germany. Overlaps are taken into consideration (adjusted for) in this figure; axes/corridors have not been factored into the calculations. For reasons of clarity, following **SSYMANK (2000)**, only sites of 200 hectares and greater were ultimately represented on the nationwide map, which has a scale of 1:1,000,000.

B 2 SPECIFIC SPACES AND FUNCTIONS

Apart from the examination of the whole of Germany's territory to identify significant spaces for the protection and development of biological diversity, the Federal Green Infrastructure Concept devotes particular attention to various types and/or categories of space that demand special attention for various reasons.

- A range of cultural and natural landscapes constitute **landscapes with particular qualities** in terms of their functions for the cultural and natural heritage or recreation.

- **River floodplains** are significant, in particular, as near-natural sites to be conserved and enlarged; on the one hand, they may be of great significance for biological diversity and engagement with nature; on the other hand, as natural and near-natural inundation areas, they may obviate the need for, or support, expensive technological measures taken under the methodologies for flood protection that will be increasingly significant as the climate changes. The functional unit of the river and floodplain is of decisive significance in this respect. The German Federation is accorded particular responsibility for Germany's major rivers, which are designated as federal waterways.
- Under nature conservation law, the Exclusive Economic Zone (EEZ) in the **North Sea and Baltic Sea**, including the species that live in it and the habitats that are found there, falls within the immediate competence of the Federation, so that the Federation has direct responsibility for it.
- On the one hand, green infrastructure is under particular pressure in the **urban areas** where the majority of Germany's people live but, on the other hand, there is strong demand for diverse ecosystem services in these places. Urban nature is beneficial to people in their immediate living environments and contributes significantly to sustainable urban development.
- Individual **soils** have outstanding significance as carbon stores and therefore a very great deal of potential to make significant contributions to climate protection. In particular, intact peatlands and wetlands are to be highlighted in this respect.



B 2.1 LANDSCAPES WITH PARTICULAR QUALITIES

Cultural landscapes that have developed organically over time, but also natural landscapes provide a large number of ecological and cultural services for humans. They form an essential foundation for human identity, in addition to which they are of outstanding significance for recreation and the conservation of biological diversity.

Varied cultural landscapes with their typical, unique regional characters and dynamics are ultimately the products of the interplay of nature and society, they are the results of continuing processes that have been, and are being, shaped by the evolution of society. The rapid acceleration of such processes caused by the development of settlements, the expansion of infrastructure (transport, energy) and how these changes overlap with each other is an essential aspect of the contemporary transformations our landscapes are going through (SCHMIDT ET AL. 2014). By contrast, there are landscapes that have preserved the near-natural character determined by their particular cultural histories, and are less influenced by such changes. They are significant at the federal level in view of their unique character, which they have been able to preserve over prolonged periods of time.

The landscape-related concepts in place at the federal level (e.g. for undissected low-traffic areas, landscapes worthy of protection) address the significance of landscapes and/or landscape segments in terms of particular properties such as their low noise levels, their homogeneity over a wide area or their significance for species and biotope conservation. By contrast, their significance for the conservation of the cultural and natural heritage, and landscape-based recreation has still not been adequately assessed because there have not been any operationalisable methods with which to undertake such assessments to date (CF. ALSO ALBERT ET AL. 2015). In addition to this, there are other relevant features such as low levels of light pollution, aesthetic qualities, etc. There is need for further development work in this field (cf. Section C).

The significance of individual landscapes and/or landscape segments for the conservation and development of biological diversity is already reflected in large part by the site categories discussed above. In addition to this, **undissected low-traffic areas** are represented for information purposes only in the Federal Green Infrastructure Concept.

Undissected low-traffic areas are areas of > 100 km² that are not crossed by one of the following forms of transport infrastructure:

- roads (motorways, federal, Land and county roads) with a traffic volume of 1,000 vehicles or greater a day,
- double-track railway lines and single-track electrified railway lines that have not been closed,
- canals with the status of Category IV or higher federal waterways.

The assessment of fragmentation effects therefore takes the actual and/or modelled traffic loads on transport axes into consideration. Since the 1970s, 'undissected low-traffic areas' have been identified by the Federal Agency for Nature Conservation and have established themselves as an important basic data set for nationwide landscape-related or nature conservation analyses, partly with a view to the provision of recreational facilities (LASSEN 1979). The federal relevance of the undissected low-traffic areas concept results in particular from the aim included in the National Strategy on Biological Diversity of conserving undissected low-traffic areas, as well as how such areas are taken into consideration in the current Federal Transport Infrastructure Plan.

Apart from this, landscape segments are to be highlighted in which developments largely undisturbed by the influence of human uses are made possible and that consequently (are



Map: Undissected low-traffic areas > 100 km² in 2010 (Daten zur Natur 2016)

able to) develop in a more natural direction. Such **wilderness (development) areas** are spaces in which nature is able to develop undisturbed and unpredictably with its own dynamics. Since many species are reliant on these dynamic, unguided processes, the protection of natural processes is a significant aim for nature conservation in Germany. However, people are not supposed to be completely excluded from wilderness areas, but are able to consciously learn about them and understand them better by engaging with and appreciating such unmanaged processes (BfN 2014). Post-mining landscapes, former military training areas, areas along watercourses, marine coasts, peatlands, woodlands and high mountains come into consideration as possible wilderness areas (BMU 2007).

On account of the ongoing coordination of the quality criteria for possible wilderness (development) areas between the German Federation and the Länder, it is not possible for them to be represented cartographically. As soon as further wilderness areas have been designated by the Länder or under the National Natural Heritage scheme, they will become components of the Federal Green Infrastructure Concept.

B 2.2 RIVER FLOODPLAINS

Floodplains are shaped by the alternation of inundation and drying. This is the decisive factor that influences an intact floodplain ecosystem. Their biotic communities are the most productive and most species-rich in Central Europe (SCHOLZ ET AL. 2012).

The status of Germany's river floodplains was recorded and assessed at the federal level for the first time in the Status Report on German Floodplains (BMU AND BfN 2009). The report gives a nationwide overview of the scale of local changes to floodplains. The study was carried out across administrative boundaries at the level of the main river catchments of the Rhine, Elbe, Danube, Weser, Ems and Oder, as well as watercourses that flow directly into the North Sea and Baltic Sea (BMU AND BfN 2009).

As a result of dyke building and waterway engineering, just one third of the former inundation areas (morphological floodplains) along the major rivers in Germany have been conserved through to the present. Furthermore, the floodplains that are still inundated (active) scheme have an overwhelmingly poor status, which entails a loss of the diverse functions and/or ecosystem services they perform for humans and nature. These include:

- natural and/or near-natural flood protection thanks to the retention of water in floodplain sites,
- the purification of water as a result of nutrient retention,
- the reduction of greenhouse gas emissions due to carbon storage,



River floodplains

- Inactive floodplains
- Active floodplains

Sources: Federal Agency for Nature Conservation (BfN), 2016
Basic Spatial Data: © GeoBasis - DE / BKG 2015

- the conservation of biological diversity,
- their suitability and significance for local recreation and tourism.

In order to conserve and/or reinstate these functions, sites on active floodplains must be protected and previously lost sites restored. In addition to this, the aspiration should be for floodplains to be used more extensively. The near-natural floodplain structures and features that still exist are to be conserved and developed. Heavily modified floodplain areas should be reactivated over the long term as well, even if this presupposes complex planning processes and measures. Not least for reasons of precautionary flood defence, inactive floodplains are to be increasingly integrated into rivers' natural flooding events again by relocating dykes. The near-natural development of floodplains is important, above all in areas that are heavily settled or used intensively for agriculture; it increases these areas' attractiveness and, furthermore, contributes to recreational opportunities. The aim is therefore to create near-natural river landscapes that provide a large number of ecosystem services.

The inventory of sites of active and inactive floodplains has been included and mapped in the Federal Green Infrastructure Concept. Consequently, spaces have been earmarked in which the functions specified above are to be conserved and improved. On active floodplains, for example, it is possible to do this by reconnecting cut-off meanders, extensivising land use and carrying out rewetting measures or measures to develop floodplain woodland that do not increase the likelihood of flooding; on inactive floodplains, inundation areas can be restored by relocating dykes. The implementation of such measures is to be specified in concrete spatial terms by further studies and plans.

B 2.3 SETTLED AREAS

The overwhelming majority of Germany's population live in towns, cities and urban regions. Urban green infrastructure supports diverse societal objectives pursued in the spirit of socially, economically and ecologically sustainable urban development. These include, for example, the promotion of health and wellbeing, adaptation to climate change and biological diversity.

The EU's Green Infrastructure Strategy explicitly incorporates urban spaces. At the national level, concerns relating to urban nature are anchored in strategically important documents: The National Strategy on Biological Diversity also formulates visions for urban landscapes and underpins them with aims and measures. The Nature Conservation Action Programme 2020 anchors 'Greening our Cities – Engaging with Nature' as one of

ten priority action areas for nature conservation and has the goal of giving municipalities technical support for the development and conception of urban green infrastructure. The green paper published by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety in 2015, *Green in the City – For a Future Worth Living In*, also highlights the significance of biological diversity and the various services provided by urban ecosystems for sustainable urban development (BMUB 2015A).

According to Article 1 of the Federal Nature Conservation Act, nature conservation in towns and cities not only encompasses methodologies for species and biotope protection (biological diversity), and the protection of abiotic resources such as water, air and the climate (natural balance), but also societal, social and cultural aspects (ecosystem services generally). This allows the contributions made by urban green spaces and urban nature to landscapes, outdoor recreation, engagement with nature and people's health to be clearly identified.

Green infrastructure in urban areas provides support for the urban biological diversity typical of settlements, adaptation to climate change and resilience, human health and wellbeing, social cohesion and participation, engagement with nature, sustainable economic development and resource-efficient urban development. Urban green infrastructure improves towns and cities' appearance, strengthens their quality as places to do business and their identities – and therefore enhances their quality of life and attractiveness. Further to the requirements placed on the inventory of conservation sites, green infrastructure in urban spaces therefore offers opportunities to view nature conservation, open space planning and urban development more and more as a holistic matter, to bring together municipal actors from the 'green sector' of the specialist authorities responsible for the environment, landscape, open and green space planning, and nature conservation, and to reinforce integrative approaches pursued together with other disciplines that are, for example, responsible for mobility or health.

For reasons of scale, the Federal Green Infrastructure Concept is not able to represent urban green infrastructure in concrete spatial terms and depict it cartographically, but merely address it programmatically. First indicative statements have previously been made concerning selected functions at the federal level, for example on the accessibility of public green spaces in towns and cities (GRUNEWALD ET AL. 2016). These statements provide initial guidance for settled areas that have inadequate provision in this respect. They will require further, detailed underpinning at the municipal level if targets are to be derived from them for the development of concrete urban green infrastructure.



It is necessary to bear in mind the following essential activities and principles of action for the strategic safeguarding, planning, maintenance and management of urban green infrastructure, which derive from the requirements that have been formulated. They are primarily intended for municipal actors, but are also relevant in the context of urban development activities for the German Federation.

- The safeguarding and development of habitats for urban biological diversity by means of ecological green space management and support for species that inhabit buildings,
- the promotion of engagement with nature, including engagement with and the appreciation of various species, by means of the provision of diverse opportunities to experience urban nature and action to increase species diversity in public green spaces, as well as in residential and working environments,
- the conservation, and quantitative and qualitative improvement of urban green infrastructure in order to improve urban quality of life and the accessibility of green spaces,
- support for multiple uses and the diversity of functions performed by green and open spaces,
- the management of land take for settlements and transport in the spirit of 'dual inner development' that uses land reserves purposefully while improving the availability and quality of urban green spaces, as well as action to keep bottlenecks in the habitat network free when settlements are expanded (cf. section B 1.2.2),
- the creation of systems of interlinked green spaces at various levels of scale (urban region, whole town or city, neighbourhood, quarter),
- targeted use of green space for adaptation to the consequences of climate change (urban heat effects, water retention),
- the integrated development of green, grey and social infrastructure; the starting points are rainwater management, building greening/living buildings, mobility concepts for pedestrian and cycle traffic, and the equipment of social institutions like kindergartens, schools, hospitals and retirement homes with green spaces that relate to their buildings such as nature experience areas, small parks or urban gardens,
- the promotion of cooperative arrangements and alliances between the specialist authorities responsible for the environment, landscapes, open and green space planning, urban development, nature conservation and other disciplines such as mobility, utilities, waste disposal and health, as well as civil society organisations active in the

fields of nature conservation, environmental education, sport and architecture, and the urban population.

Municipal landscape plans (and/or the landscape programmes adopted by Germany's city states) will be used to identify and specify the objectives that are being striven towards in order to safeguard and improve nature and landscapes, as well as the quality of life in settlements that is associated with them. Landscape plans are suited to a particular degree as comprehensive environmental information systems and forward-looking, management tools for the application of green infrastructure planning principles, and can make these principles binding on municipal administrations. As a formal instrument, they are accorded particular significance in the planning and implementation of green infrastructure.

B 2.4 SEAS

Marine ecosystems provide a range of services for human beings (e.g. food supplies, recreational services in coastal areas, regulating services; cf. the thorough discussion of this topic in **NATURAL CAPITAL GERMANY 2016**). They display the biological diversity typical of these natural regions, which it is necessary to safeguard and develop on account of both international and national provisions. Given its specific uses, green infrastructure is accorded a particular role in a marine context, in particular the protection, conservation and maintenance of habitats and species. This supports adaptation of human activities in ways that are ecosystem-friendly and future-proof, an approach from which these uses can benefit over the long term as well (e.g. fisheries).

The North Sea and Baltic Sea have been impacted by anthropogenic activities. Often, these activities cannot be regulated nationally, but only within the frameworks laid down by European law (fisheries - Common Fisheries Policy) or supra-national agreements (maritime navigation – Convention on the Law of the Sea). In the interests of nature conservation and in order to prevent adverse effects being caused to the marine environment by these various uses, the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and the Federal Agency for Nature Conservation (BfN) are responsible for, among other things, designating marine protected areas in the EEZ and managing them.

In order to guarantee that, despite the diverse ways the sea is used, the limits of marine ecosystems' viability are taken into consideration, but also in order to resolve the conflicts between current uses, there is a need for, among other things, responsible, integrated spa-



tial planning for marine areas. Back in 2006, the Federal Agency for Nature Conservation therefore published nature conservation objectives and principles which, provide a model for sustainable development of the EEZ in the North Sea and Baltic Sea, as well as safeguard and develop of the EEZ as a natural region (BfN 2006). These objectives and principles support spatial development the EEZ that is sustainable from the point of view of nature conservation. The objectives include, for example, the specification of protected areas as priority nature conservation areas for or action to keep migratory corridors open for bird migration.

When the European Marine Strategy Framework Directive (MSFD 2008) entered into force, a uniform planning framework was created within which to assess the ecological status of Europe's seas, lay down environmental targets coordinated between the littoral states that share Europe's various marine regions and, not least, elaborate suitable measures for the achievement of the Directive's targets. The MSFD was the first piece of European legislation that formulated it as a binding requirement for Europe's seas to achieve a Good Environmental Status (GES) by 2020. The MSFD's targets explicitly make reference to the need to protect marine ecosystems, since the marine environment is to be protected and conserved, its deterioration prevented or, where practicable, marine ecosystems restored in areas where they have been adversely affected (cf. Article 1 MSFD).

Although the initial assessments were not comprehensive in all areas, it was concluded unanimously by the German Federal Government and the coastal Länder that the North Sea and Baltic Sea were not in a good environmental status at that time (see 'Anfangsbewertung der deutschen Ostsee, Anfangsbewertung der deutschen Nordsee', published in 2012; cf.: <http://www.meeresschutz.info>). Since the MSFD acts as an umbrella for the many (Anfangsbewertung der deutschen Ostsee, Anfangsbewertung der deutschen Nordsee) individual targets set under various strategies and directives, and also pays regard to the implementation of statutory provisions for the marine environment, the targets formulated in the Directive are included without alteration in the Federal Green Infrastructure Concept. Not all the targets mentioned can be spatially operationalised for the Federal Green Infrastructure Concept; most can merely be incorporated in text form and for information purposes only. Nevertheless, all the targets set out are relevant to the good environmental status of marine waters, and should be taken into consideration in future plans.

The spatially operationalisable environmental targets (*Festlegung von Umweltzielen für die deutsche Nord- und Ostsee*, 2012; cf.: <http://www.meeresschutz.info>) include:

- There are adequate zones for retreat and resting – as regards both space and periods of time – for ecosystem components. To protect marine life from anthropogenic disturbance, for example, areas and periods of time where uses are prohibited and/or restricted are established (Target 3.1).
- Reintroduction of locally extinct species or species endangered at the population level (Target 3.3).
- Action to guarantee passable migration corridors (Target 3.4).
- Conservation goals and objectives have priority within the protected areas in the German North Sea and Baltic Sea (Target 4.5).
- The use or exploration of non-living resources does not damage or significantly disturb the ecosystem components of the German North Sea and Baltic Sea, especially sensitive, declining, and protected species and habitats (e.g. sand, gravel) (Target 4.6).
- The anthropogenic sound input from impulsive signals and shock waves does not cause physical damage or significant disturbance to marine organisms (Target 6.1).

- Inputs of noise caused by continuous, especially low-frequency, broadband sound have no adverse effects on marine organisms spatially or over time (Target 6.2).

It has not been possible for good environmental status and the operational targets for the North Sea and Baltic Sea under the MSFD to be achieved with the measures implemented to date in marine areas (also and above all with regard to the protection of marine species and habitats). The German Federation and the Länder jointly developed the national MSFD Programme of Measures and reported to the European Commission in March 2016 (MSRL-Maßnahmenprogramm zum Meeresschutz der deutschen Nord- und Ostsee; English Summary: *MSFD Programme of Measures for Marine Protection in the German Parts of the North Sea and the Baltic Sea*, 2016; cf. <http://www.meeresschutz.info>).

This German 'Programme of Measures' contains 31 new measures. Above all, the following measures for the protection of marine biodiversity have been adopted:

- the inclusion of species and habitats types that define the value of an ecosystem in protected area ordinances,
- measures to protect migratory species in marine areas,
- measures relating to fisheries,
- the derivation and application of biological threshold for the impact of underwater noise on relevant species,
- the development and application of noise mitigation measures for the North Sea and Baltic Sea.

According to the MSFD, all measures had to be operationalised by the end of 2016 in order to guarantee the achievement of Good Environmental Status by 2020. The extent to which it will be possible for the MSFD to contribute to the conservation of marine biodiversity in Europe's seas will become apparent during the second MSFD implementation cycle. The status of the seas will be determined and the environmental targets reviewed in 2018.

Currently, the spatial extend of the measures to achieve environmental targets is not specified (cf. section C). Until such concepts and/or detailed information are available, only the Natura 2000 sites in the EEZ will therefore be represented in the Federal Green Infrastructure Concept.



B 2.5 SOILS

Soils perform diverse functions in the natural balance and therefore provide regulating and provisioning services. They are the physical resource base and habitat for plants and animals, they filter harmful substances and, by doing so, reduce the levels of pollution in groundwater. Furthermore, they bear witness to the natural and cultural development of our landscapes, since soils also document the development of the landscape, and numerous historical monuments are protected and preserved for future generations in soil. Soils are of central significance for the production of foodstuffs, for which they constitute an indispensable resource. This is true in particular for soils with a high level of natural fertility, and it is necessary for such soils to be protected from loss due to land take and managed sustainably in order to preserve them from loss due to erosion.

In view of climate change, soils' function as carbon stores is becoming ever more significant. The conservation and development of soils with high carbon storage capacities shows particularly great synergies with nature conservation targets (cf. LLUR 2012). According to estimates, 7.1 ± 4.6 Gt of carbon is bound up in land ecosystems in Germany, of which 78 per cent is in soils and 22 per cent in biomass. The most significant ecosystems from this point of view are woodlands and peatlands (33 per cent each, although peatlands occupy a markedly smaller area of land), followed some way behind by grassland and arable land (FREIBAUER ET AL. 2009). The amount of carbon bound up in these ecosystem types varies depending on specific local conditions and, in particular, the ways in which land is used. Undisturbed peatlands are significant carbon stores and have been found to be merely minor sources of emissions. Where sites are managed inappropriately, however, draining is turning this immense store of carbon into a source, and greenhouse gas (GHG) emissions are increasing (VON HAAREN 2010).

As a result of their function as CO₂ stores and sinks, peatlands and other wetlands play a very important role in climate protection, while the large numbers of rare and specialised species to which they are home are significant for nature conservation (LLUR 2012). As a result of their anthropogenic use and remodelling, the distribution of these habitats is currently being severely decimated, fragmented and pressurised. This is why, apart from floodplains, Germany has prioritised peatlands in its implementation of the EU's target for the restoration of ecosystems (Target 2, Action 6a EU Biodiversity Strategy; BMUB 2015C).

According to estimates, approximately 95 per cent of the peatlands in Germany are degraded and drained, as a result of which they are becoming the greatest carbon and nitrous oxide (N₂O) sources among the country's habitats. Site-adapted land use strategies will be required if it is to be possible for soils and habitats to contribute to climate protection in line with their potential and not generate additional emissions (GERMAN FEDERAL GOVERNMENT 2008). As a matter of principle, a strong emphasis is to be placed on landscape hydrological balance when protective and management measures and/or renaturing projects are carried out. In consequence, soils and habitats could contribute to the target of reducing greenhouse gas emissions 14 per cent compared to 2005 by 2020 (EUROPEAN PARLIAMENT AND COUNCIL OF THE EUROPEAN UNION 2009; MÖCKEL 2015). The National Strategy on Biological Diversity sets the target of increasing land habitats' natural CO₂ storage capacity ten per cent by 2020, for example by means of the rewetting and renaturing of peatlands, and the expansion of, and/or establishment of new, near-natural woodlands (BMU 2007).

Peatland soils shown on the map of Germany's surface soils published by the Federal Institute for Geosciences and Natural Resources, *Bodenarten in Oberböden Deutschlands 1:1 000 000* (BGR 2007) are integrated into the Federal Green Infrastructure Concept because they perform a particularly important role in activating ecosystems' carbon-binding potential.



B 3 NATIONWIDE GREEN INFRASTRUCTURE

An integrated approach and cartographic representations bring together components of green infrastructure so that it is possible to gain a rapid, comprehensive overview of Germany's nationwide green infrastructure.

The following components of green infrastructure are included:

- Sites with nationwide significance for biological diversity (national parks, Natura 2000 sites, nature conservation areas, national nature monuments, wetland, dryland and near-natural woodland habitat networks (core spaces), Ramsar sites, HELCOM and OSPAR marine protected areas, biosphere reserves (core and buffer zones), areas eligible for funding under large-scale nature conservation projects,
- nationally significant axes/corridors for ecological networks (wetland, dryland and near-natural woodland habitats, large mammals), Green Belt,
- peatlands on account of their significance for climate protection and as soils for carbon storage,
- Natura 2000 sites in the EEZ,
- active and inactive floodplains.

The data and maps that have been discussed are available at <http://www.bfn.de/bkgi> (German only).

The map does not weight the cartographically representable content and/or break it down into assessment classes because this has not been done for the components of green infrastructure on which it is based either.

A range of aspects of green infrastructure are not included in this map because, for reasons of scale, their integration is not possible or expedient (e.g. national nature monuments or settlements) and/or still not possible at the federal level (e.g. species). This is to be taken into consideration during the application of the spatial inventory that is depicted.

- National parks, Nature conservation areas, Natura 2000 sites, Ramsar sites, Biosphere Reserves (core-/buffer zones), National nature monuments, large-scale nature conservation projects (areas eligible for funding), OSPAR/HELCOM marine protected areas, nationwide ecological networks (open land, woodland), habitat networks (core spaces)
- Nationally significant axes/corridors for the system of nationwide ecological networks (dryland, wetland and near-natural woodland habitats, large mammals), Green Belt
- Outer limit of Exclusive Economic Zone
- 12-mile zone including deep-water anchorages

Sources: Federal Agency for Nature Conservation (BfN), 2016, protected areas based on information supplied by the Länder
 Bodenübersichtskarte 1: 1 000 000
 BÜK 1000 © Federal Institute for Geosciences and Natural Resources (BGR), Hannover, 2013
 Basic Spatial Data: © GeoBasis-DE / BKG 2015

- Peatlands (high potential significance for habitat diversity and climate protection)
- Active and inactive floodplains

* For design reasons, only sites > 200 hectares are depicted





**NATURE
CONSERVATION
CONCEPTS
CURRENTLY
UNDER
DEVELOPMENT**

C. NATURE CONSERVATION CONCEPTS CURRENTLY UNDER DEVELOPMENT

At present, there are inconsistencies both in the data and knowledge available, and in the maturity of the methods used to survey and assess the content of the Federal Green Infrastructure Concept. For example, while a whole range of informal concepts and activities on biological diversity have been put in place at the federal level, a great deal of development work is still needed when it comes to topics such as landscape diversity, the implementation of the Germany's Blue Belt (BBD) programme or the marine environment. These concepts are currently in preparation and will be integrated into the Federal Green Infrastructure Concept in the years to come.

C1 NATIONALLY SIGNIFICANT LANDSCAPES

The protection of landscapes is pertinent both to the safeguarding of diversity and to people's concrete engagement with and appreciation of its features, including recreational uses. For instance, the Federal Nature Conservation Act mentions the protection of natural landscapes and historically evolved cultural landscapes as an aspect of national conservation in its own right alongside their relevance for recreation. Landscapes are accordingly to be protected permanently and/or their quality enhanced both as parts of Germany's natural and cultural heritage and in view of the value placed on their functions offering opportunities for engagement with and appreciation of nature, including landscape-based recreation.

In this respect, the most important objective is the elaboration of a technically well-founded nationwide inventory of significant landscapes. The relevance of this inventory becomes apparent in particular in the context of the enhancement of landscapes' value as an important issue when other planning-relevant decisions are taken, as well as the qualitative improvement and further development of landscapes, for example using protected area ordinances, funding instruments and persuasive/cooperative instruments.

The identification of nationally significant landscapes for the natural and cultural heritage, but also landscapes significant on account of other qualities (aesthetics, low levels of light pollution, recreational uses), is currently the subject of research projects commissioned by the Federal Agency for Nature Conservation.



C2 GERMANY'S BLUE BELT

The renaturing of watercourses and floodplains along federal waterways is to be promoted with the Federal Government programme Germany's Blue Belt (BBD). This is to involve reviewing and, if possible, renaturing the 2,800-km-long network of secondary federal waterways, which are no longer required for freight traffic or only carry modest numbers of vessels. However, measures such as the reconnection of cut-off meanders and flood channels, the restoration of shallow water areas, the levelling-off of banks and the development of damp and wet meadows are to be pursued within the core of the federal waterways network as well.

The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB 2015b) mentions the 'removal of bank reinforcements, the restoration of floodplain-typical habitats, floodplain water bodies, wetlands and pioneer sites, the promotion of extensive and site-adapted uses, and the safeguarding of sites, the improvement of discharge dynamics and the reduction of backup effects' as measures that will continue to be fundamentally suitable for the development of near-natural water bodies and floodplains. Measures to reduce excessive levels of extensive bottom erosion and precautionary flood protection, in particular the recovery of natural flood storage areas, are also important components of the development of near-natural water bodies.

This federal programme has been adopted by the German Federal Government (BMUB AND BMVI 2017). The concrete implementation of the Federation's Blue Belt programme is being coordinated at present between the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and the Federal Ministry of Transport and Digital Infrastructure (BMVI), and is currently in an intensive phase of development.





Bundesministerium
für Verkehr und
digitale Infrastruktur



Bundesministerium
für Umwelt, Naturschutz,
Bau und Reaktorsicherheit



Bundesprogramm
Blaues Band
Deutschland



Bundesprogramm
Blaues Band Deutschland

Eine Zukunftsperspektive für die Wasserstraßen

– beschlossen vom Bundeskabinett am 1. Februar 2017

C3 NATIONAL ACTION PLAN FOR PROTECTED AREAS

The Action Plan for Protected Areas is accorded an important role in cross-Länder cooperation and coordination for the further development of protected areas. It has been drawn up jointly by the German Federation and the Länder. The goal is to safeguard the substantial contribution made by protected areas to the conservation of biological diversity, and to further develop that role with a view to current and future challenges. Important foundations and building blocks are currently being elaborated for this purpose under the auspices of a research and development project commissioned by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and the Federal Agency for Nature Conservation with the involvement of representatives from the Länder. This investigation will involve, among other things, the following phases:

- A nationwide study of qualitative and quantitative aspects of the network of protected areas, for example their representativeness, the links between them, their management and their integration into surrounding landscapes, as well as how to bolster acceptance for protected areas.
- The flagging-up of options for the further development of the network of protected areas in the light of the aspects that have been investigated with a time horizon up to 2030.



C4 MARINE ENVIRONMENT

The immediate competence of the German Federation in the German EEZ in the North Sea and Baltic Sea gives it particular functions for marine conservation. However, local protection measures alone are often not sufficient in order to ensure good environmental status and/or favourable conservation status are achieved because, for example, a large number of the most various species in marine areas frequently migrate between their feeding, wintering and breeding grounds. These migrations have only been insufficiently taken into consideration in the networks of protected marine areas up until now. This is why, to complement marine protected areas with effective protective provisions, additional spatial measures are also necessary that ensure connectivity between such areas. The MSFD and marine spatial planning may be of assistance here because they make measures mandatory outside protected areas as well.

The Federal Agency for Nature Conservation is developing appropriate concepts in order to spatially implement the measures taken under the MSFD. At present, however, it has to be assumed that considerably more time will still be required before the measures are successfully implemented because the MSFD itself does not provide the Member States with any instruments of its own for the implementation of such measures. This means that, as a rule, they can only be implemented within the framework laid down by previously existing implementation instruments.

Marine spatial planning is also accorded great significance when it comes to the establishment of spatially operationalisable measures to ensure uses are compatible with the conservation targets for the seas. The Federal Agency for Nature Conservation defined the requirements placed on spatial planning in the EEZ in concrete objectives and principles from the point of view of nature conservation in the nature conservation planning paper it issued in 2006 (BfN 2006).

Due to the availability of new findings about marine ecology, as well as methods and concepts for the integration of nature conservation into marine spatial planning, the Federal Agency for Nature Conservation is working towards a comprehensive updating of the above mentioned objectives and principles. This is being prepared and supported by appropriate research and development projects. These projects are intended to identify and analyse requirements of endangered and representative species and habitats spatial in the German EEZ and translate those in spatial planning options.

In this respect, an ecosystem approach plays a particular role. It is intended to strengthen networking structures in marine areas, and therefore also contribute to the implementation of an ecosystem-based methodology when it comes to the planning of human activities in the sea. This will involve, for example, studies on the spatial specification of migration corridors for migratory species in and over the German North Sea and Baltic Sea. The shared goal is to acknowledge and respect the limits of marine ecosystems' viability and resilience, and to take them into consideration in all human activities. In an open ecosystem such as the sea, this offers the opportunity to make the transition from types of protection that are often too segregated to a set of integrative measures.





PROSPECTS

D. PROSPECTS

With the Federal Green Infrastructure Concept, a spatial nature conservation concept is presented that highlights sites and spaces of nationwide significance for the conservation of biological diversity and individual ecosystem services. Further nature conservation concepts that are in development will gradually be added to the Federal Concept after technical discussion. Alongside this, the development of green infrastructure and the diverse ecosystem services it supports will need to be observed in future, further assessed and linked up with the nationwide surveying and assessment of ecosystem services as part of the implementation of Target 2 and Action 5 of the EU Biodiversity Strategy to 2020. For example, support is to be given to one significant function of green infrastructure that has not yet been sufficiently discussed to date, the protection, conservation and development of endangered animal and plant species. In order to guarantee this, further derived and prioritised data on the occurrence and distribution of animals, plants and fungi are to be integrated into the Federal Green Infrastructure Concept in future. Moreover, the aspiration is to expand Germany's green infrastructure yet further and underpin it with a view to the protection of landscapes and their aesthetic qualities.

As far as the handling of natural resources is concerned, there are various standards in place at the national and European levels applicable to the projects undertaken by the German Federation. To date, it has been customary for the various actors to have to draw the relevant fundamental data from numerous sources. This approach has not been very efficient. The Federal Green Infrastructure Concept now offers federal authorities assistance in this respect. At present, the following fields of application are seen above all:

TRANSPORT INFRASTRUCTURE PLANNING

The Federal Transport Infrastructure Plan includes a range of roadbuilding and waterways projects that are to be assessed as particularly conflict-laden from a nature conservation perspective. The planning work on many of these projects will continue over the next few years. Thanks to the Federal Concept, fundamental data is being made available to parties involved in the planning of these projects that gives guidance on how to cope with nature conservation problems and is therefore able to bolster the legal security of planning procedures.

EXPANSION OF POWER GRIDS

The energy transition demands the expansion of existing power grids and the construction of new grids throughout the German Länder. Overall, several thousand kilometres of new power lines are to be planned. Important information on nature conservation issues has already been made available for the studies that are required. This information will be accessible in future under the Federal Concept and will be incorporated into concrete planning procedures.

FEDERAL SPATIAL PLANNING

The protection of biological diversity is expressly mentioned for the first time as an important concern in connection with the principles of regional planning by the re-enacted Federal Regional Planning Act of 2016. Furthermore, the German Federation's competences when it comes to the drafting of cross-Länder spatial development plans have been extended, for instance in relation to flood control and the renaturing of federal waterways. The Federal Green Infrastructure Concept is also mentioned in the models and strategies for action on spatial development in Germany that have been adopted by the Standing Conference of Ministers Responsible for Spatial Planning (MKRO). There are new functions for the German Federation here that demand a solid data basis.

REDUCTION OF LAND TAKE FOR SETTLEMENTS AND TRANSPORT

It is the German Federal Government's target to reduce daily new land take for settlements and transport to 30 hectares minus x per day by 2030. This applies not only for the upgrading of infrastructure in undesignated outlying areas, but also for the land-saving treatment of inner-urban areas, which has to be taken account of by building law. The availability and up-to-dateness of data on green infrastructure are of decisive significance for the careful, economical treatment of land.

IMPLEMENTATION OF THE GREEN IN THE CITY PAPER

In its Green in the City green paper, the German Federation committed itself to take measures to improve the green amenities in our towns, cities and communities. The development, configuration and management of urban green infrastructure is to be viewed and thought of as being of equal value with other concerns. Within the framework for urban development funding, for example, guidelines are to be developed for the new Urban Green Space in the Future funding programme in which the upgrading of green infrastructure in settlements will have a prominent place.

IMPLEMENTATION OF THE NATURE CONSERVATION CAMPAIGN 2020

With the Nature Conservation Campaign 2020, the Federal Environment Ministry has presented a programme of urgent measures for the implementation of the National Strategy on Biological Diversity. It states, among other things, that agriculture is accorded a high level of responsibility for the conservation of biological diversity. One central goal of the Nature Conservation Campaign is therefore the nature-friendly configuration of agricultural policy and agricultural support. Various cartographic representations included in the Federal Concept highlight the low density of green infrastructure, especially in areas of intensive land husbandry. This shows how much more work there is to be done.

FEDERAL FUNDING INSTRUMENTS

The Federal Concept describes priority areas and topics for the conservation of green infrastructure in Germany. This means it can be drawn on in future as an aid to decision-making on the deployment of federal funding instruments.

TRANS-EUROPEAN NETWORKS

The European Union is supporting the development of trans-European networks in the transport, energy and telecommunications sectors. These projects will be implemented in conformity with the planning law of each of the Member States. Consequently, aggregated data on natural amenities are a planning-relevant necessity here. Furthermore, the Federal Green Infrastructure Concept serves as a national data basis for the development of the Trans-European Green Infrastructure Network that is envisaged by the European Commission.

These examples demonstrate the breadth of the demand for aggregated information about natural amenities at the federal level. As far as the application of the Federal Concept is concerned, it seems obvious to develop targeted advice for individual addressees.

The safeguarding and development of this green infrastructure will demand a lengthy implementation process that will necessitate cooperation with other departments at the federal level and, not only that, cooperation between the German Federation, the Länder and the municipalities.



GLOSSARY

E. GLOSSARY

Biological diversity

The diversity of life on our Earth (shortened as: biodiversity) is characterised by the variability of living organisms and the ecological complexes they form. It encompasses the following three levels: the diversity of ecosystems and/or biotic communities, habitats and landscapes; the diversity of species; and genetic diversity within the various species.

Biotope

Spatially delimited habitat of a particular biotic community (biocenosis).

Biotope type

Abstracted type of an entire group of homologous biotopes defined on the basis of abiotic features (e.g. moisture, nutrient content) and biotic features (occurrence of particular vegetation types and structures, plant communities, animal species). With its ecological characteristics, it offers largely uniform conditions for biotic communities that differ from those of other biotope types.

Birds Directive

Council Directive of 2 April 1979 on the conservation of wild birds (79/409/EEC).

Bottleneck in habitat network

A bottleneck is a concrete landscape segment in which one or several habitat networks could be disrupted by settlements and/or new built-up areas merging together.

Cultural landscape

Landscape with overwhelmingly anthropogenic ecosystems (in contrast to a natural landscape) formed as a result of its use by humans in historical time and shaped by the forms in which it has been used.

Ecological networks

An ecological network is characterised by the preservation, regeneration or restoration of traditional ecological relationships in the landscape and the development of functional new ecological relationships. These exist and/or existed both between wholly different biotope types (biotope complexes, landscape complexes) and also between populations of the same habitat type. In this respect, the relationships between near-natural areas and cultivated/farmed areas are also expressly included in such systems.

Ecosystem

Designates the components of a delimited natural region (e.g. the Lower Saxon Wadden Sea) or a particular type of natural feature (e.g. nutrient-poor watercourses) and their interactions. The term may relate to various spatial levels (local, regional), and encompasses both (semi-)natural ecosystems (e.g. undisturbed raised peatlands), near-natural ecosystems (e.g. oligotrophic chalk grassland) and heavily human-influenced ecosystems (e.g. agricultural ecosystems).

Ecosystem service

Designates direct and indirect contributions made by ecosystems to human well-being, in other words services and goods that deliver direct or indirect economic, material, health or mental benefits for human beings.

Exclusive Economic Zone (EEZ)

Marine area between 12 and 200 nautical miles (NM) off the coast.

Floodplain

Valley bottoms and low-lying areas along streams and rivers shaped by inundations and changing water levels.

Fragmentation

Active anthropogenic fragmentation, including habitats, as a result of linear interventions (e.g. the construction of roads and railways, energy lines, buildings).

Green Belt

It was possible for nature to develop undisturbed for decades along the former border strip that divided the two German states. This was true not only of the actual border strip but, on account of their isolation, many large adjoining areas as well. The Green Belt runs like a string of pearls through a series of extensive, valuable areas and cleared, intensively used agrarian landscapes such as the North German loess plains.

It therefore forms an important axis for the nationwide ecological network in Germany. In particular, it combines various, above all extensively used, open land biotope types, which alternate with watercourses, standing waters, and pioneer, mixed and coniferous woodlands.

Green infrastructure

Green infrastructure is to be defined as a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It includes terrestrial and aquatic ecosystems, as well as other physical features in terrestrial (including coastal) and marine areas. On land, green infrastructure is present in both urban and rural settings.

Habitat

The location where populations or subpopulations of a species live.

Habitat networks

Habitat networks are systems of similar, spatially neighbouring habitats that are particularly worthy of protection and potentially have close functional links with one another. When interventions are planned, networks should primarily be examined at strategic planning levels to ensure supralocal implications are taken into consideration.

Habitats Directive

Council Directive of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (92/43/EEC).

Large-scale nature conservation project

Projects under the German Federation's Establishing and Securing Conservationally Important Components of Nature and Landscapes of National Importance Funding Programme (since 1979) and Riparian Zone Programme (since 1989).

Migratory fish species

Fish during whose life cycles a phase of long-distance migration occurs between the locations where they mature and spawn.

Natura 2000

European system of protected sites that includes Special Protection Areas (SPAs) under the Birds Directive and Sites of Community Importance (SCIs) under the Habitats Directive.

Natural

Unchanged by human beings, in its original state; secondary near-natural and/or semi-natural types are also referred to in the EU's nature conservation directives (e.g. Habitats Directive) as 'natural habitats' (Annex 1 Habitats Directive) (i.e. 'natural' is used in a broad sense).

Natural balance

Encompasses the components soil, water, air, climate, animals and plants, as well as the web of interactions between them (cf. Federal Nature Conservation Act Article 7).

Natural capital

The term 'natural capital' is an economic metaphor for the finite stock of the Earth's physical and biological resources, and the limited provision of goods and services by ecosystems.

Natural goods

Include the natural landscape factors soil, water, air, fauna and flora. It is possible to distinguish non-regenerative natural goods (usable rocks and soils, minerals, fossil organic matter, juvenile water, virgin landscapes) from regenerative natural goods (soil, vadose water, the atmosphere, flora, fauna).

Near-natural

Formed without direct human influence and not significantly modified by human beings, approximating to natural conditions; also used (e.g. in international contexts) in the sense of semi-natural, mostly extensively managed.

Population

Natural group of individuals of a species that is, in principle, capable of breeding and reproduction.

Ramsar sites

Sites protected pursuant to the Convention on Wetlands of International Importance especially as waterfowl habitat (Ramsar Convention, 1971).

Renaturing

Conversion of anthropogenically modified habitats into a more natural state; restoration of previously intensively used sites with a focus on their development and use as nature conservation sites – nature conservation-oriented remediation.

Resettlement

Release of individuals of a taxon in an area in which it was previously native, but has become extinct, in order to establish new, self-sustaining populations in its former area of distribution.

Resources

Material and intellectual assets that are usually only available in finite quantities. Natural resources are referred to as natural goods.

Species

Group of natural populations that naturally interbreed and are isolated from other groups of this kind. Basic unit of biosystematics.

TEEB

Acronym for: The Economics of Ecosystems and Biodiversity. The aim of this project is to evaluate the economic value of the services provided by nature, survey the economic impacts of damage to ecosystems and, on this basis, make the costs of failing to take action 'visible'.

Terrestrial

Belonging to the Earth; living or occurring on land.



LITERATURE

F. LITERATURE

ACKERMANN, W. AND SACHTELEBEN, J. (2012): *Identifizierung der Hotspots der biologischen Vielfalt in Deutschland: Erarbeitet im Rahmen des gleichnamigen F+E-Vorhabens (FKZ 3510 82 3700)*, BfN-Skripten 315, 133 pp., online: http://www.bfn.de/0502_biodiv_vilm-reports.html (last accessed: 13 December 2016).

ALBERT, C., BURKHARD, B., DAUBE, S., DIETRICH, K., ENGELS, B., FROMMER, J., GÖTZL, M., GRÊT-REGAMEY, A., JOB-HOBEN, B., KELLER, R., MARZELLI, S., MONING, C., MÜLLER, F., RABE, S.-E., RING, I., SCHWAIGER, E., SCHWEPPE-KRAFT, B. AND WÜSTEMANN, H. (2015): *Empfehlungen zur Entwicklung bundesweiter Indikatoren zur Erfassung von Ökosystemleistungen: Diskussionspapier*, BfN-Skripten 410 (Bonn, Bad Godesberg).

BURKHARDT, R., BAIER, H., BENDZKO, U., BIERHALS, E., FINCK, P., LIEGL, A., MAST, R., MIRBACH, E., NAGLER, A., PARDEY, A., RIECKEN, U., SACHTELEBEN, J., SCHNEIDER, A., SZEKELY, S., ULLRICH, K., HENGEL, U. VAN, ZELTNER, U. AND ZIMMERMANN, F. (2004): *Empfehlungen zur Umsetzung des § 3 BNatSchG 'Biotopverbund': Ergebnisse des Arbeitskreises 'Länderübergreifender Biotopverbund' der Länderfachbehörden mit dem BfN*, Naturschutz und Biologische Vielfalt 2, 84 pp.

EUROPEAN COMMISSION (2011): *Our life insurance, our natural capital: an EU biodiversity strategy to 2020*, Brussels, 3 May 2011, COM(2011) 244 final, online: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0244:FIN:EN:pdf> (last accessed: 24 May 2017).

EUROPEAN COMMISSION (2013): *Green Infrastructure (GI) – Enhancing Europe's Natural Capital*, Brussels, 6 May 2013, COM(2013) 249 final, online: http://ec.europa.eu/environment/nature/ecosystems/docs/green_infra_structures/1_EN_ACT_part1_v5.pdf (last accessed: 25 May 2017).

EUROPEAN PARLIAMENT AND COUNCIL OF THE EUROPEAN UNION (2009): Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

FEDERAL AGENCY FOR NATURE CONSERVATION (BfN) (2006): *Naturschutzfachlicher Planungsbeitrag des Bundesamtes für Naturschutz zur Aufstellung von Zielen und Grundsätzen der Raumordnung für die deutsche Ausschließliche Wirtschaftszone der Nord- und Ostsee*, online: http://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Raumordnung-in-der-deutschen-AWZ/Planungsbeitrag_zur_Raumordnung_AWZ_2006.pdf (last accessed: 13 December 2016).

FEDERAL AGENCY FOR NATURE CONSERVATION (BfN) (2014): 'National Natural Heritage', online: http://www.bfn.de/0325_nationales_naturerbe+M52087573abo.html (last accessed: 23 May 2017).

FEDERAL AGENCY FOR NATURE CONSERVATION (BfN) (2016): 'Bonner Konvention', online: http://www.bfn.de/0302_cms.html (last accessed: 13 December 2016).

FEDERAL INSTITUTE FOR GEOSCIENCES AND NATURAL RESOURCES (BGR) (2007): *Bodenarten in Oberböden Deutschlands* 1 : 1 000 000, version 2.0. (Hanover).

FEDERAL INSTITUTE OF HYDROLOGY (BfG) (2010): *Herstellung der Durchgängigkeit an Staustufen von Bundeswasserstraßen: Fischökologische Einstufung der Dringlichkeit von Maßnahmen für den Fischeaufstieg*, BfG-Bericht 1697.

FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY (BMU) (2007): *National Strategy on Biological Diversity*.

FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY (BMU) (2012): *Bundesprogramm Wiedervernetzung – Grundlagen – Aktionsfelder – Zusammenarbeit*, online: http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Naturschutz/bundesprogramm_wiedervernetzung_bf.pdf (last accessed: 20 February 2017).

FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY (BMU) AND FEDERAL AGENCY FOR NATURE CONSERVATION (BfN) 2009: *Auenzustandsbericht: Flussauen in Deutschland*.

FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION, BUILDING AND NUCLEAR SAFETY (BMUB) (2014): 'Nationales Naturerbe', online: <http://www.bmub.bund.de/themen/natur-biologische-vielfalt-arten/naturschutz-biologische-vielfalt/gebietsschutz-und-vernetzung/nationales-naturerbe/> (last accessed: 20 February 2017).

FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION, BUILDING AND NUCLEAR SAFETY (BMUB) (2015A): *Grün in der Stadt – Für eine lebenswerte Zukunft: Grünbuch Stadtgrün*.

FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION, BUILDING AND NUCLEAR SAFETY (BMUB) (2015B): 'Fragen und Antworten zum Bundesprogramm "Blaues Band"', online: <http://www.bmub.bund.de/themen/wasser-abfall-boden/binnengewasser/fluesse-und-seen/faqs-blaues-band/> (last accessed: 20 February 2017).

FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION, BUILDING AND NUCLEAR SAFETY (BMUB) (2015C): *Priorisierungsrahmen zur Wiederherstellung verschlechterter Ökosysteme in Deutschland (EU-Biodiversitätsstrategie, Ziel 2, Maßnahme 6a)*, online: http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Naturschutz/oekosysteme_priorisierungsrahmen_bf.pdf (last accessed: 20 February 2017).

FEDERAL MINISTRY OF TRANSPORT AND DIGITAL INFRASTRUCTURE (BMVI) (2017): *Bundesprogramm Blaues Band Deutschland*, online: http://www.blaues-band.bund.de/SharedDocs/Downloads/DE/Publikationen/BBD_o2_2017.pdf;jsessionid=ECD9D741E806F2D4FC3D4426835E8529.live11293?__blob=publicationFile&v=5 (last accessed: 20 February 2017).

FEDERAL MINISTRY OF TRANSPORT, BUILDING AND URBAN AFFAIRS (BMVBS) (2012): *Erhaltung und Wiederherstellung der ökologischen Durchgängigkeit der Bundeswasserstraßen: Erläuterungsbericht zu Handlungskonzeption und Priorisierungskonzept des BMVBS*, online: http://www.bafg.de/DE/02_Aufgaben/03_Oekologie/02_Themen/Durchg/prio_konzept.pdf?__blob=publicationFile (last accessed: 13 December 2016).

FEDERAL STATISTICAL OFFICE (DESTATIS) (2016): 'Anstieg der Siedlungs- und Verkehrsfläche', online: <https://www.destatis.de/DE/ZahlenFakten/Wirtschaftsbereiche/LandForstwirtschaftFischerei/Flaechennutzung/FlaechennutzungAktuell.html> (last accessed: 20 February 2017).

FINCK, P., RIECKEN, U. AND ULLRICH, K. (2005): 'Europäische Dimension des Biotopverbunds in Deutschland', *Natur und Landschaft* 80 (8): pp. 364–369.

FREIBAUER, A., DRÖSLER, M., GENSIO, A. AND SCHULZE, E.-D. (2009): 'Das Potenzial von Wäldern und Mooren für den Klimaschutz in Deutschland und auf globaler Ebene', *Natur und Landschaft* 84 (1/2009), pp. 20–25.

FUCHS, D., HÄNEL, K., LIPSKI, A., REICH, M., FINCK, P. AND RIECKEN, U. (2010): *Länderübergreifender Biotopverbund in Deutschland – Grundlagen und Fachkonzept*, Naturschutz und Biologische Vielfalt 96, 191 pp.

GERMAN FEDERAL GOVERNMENT (2008): *German Strategy for Adaptation to Climate Change*, adopted by the Federal Cabinet on 17 December 2008.

GRUNEWALD, K., RICHTER, B., MEINEL, G., HEROLD, H. AND SYRBE, R.-U. (2016): 'Vorschlag bundesweiter Indikatoren zur Erreichbarkeit öffentlicher Grünflächen: Bewertung der Ökosystemleistung "Erholung in der Stadt"', *Naturschutz und Landschaftsplanung* 48 (7), pp. 218–226.

GRUTTKKE, H., LUDWIG, G., SCHNITTLER, M., BINOT-HAFKE, M., FRITZLAR, F., KUHN, J., ASSMANN, T., BRUNKEN, H., DENZ, O., DETZEL, P., HENLE, K., KUHLMANN, M., LAUFER, H., MATERN, A., MEINIG, H., MÜLLER-MOTZFELD, G., SCHÜTZ, P., VOITH, J. AND WELK, E. (2004): 'Memorandum: Verantwortlichkeit Deutschlands für die weltweite Erhaltung von Arten – verabschiedet durch das Symposium: "Ermittlung der Verantwortlichkeit für die weltweite Erhaltung von Tierarten mit Vorkommen in Mitteleuropa"', Vilm, 17.–20. November 2003', in: Gruttke, H. (ed.) (2004): *Ermittlung der Verantwortlichkeit für die Erhaltung mitteleuropäischer Arten: Referate und Ergebnisse des Symposiums 'Ermittlung der Verantwortlichkeit für die weltweite Erhaltung von Tierarten mit Vorkommen in Mitteleuropa' auf der Insel Vilm vom 17.–20. November 2003*, Naturschutz und Biologische Vielfalt 8 (Bonn, Bad Godesberg: Federal Agency for Nature Conservation), pp. 273–280.

HAAREN, C. VON, SAATHOFF, W., BODENSCHATZ, T. AND LANGE, M. (2010): *Der Einfluss veränderter Landnutzungen auf Klimawandel und Biodiversität*, Naturschutz und Biologische Vielfalt 94 (Bonn, Bad Godesberg: Federal Agency for Nature Conservation).

HÄNEL, K. (2007): 'Methodische Grundlagen zur Bewahrung und Wiederherstellung großräumig funktionsfähiger ökologischer Beziehungen in der räumlichen Umweltplanung – Lebensraumnetzwerke für Deutschland', dissertation, University of Kassel, FB 06 Faculty of Architecture, Urban Planning, Landscape Planning, 380 pp., online: <http://nbn-resolving.org/urn/resolver.pl?urn=urn:nbn:de:hebis:34-2007121319883> (last accessed: 13 December 2016).

HÄNEL, K. AND RECK, H. (2011): *Bundesweite Prioritäten zur Wiedervernetzung von Ökosystemen: Die Überwindung straßenbedingter Barrieren: Ergebnisse des F+E-Vorhabens 3507 82 090 des Bundesamtes für Naturschutz*, Naturschutz und Biologische Vielfalt 108, 353 pp.; English summary (2010): *Nationwide Priorities for Re-Linking*

Ecosystems: Overcoming Road-Related Barriers (Federal Agency for Nature Conservation), online: <https://www.bfn.de/fileadmin/MDB/documents/themen/eingriffsregelung/Nationalwide%2oPriorities%2Ofor%2oRe-Linking%2oEcosystems.pdf> (last accessed: 26 May 2017).

HÄNEL, K., BAIERL, C. AND ULRICH, P. (2016): *Lebensraumverbund und Siedlungsentwicklung in Deutschland: Identifikation von Engstellen und Planungsempfehlungen: Ergebnisse des F+E-Vorhabens 3512 82 0700 des Bundesamtes für Naturschutz*, Naturschutz und Biologische Vielfalt.

HEILAND, S., MENGEL, A., HÄNEL, K., GEIGER, B., ARNDT, P., REPPIN, N., WERLE, V., HOKEMA, D., HEHN, C., MERTELMEYER, L., BURGHARDT, R. AND OPITZ, S.; ADVISED BY: WERK, K. (2017, IN PREPARATION): *Bundeskonzept Grüne Infrastruktur – Fachgutachten: Ergebnisse des F+E-Vorhabens FKZ 3514821400 ‘Fachplanerischer Beitrag zur Umsetzung bundesweiter Ziele des Naturschutzes und der Landschaftspflege (Hauptvorhaben)’*, BfN-Skripten 457 (Bonn, Bad Godesberg).

JESSEL, B. (2011): ‘Vorwort’, in: *Das deutsche Schutzgebietssystem – Schwerpunkt: streng geschützte Gebiete: Aktivitäten der Bundesländer*, BfN-Skripten 294 (Federal Agency for Nature Conservation), online: https://www.bfn.de/fileadmin/MDB/documents/service/skript_294.pdf (last accessed: 13 December 2016).

LASSEN, D. (1979): ‘Unzerschnittene verkehrsarme Räume in der Bundesrepublik Deutschland’, in: *Natur und Landschaft* 54 (10), pp. 333–334.

LUDWIG, G., HAUPT, H., GRUTTKE, H. AND BINOT-HAFKE, M. (2009): ‘Methodik der Gefährdungsanalyse für Rote Listen’, *Naturschutz und Biologische Vielfalt* 70 (1), pp. 23–71 (Bonn, Bad Godesberg: Federal Agency for Nature Conservation).

MARINE STRATEGY FRAMEWORK DIRECTIVE (MSFD) (2008): Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy.

MÖCKEL, S. (2015): ‘Politische und rechtliche Ziele zum vorsorgenden Schutz der Böden in Deutschland’, *Natur und Landschaft* 90 (11/2015), pp. 497–502.

NATURAL CAPITAL GERMANY – TEEB DE (2016): *Ökosystemleistungen in ländlichen Räumen – Grundlage für menschliches Wohlergehen und nachhaltige wirtschaftliche Entwicklung*, ed. Haaren, C. von and Albert, C. (Hanover, Leipzig: Leibniz Universität Hanover, Helmholtz Centre for Environmental Research (UFZ)).

RECK, H., HÄNEL, K., BÖTTCHER, M., TILLMANN, J. AND WINTER, A. (2005): *Lebensraumkorridore für Mensch und Natur*, *Naturschutz und Biologische Vielfalt* 17, 313 pp.

RECK, H., HÄNEL, K., JEBBERGER, J. AND LORENZEN, D. (2008): *UZVR, UFR + Biologische Vielfalt: Landschafts- und Zerschneidungsanalysen als Grundlage für die räumliche Umweltplanung: Ergebnisse aus dem Forschungs- und Entwicklungsvorhaben ‘Möglichkeiten und Grenzen der unzerschnittenen verkehrsarmen Räume zur qualitativen Bewertung und Steuerung von Flächeninanspruchnahmen’ im Auftrag des Bundesamtes für Naturschutz, FKZ 805 82 025*, *Naturschutz und Biologische Vielfalt* 62, 181 pp. + map.

ROSENTHAL, G., MENGEL, A., REIF, A., OPITZ, S., SCHOOF, N. AND REPPIN, N. (2014): ‘Umsetzung des 2 % Ziels für Wildnisgebiete aus der Nationalen Biodiversitätsstrategie: F+E-Vorhaben FKZ 3512 85 0300’ (Federal Agency for Nature Conservation), unpublished, 276 pp.

SCHERFOSE, V. (2011): ‘Das deutsche Schutzgebietssystem im Lichte des 2010-Ziels – unter besonderer Berücksichtigung der Naturschutzgebiete und Nationalparke’, in: *Das deutsche Schutzgebietssystem – Schwerpunkt: streng geschützte Gebiete* (Federal Agency for Nature Conservation), online: https://www.bfn.de/fileadmin/MDB/documents/service/skript_294.pdf (last accessed: 13 December 2016).

SCHLESWIG-HOLSTEIN STATE AGENCY FOR AGRICULTURE, ENVIRONMENT AND RURAL AREAS (LLUR) (2012): *Eine Vision für Moore in Deutschland: Potentiale und Ziele zum Moor- und Klimaschutz: Gemeinsame Erklärung der Naturschutzbehörden* (Kiel).

SCHOLZ, M., MEHL, D., SCHULZ-ZUNKEL, C., KASPERIDUS, H., BORN, W. AND HENLE, K. (2012): *Ökosystemfunktionen von Flussauen: Analyse und Bewertung von Hochwasserretention, Nährstoffrückhalt, Kohlenstoffvorrat, Treibhausgasemissionen und Habitatfunktion*, *Naturschutz und Biologische Vielfalt* 124.

SSYMANK, A. (2000): ‘Rahmenbedingungen für die naturschutzfachliche Bewertung großer Räume und fachliche Anforderungen an ein Bundesvorrangflächensystem für den Naturschutz’, in: Ssymank, A. (ed.) (2000): *Vorrangflächen, Schutzgebietssysteme und naturschutzfachliche Bewertung großer Räume in Deutschland: Referate und Ergebnisse einer Fachtagung auf der Insel Vilm vom 19. bis 21. November 1998*, Schriftenreihe für Landschaftspflege und Naturschutz 63, (Bonn, Bad Godesberg: Federal Agency for Nature Conservation), pp. 11–47.

