Beech Forests

diverse · unique · sustainable

Contents

Foreword

Germany lies at the centre of the beech distribution, which is confined to Europe, and the Central European settlement and cultural history is closely linked to beech forests. Currently 17 % of the existing forest area of 11.1 million hectares is dominated by beech forest. This corresponds to a beech forest area of 1.89 million hectares with a standing wood volume of 583 million m³. It is pleasing to see that the area of beech forest has expanded over the last 20 years.

In this brochure "Beech Forests – diverse.unique.sustainable", the importance of the beech forests for forest owners and wood processors, and also for the ecological diversity of forest ecosystems is presented. The sustainable management of beech forests not only provides a valuable, renewable resource that generates income for forest enterprises and forms the basis of a multitude uses of wood as a raw material and a source of energy, it also counteracts the greenhouse effect by increasing the carbon storage in wood products.

In Germany, about 10 million m³ of beech wood is harvested annually. In the 230 hardwood sawmills, about 1.2 million m³ of beech sawn timber is produced, of which almost 400 000 m³ is exported. The beech wood processing industry provides secure employment opportunities for many people, predominantly in rural areas.

Only the sustainable management of beech forests will ensure that all the benefits of this beautiful and valuable tree species, outlined above, will continue to be available in the future. The aim of this brochure is to strengthen the commitment to ongoing development of sustainable management of beech taking into consideration nature conservation, climate protection and biodiversity.

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Präsident des DHWR

Forest Management and Nature Conservation Two sides of the coin

Conservation of biological diversity

Multiple-use forestry

Conservation through utilisation

UNESCO-World Natural Heritage

Forest Management and Nature Conservation
Two sides of the coin

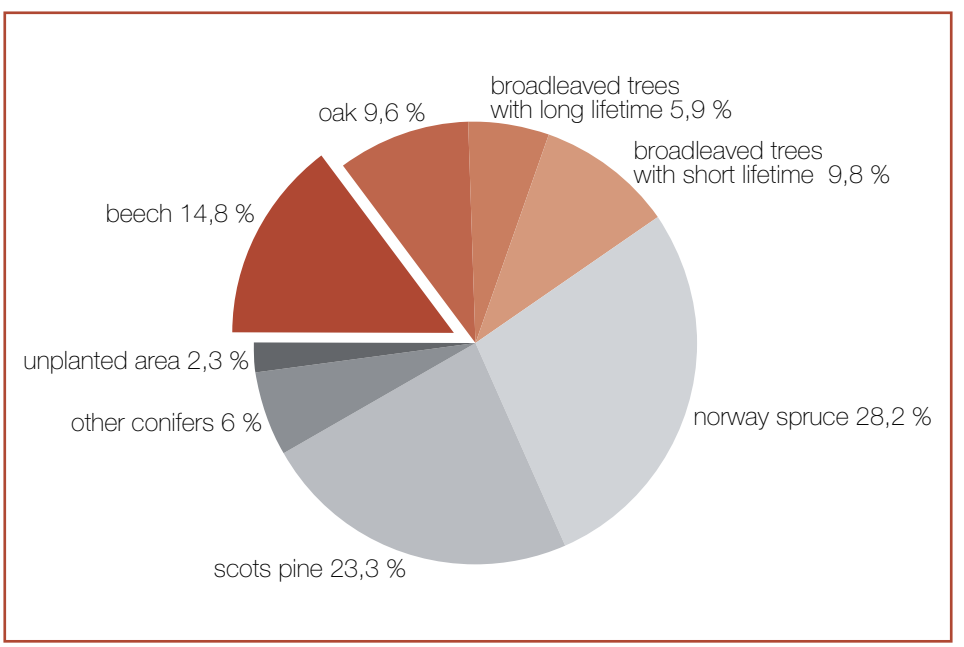
Germany is, by nature, a forested land. Without human influence, well over four fifths of its land area would be covered by forest. In fact, in the varied development of our cultural landscape over more than 1000 years, forests comprise only almost one third of the total area. By far the most important tree species, and that which characterises vast areas of the natural vegetation in Germany, is beech (Fagus sylvatica L.).

Beech forests in Germany

Beech is the most common broadleaved species in Germany. Currently, it accounts for about 15 %. In the last 15 years, the area of beech has increased by about 150 000 ha. Predominantly under near-natural management, beech forests are a prime example of a sustainable, multiple-use forest management. Beech forests are accessible to the population for recreation, and they provide near-natural habitats for many plants and animals. At the same time, high quality beech wood is produced for a wide variety of uses. The integrated approach of this multiple-use management is an ideal example for the achievement of the aims of the Convention on Biological Diversity (CBD).

Aims of the CBD

The CBD is the central international instrument for the conservation of biological diversity worldwide. The convention was signed in 1992 at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. The aim of the convention is to maintain the genetic diversity, the diversity of all animal and plant species, and the diversity of ecosystems. In addition, in keeping with the CBD work programme on forest biological diversity, initiated in 2002, the biological diversity of forests should be maintained and improved. Forest should be managed so that the natural resources within them are used in a sustainable way. The distribution of the benefits from forest management should be just and balanced.



Conservation through utilisation

In Germany, specific measures have been implemented to maintain the forest genetic resources since 1985. Genetic investigations, in addition to surveys of plant and animal species in beech forests, show that the biological diversity of both beech and the species living in association with it occurs at a high level.

Ministerial Conference on the Protection of Forests in Europe

At the European Ministerial Conferences in Strasburg (1990), Helsinki (1993), Lisbon (1998) and Vienna (2002), pan-European criteria and indicators for sustainable forest management were listed. The standards for the pan-European certification system were based directly on the Helsinki criteria. The ecological criteria, together with the economic and social criteria, form the basis of a forest management in accordance with the CBD.

UNESCO-World Natural Heritage

With the support of the German Federal Ministry for Environment, Nature Conservation and Reactor Security, the states, Brandenburg, Mecklenburg-Vorpommern and Thuringen are in the process of seeking nomination for UNESCO World Natural Heritage of a cluster of German beech forests, comprising selected areas of national parks and forest nature reserves. Germany has an especial responsibility for the conservation of beech forests in Europe following the suggestion for a transnational nomination submission incorporating beech forests in Germany, Slovakia and the Ukraine.

Beech – Winner in near-natural forest management

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Close-to-nature silviculture

Natural regeneration

Plantings of beech in coniferous stands

Beech – Winner in near-natural forest management

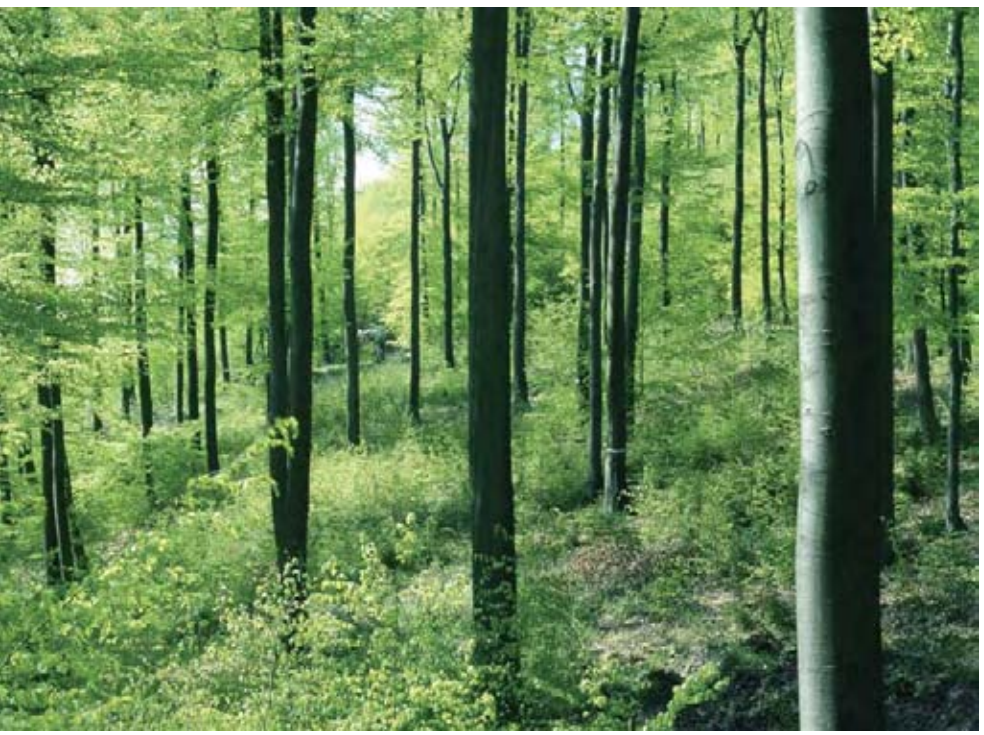
By nature, beech attains dominance in mature plant communities almost everywhere, except where its adaptability is overtaxed by the lower temperatures at higher elevations, the lack of oxygen in the growing season as a result of a high water table or waterlogged soils, or by prolonged water shortage in summer. Under natural conditions, beech might characterise about three quarters of Germany's forest area. In a "beech belt", which encompasses the German states Saarland, Rhineland-Palatinate and Hessen, as much as 90 % of the area covered by forest today would comprise beech.

Today, beech occurs on only about 10 % of the area of managed forests in Germany and, even in the states within the "beech belt", it constitutes the main tree species on only 20 to 30 % of the managed forest area. This distribution is primarily due to historical cultural activities, which often reach back a very long way. In the middle ages, the agricultural communities preferred oak for many centuries (for construction and forest pasture) followed by other hardwood species particularly suitable for coppicing (as firewood).
Furthermore, up until recent times, the widely distributed forest devastation arising from overuse and humus removal continued into the recent past, after which major efforts were made to reforest these areas with the less demanding conifer species, especially in the 19th century (forest re-establishment phase). In the first half of the 20th century, forestry gave preference, either consciously or out of necessity, to establishing plantations on large tracts of land laid clear after the war, or from bark beetle infestation and major storm damage. Yet it should be recognised that, in the first decades after the Second World War, beech suffered regional losses due to clear cutting and the subsequent conversion to coniferous forests.

Close-to-nature silviculture

With the transition to close-to-nature silviculture, which gradually became more prevalent in the 1980s and continues to influence forest management practices in Germany, a complete reversal in the management trend occurred (forest conversion phase). Near-natural forest management is ideally suited to accommodating the multiple-use objectives for German forests. With its main characteristic, the ability to fit in with the natural processes as much as possible, this type of management has become the pillar of globally competitive forest management in the densely settled, industrialised Europe.

The aim of adjusting to the natural processes places in focus the tree species that is a characteristic, often dominating element in most habitats: the beech. Therefore, it is not surprising that here, in Germany, beech is the main winner in near-natural forest management. One only needs to look at virtually any forest under near-natural management to be convinced. This is also shown by a comparison of the national forest inventory data from 1987 and 2002. These findings correspond to a number of forest management features, which already promote the high natural ability of beech to assert itself.



Natural regeneration

A very important feature of near-natural forest management is that it gives priority to the natural regeneration of forests. Natural regeneration is always adopted when the species, origin and quality of the existing trees in the forest are sufficiently well adapted to the prevailing site conditions. For beech, these prerequisites exist almost without exception. In fact, like virtually no other species in Germany, beech has been regenerated predominantly naturally as long as one can remember. Thus, seed bearing beech trees are nearly always members of a natural regional population today, and still continue to pass on their native, and hence well-adapted genetic identity to the next forest generation. Moreover, the long regeneration periods associated with near-natural forest management also gives beech a particular advantage. Even before sufficient light reaches the forest floor for the germination and growth of the progeny of other species, thanks to the outstanding shade tolerance of beech, the young seedlings have many years in which to become estab-lished underneath the tree canopy of the former generation.

Silvicultural measures also are geared to the early promotion of selected trees, and are becoming more widespread in Germany. After natural selection through strong competition between young trees, the crown development of the more vigorous individuals is favoured. In turn, this promotes the comparatively early and plentiful production of beech seed. Thus, the shade tolerant beech can produce progeny, and supplement it, very early.

Beech plantings in coniferous stands

In addition to these largely spontaneous, often incidental effects of near-natural forest management, silvicultural measures for the conversion of secondary coniferous forests to near-natural mixed forests are being undertaken throughout Germany. This largely has involved planting beech seedlings and sowing beechnuts under Norway spruce, Douglas fir and Scots pine stands. For example, several years ago, Rhineland–Palatinate commenced a program to convert half of the pure Norway spruce and Douglas fir stands that were over 40 years old at the beginning of this century to mixed stands

within 20 years by planting other tree species in these stands. Beech plays, by far, the most important role in this process. Often beech plants, which have regenerated naturally and are abundant almost everywhere, have been transplanted for this purpose.
This contribution only refers to the most important effects of near-natural forest management, which is widely distributed in Germany and has been applied and refined in multiple-use forest management, as they relate to beech, one of the most important native tree species. The extent to which this nature-oriented approach to forests has been effective is documented in the national forest inventories, which report an almost 2 % increase in the area covered by beech in only 15 years. In a production period of 150 years for beech, this development, if constant, would lead to a nation-wide increase in beech area from 15 % to 35 %.

Thus beech is the main winner in the near-natural management of multiple-use forests in Germany.

Future of beech in Germany

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Adaptation potential in a changing climate

Ecotypes for the future

Adapted forest management

Natural regeneration as a survival strategy

Adapted game population densities

Maintaining and increasing beech forest area

Future of beech in Germany

Beech occurs in very different habitats, and occupies these permanently. This species provides an ideal example of the competitive strength and dominance in forest stands. It is described often as "presently the most successful plant species in Germany and Central Europe". In natural beech forest communities, other species can persist against beech only in those niches where they are more competitive.

Chance for an adaptable tree species in a changing climate

The predicted climate changes will restrict the occurrence of beech primarily on the sites typified by summer drought at the boundary of its distribution. The potential area of beech distribution will shift to the north and into higher elevations in the mountains, while retreating from the lower elevations, the more southerly regions and from the east. At the drought determined limits of beech's distribution, oaks and other species that require warm temperatures will increase their presence in forests. In contrast, at the elevation limit of beech, beech increasingly will penetrate the Norway spruce forests.

Ecotypes for the future

In the next regeneration cycle, a tree species diversity suited to the site should be established. Here, those beech ecotypes must be considered that can be expected to have a high adaptability to the changing habitats. During the recolonisation of Europe after the ice age, beech adapted successfully to the different climatic and edaphic conditions. Beech ecotypes, which could be of considerable interest in view of the current and projected climatic changes in Germany, developed in areas along the distribution boundary. The occurrence of beech in the central and southeast European range of its distribution, characterised by a continental climate, is of particular interest because we may find that the potential to adapt to the changing climatic conditions may be concentrated in this area.

The observation of the adaptation process in our beech forests to the current climate change is equally important. Natural forest reserves in beech forests may serve as field laboratories for the forestry investigations to this end.

Forest management – adaptation to changing habitats and societies' demands

If the factors that define habitats, such as temperature and the level and distribution of precipitation, change, it initially affects the competition in the tree layer of beech forests, the competition between the individual forests layers and the opportunities for forest regeneration to survive under the mature beech canopy. As a result, current investigations relating to the management of beech forests ensue long before even greater changes to habitats enable other (tree) species to penetrate beech forests and bring about a change in the competition

between these intruding species and beech. The principle is simple: the more an increase in temperature in the growing season, when precipitation remains constant or decreases, lead to deficits in water availability, the more open forest structures will become. This includes beech forests. The situation at higher elevations in the central mountain ranges differs: up until now, the temperature, associated with a more than adequate precipitation, has limited opportunities for beech development. Temperature increases in the growing season in these locations could create a mosaic of small beech forest management areas.

Buffering environmental effects with silviculture

Through targeted tending and thinning measures, one aims to achieve beech stands and mixed beech stands as close as possible to their natural states. Different forest management objectives may be pursued depending on the production potential of stands, the aims, but also on the current economic situation of the forest enterprise and the changing wood demand. Yet in all cases, a sustainable wood production and use, the core of global sustainability strategies, must be considered. On this basis, beech forest management suited to local conditions can be practised with the primary aim of maintaining the species and structural diversity of natural beech forests. Beech forest management that is based on the production of quality wood from a relatively small number of trees affords many opportunities in this respect. The use of individual beech trees that have reached their target diameters creates

small regeneration areas. Localised areas in the decomposition phase are permissible where single beech trees or groups of beech have poor wood qualities for utilisation, but are of considerable importance for the diversity of beech forest habitat type (cf. NATURA 2000). This link of quality wood production with a targeted development of habitat diversity forms a transition to beech forests, which are managed to produce a broad range of utilisable timber – from wood for producing energy and firewood, smaller sawn timber assortments e.g., for parquet, to high-value timber from large-sized beech.

The biological/ecological characteristics and capacities of beech, described as the "mother of the forest", supports the integrated use and conservation approach implemented by forestry in Germany for some time. The diversity of sites, the silvicultural management models, the utilisation scenarios, which are dependent on the wood market, and the changing demands of society about the different functions forests should fulfil over the entire area do not support a fundamental segregation of conservation and use.

Natural regeneration as a survival strategy

Natural regeneration initiates a generation change in beech forests. The seeds germinate under the shade of mature beech trees. Often the young beech seedlings cover the forest floor like a carpet and will die if insufficient light reaches the forest floor. The use or decomposition of mature trees initiates a new cycle of forest development. Many thousands of these

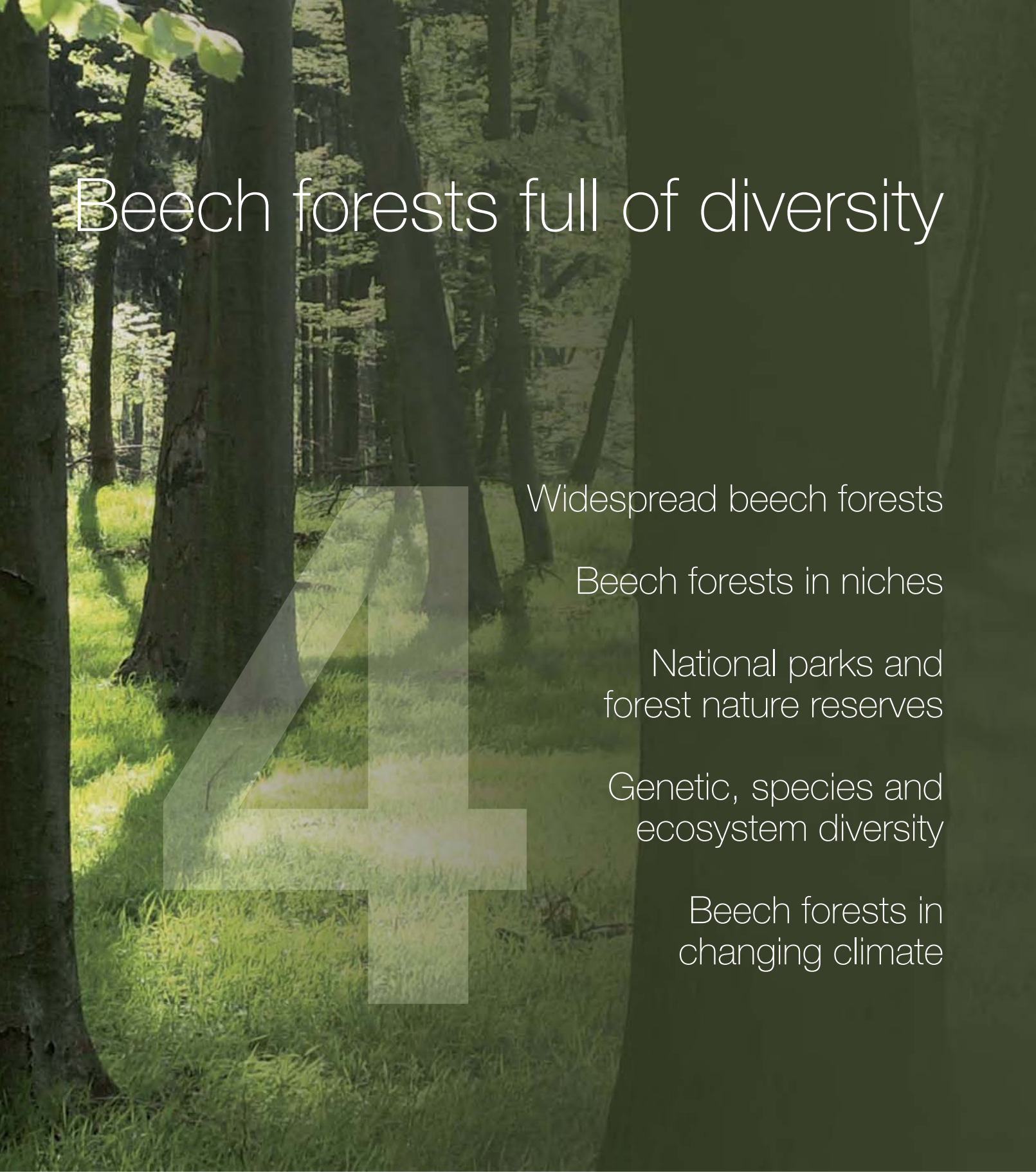
young beech seedlings constitute considerable competition and selection, but also adaptation potential for the changing growing conditions. The natural regeneration of admixture species – silver fir, sycamore maple, plane maple, wych elm, common ash, oaks, and fruit trees on the drier, calcareous soils in the lower mountain elevations – can compete successfully against beech only in small areas, which represent an ecological niche for that species. The admixture species should be planted in these niches where they have a competitive advantage if one does not want to continue to fight against the competition from beech regeneration. It is possible for a manager to achieve his aims with little effort when he works with nature.

Game suppresses admixture tree species

Even when the ecological conditions for natural regeneration are fulfilled, game may have a decisive influence on the composition of the secondary stand. The impacts of game may result in a reduction in species mixture and changes in the species composition of the regeneration, particularly when the regeneration of the stand is planned to coincide with the removal of single stems over the entire area.
Stable forest communities can be attained by maintaining game population densities at levels that do not impair forest regeneration, including that of the admixture species.

Maintaining and increasing beech forest area

The maintenance of, and increase in, beech forest ecosystems, the creation of near-natural stand structures, and the conservation of mature stands are given particular attention. As well as maintaining the beech forest area, additional opportunities are available for the expansion of beech in Germany, including the promotion of natural beech regeneration by adhering to specific conditions (establishing acceptable game population densities), conducting advance beech plantings and planting which take the successional stages into account.



Beech forests full of diversity

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Widespread beech forests

Beech forests in niches

National parks and forest nature reserves

Genetic, species and ecosystem diversity

Beech forests in changing climate

Beech forests full of diversity

The forest is the characteristic vegetation type of the natural Central European landscape. We maintain the biological diversity of the central European beech forests, as our global natural heritage. Our efforts are also directed to conserving forest species whose centre of continental and global distribution range is located here.

Widespread beech forests

The most frequent natural forest community in Germany, especially in hilly and mountain regions, is the woodrush-beech forest type named after the white woodrush. The site conditions and the species composition of the wavy hair grass-beech forest type in the north German lowlands are very similar.
Due to the broad distribution of species-poor beech forests on acidic soils, an interesting zonal geographic and elevation variability can be found. Depending on the elevation, predominantly oaks occur in association with beech, which dominates all species present.

At higher elevations, silver fir and Norway spruce are also present in the tree layer.
Beech forests with moderate nutrient supply on slightly acidic to neutral soils, extending from the coast to the Alps, belong to the woodruff-beech forest type. In the optimum phase, they are dominated by beech, occasionally admixed with common ash, sycamore maple and plane maple. The lyme grass-beech forest type grows on sites with a moderate to good nutrient supply. It occurs in Central Europe, extending from the plains to the central mountain ranges on calcareous soils from limestone or chalk, on basalt, and on calcium-rich soils. The lyme grass-beech forest type is closely associated

with the woodruff-beech forest type, which is also widely distributed in Germany. The main focus of its occurrence lies in the central limestone mountains. In the northern alpine range, and in the southern foothills of the Alps, a moist beech forest on limestone has developed.

Beech forest in niches

The orchid-beech forest type of the lowlands and hills, and also the alpine regions, is found exclusively on dry flat limestone sites. The sycamore maple-beech forest type rich in tall forbs is equally specialised in their site requirements, yet with completely different qualities. These forests are found in the higher central mountain areas and in the alpine region in damp snowy hollows, channels and on the edges of avalanche slopes.

Beech forests in national parks and forest nature reserves

An optimal network of national parks of beech forests, which includes the Jasmund, Müritz, Hainich, Eifel and Kellerwald-Edersee National Parks, has been created for the maintenance of the national natural heritage and biodiversity. There are 716 natural forest reserves distributed across Germany, comprising 31167 ha in total. The proportion of beech forests represented in these reserves corresponds to their actual area of occurrence. The natural forest reserves have not been managed for at least 30 years, and will not be managed in the future. They are “tomorrow’s virgin forests”!

Forest ecosystems and species diversity

Even relatively “poor” landscapes such as Central Europe contribute to global biodiversity. Thus, although the beech forests on acidic soils appear to be species-poor in terms of the species of flowering plants at first, its two most

important plant species, beech and woodrush, are endemic to Europe and therefore, from a global perspective, they are the two single-most important features of European vegetation. In fact, locally, a diversity of species characterise the beech forests on acidic soils, when all species groups are considered. The closer to nature the structural elements of this forest are, especially the large, fallen and standing deadwood, the higher this diversity. The different types of beech forests support a typical fauna. About 6800 animal species have been found in beech forests.
Yet the number of strongly monophagous insect species specialised in beech is low, with 96 species, (compared to 298 species in oak). The cool-humid climate in stands does not promote insect development, and the smooth beech bark offers little opportunity to hide or develop. Yet beech forests are very species-rich habitats. Investigations of fauna in a forest nature reserve in Vogelsberg, in Hessen, found that there were 4500 animal species despite the central mountain range climate, and the very recent stop to forest management activities for wood production. In this reserve, comprising only 75 ha, about 10 % of all the terrestrial animal species known to occur in Germany were found.

Projects and concepts

The natural heritage “beech forest” is secured in the European NATURA2000 Network on a large-scale. The beech forest - habitat types are listed in Appendix I of the FFH (flora-fauna-habitat) guidelines. The total area of the woodrush-beech and the woodruff-beech forest types each amounts to well over 6000 km² (ca. 5.5 % of Germany’s forest area), of which about 35 % is represented in the FFA-area in Germany. The naturally occurring habitat types, which are represented on only small areas, are covered particularly well in the FFH areas. Thus the NATURA2000 Network reflects well the potential natural vegetation (Germany’s climax vegetation zones).
A near-natural forest management ensures a high biodiversity by observing the closeness to nature of the tree species composition, including the genetic aspects, the niche diver-

sity, the key structures as well as the habitat continuity.
The credo is thus: it is possible, even with a relatively small area for the protection of processes, to integrate considerable improvements in the habitat structures into forest utilisation scientifically as long as ecologically sustainable forest management is practised on additional areas. In this case, strategies and concepts for coherence, biotope stepping-stones and biotope networks need to be considered.

Genetic aspects

In Central Europe, beech has a relatively high genetic variation, from which a considerable adaptation potential can be derived. The genetic differences between stands in Central Europe are smaller than those between Central and South-European stands. Yet even provenances from Central Europe show clear phenotypic differences. Here, the bud burst and leaf colouring are dependent on elevation. Trees from provenances from the optimal sites in the central mountain ranges are often better formed.
In Germany, beech from the southeastern central mountain ranges (Erz Mountains, Franconian forest, Fichtel Mountains, Bavarian Forest) differs from all other beech provenances as shown by a specific genetic variation at certain gene loci. This is the result of their post-ice age recolonisation history.
When genetic material is introduced artificially, the genetic quality of the reproductive stock should be paid particular attention. Only plant material of known origin, in accordance with the provenance recommendations, should be

used. In view of the climate change, planting trials of material of provenances from warmer and drier regions (e.g., south France and east Europe) needs to be tested to determine the likely success prior to its use.

Beech forests in the changing climate

Due to the broad genetic base of beech, it will cope well with the climate change. It has a very high ability to adapt to environmental changes. In most regions, it can continue to be recommended for planting due to its broad site amplitude and its genetic variation. Only in the markedly continental, and hence already dry and warm regions, should caution be exercised. Here, the tree species of the oak-hornbeam forests (oak, valuable broadleaved species) favouring higher temperatures increasingly will be considered. In the higher elevations of the central mountains and the Alps, an expansion of the distribution range and a higher competitive strength can be expected of beech. From a genetic viewpoint, the species that are present and adapted to the site conditions should be used in a natural regeneration of forest stands. As an admixed tree species, beech should be introduced on areas that are not too small and, if possible, in groups. Due to its conformism, beech plays a special role in forest conversion directed to climate change. It is difficult to introduce onto open areas, which is why the conversion to stands abundant in beech need to be commenced at the right time under a canopy, or by developing a pioneer forest.

animal species	number of species	beech forest specialists
mammals	27	(3)
birds	70	(5)
amphibians and reptiles	12	(0)
land snails	70	(5)
spider	560	(125)
myriopoda	60	(20)
beetles	1500	(200)
butterflies	1300	(550)
hymenoptera	700	(250)
diptera	1080	(340)
other insects	580	(160)
isopoda	26	(4)
worms	380	(120)
protozoa	350	(?)
total (circa)	6715	(1792)

plant species	number of species	beech forest specialists
flowering plants	200	(50)
fern	15	(4)
musci	150	(20)
liverwort	40	(0)
tresses	280	(40)
large-scale fungi	850	(20)
tremellales	40	(10)
rust fungi	110	(30)
ustilaginomycetes	45	(15)
sac fungi	800	(300)
other fungi	1500	(500)
algae	160	(?)
bacteria	120	(?)
total (circa)	4320	(1169)

Beech – “water works” in forests

Comparison beech vs. conifers:

Interception loss lower

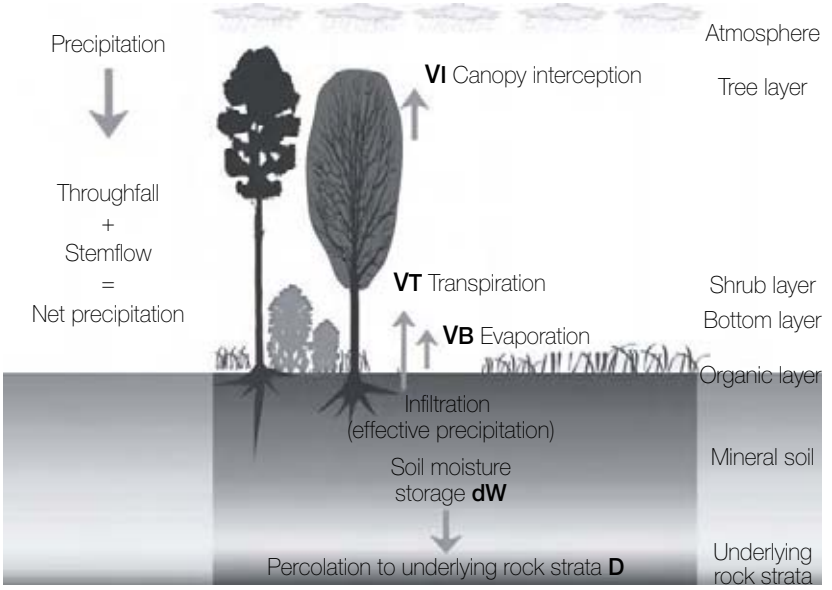
Infiltration higher

Percolation to groundwater higher

Beech – “water works” in forests

The production of water in quality and quantity is, after wood production, the most important material achievement of forests. Tree species and age, vertical layering, the species mixture and forest management substantially influence the components of the water cycle. An accurate assessment of the conditions of forest hydrology is possible only by giving consideration to their special structural features.

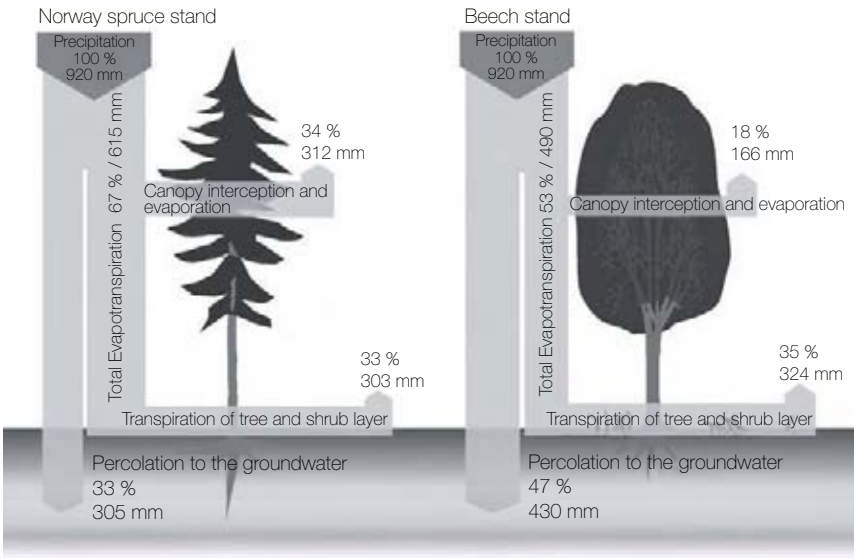
In beech ecosystems, the proportion of the precipitation intercepted by the tree crown is much smaller than that in coniferous forests. This leads to lower interception losses. The results of the redistribution of precipitation in the crown space show that mature stands have a higher stem flow. For given precipitation and soil conditions, both the low interception and the stem flow substantially determine the height and timing of the groundwater recharging, and give beech forests a hydrological advantage over coniferous forests.
Under beech, the seepage is clearly higher that under Scots pine and Norway spruce. Through the selection of tree species and stand treatment, the opportunity exists for forestry to have a targeted influence on water catchment hydrology.



Given the gradual decline in water runoff, on the one hand, and the high quality of seepage water under forests, on the other, the hydrological services of forests in a water catchment are increasingly being investigated. In particular, the importance of the forest area as a water supplier has increased considerably as a consequence. The results indicate that, under comparable weather and soil conditions, both tree species and vegetation structures have a significant influence on the key hydrological parameters. Evaporation and the recharging of ground water are functions of stand-related structural parameters, and of stand growth. By intensively recording the structural and process parameters in ecosystems, and quantifying the interactions between them, an important prerequisite for the assessment of the hydrological services of forests have been met.
With the assistance of a hydrological model, the seepage below the root space was calculated for three afforestation scenarios in a forest division in the north-eastern German lowlands. The seepage below the root space was calculated only for the selected afforestation scenarios with the given differences in vegetation and soil structure. Definite differences were found between beech and Scots pine stocking. For the beech stocking, the annual seepage rates over more than 85 % of the area were between 120 and 180 mm, whereas for Scots pine stocking on similar sites annual seepage rates

of 80 to 120 were reached on only about 8 % of the area. On the majority of the area, the seepage rates fell to between 0 and 80 mm per year. According to the seepage water calculations for the three afforestation scenarios, the potential ground water storage under beech of about 900 000 m³ per year (= 140 mm/a) is three times that of the ground water storage under Scots pine. The variant with Scots pine and beech, with a potential ground water storage of about 500 000 m³ (= 77 mm/a), fell between the Scots pine and beech variant.

Consequently beech becomes the “water works’ in forests.



Beech wood: in demand and valuable

583 million m^3 standing volume

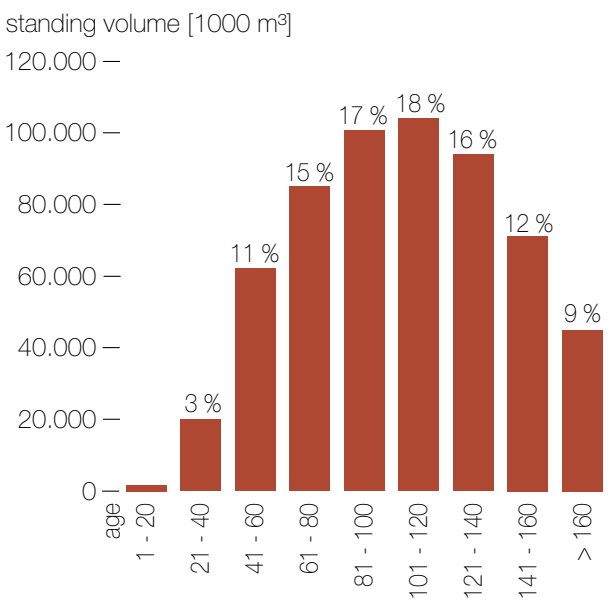
10 million m^3 annual harvesting volume

15 million m^3 annual increment

4 million m^3 exports per year

Beech wood – in demand and valuable

Beech forests in Germany have an abundant growing stock. According to the results of the second national forest inventory, the total standing volume as at 01.10.2002 was about 583 million m³, or 323 m³ per ha. Thus beech comprises about 17.3 % of the national total standing wood volume.



Abundant wood in German beech forests

The largest volumes of beech wood are found in the states Bavaria, Baden-Württemberg and Hessen. In the "beech state" Hessen, this tree species also contributes the highest proportion of total wood volume with 34 %. In the former West German states, in which an earlier beech forest inventory was conducted, the standing volume of beech wood increased by 25.8 % from 1987 to 2002. The reason for this increase is that the utilisation rate was much lower than the volume increment. This increase in volume corresponded to the political forestry aims, although the limited marketing opportunities for beech wood contributed.

Value gain or value loss? The right timing is critical

With increasing age, the tree diameters, and also the value of beech wood as a rule, increase. Yet the risk of diminishing wood value through discoloration, the so-called red heartwood, and fungal decay increases markedly with age on many sites. The art of silviculture lies in identifying the right time to harvest, and this may differ for each tree. Ideally beech should be removed when the value increment is highest and still no wood devaluating processes have commenced.

The beech forests in Germany have an abundant supply of mature wood, with 36 % of the standing wood volume in the age classes above 120 years. In future, the timely use of this volume of large wood will be critical. Yet an adequate proportion of the large trees must be

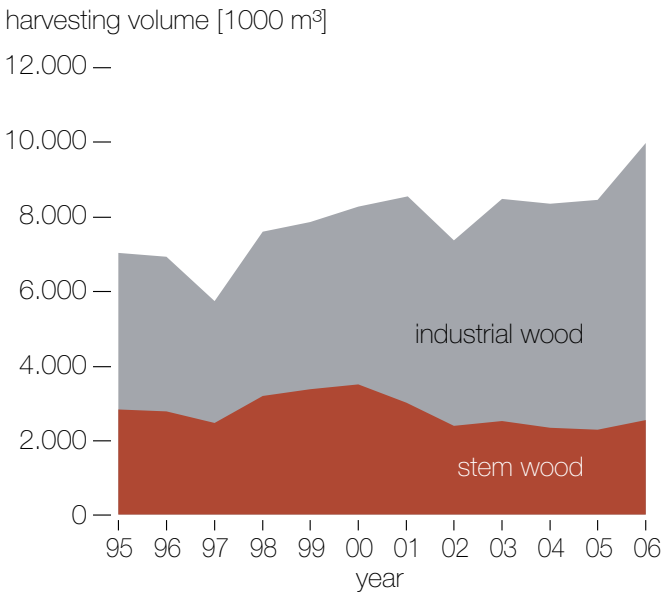
left in the forest to gradually pass into the senescent and decay phases, which are important for nature conservation. The removal of trees will allow light to enter the stands so that the next generation of beech can establish and develop. This type of management corresponds to the principle of sustainable multiple-use forestry followed in Germany, which ensures continuity and allows many of the forest functions to be fulfilled on the one area.
The management of beech forests does not only make available a valuable, renewable raw material, which serves forest enterprises as a source of income, forms the basis for multiple uses of wood as a raw material and for energy production, and guarantees employment, it also counteracts the greenhouse effect by increasing the amount of carbon stored by wood products. The duration of carbon sequestration is longer, the more durable the beech wood products are:
The range of uses extends from CO_2 neutral burning with positive substitution effects, to short-term fixation in paper products, medium-term storage in furniture and, finally, long-term sequestration in construction timber.

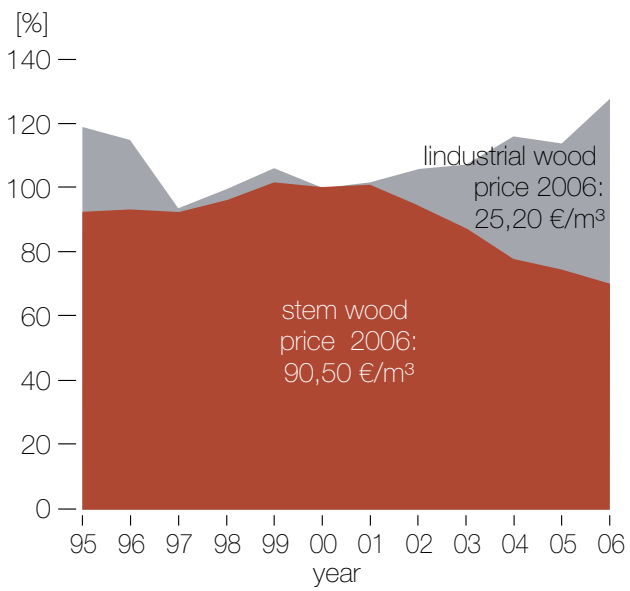
Increasing demand

In 2006, the wood harvest in Germany was about 62 million cubic metres, of which beech contributed almost 10 million m³, or about 16%. Stem wood is destined for the sawmills, after which it is used mainly as construction and furniture timber, whereas industrial wood is processed into paper, pulp or chipboard. Three quarters of the beech harvested, about 7.4 million m³, was sold as industrial wood and firewood. This market is still in a state of expansion. In contrast, the beech stem wood harvest has remained at approximately the same level in recent years.

Valuable beech wood

The increasing demand for industrial wood and firewood has lead to an increase in the price. Meanwhile there is real competition for beech industrial wood between its use for energy production, as a raw material by the pulp and paper industries, and by the wood-based panel industry.
By comparison, the prices for beech stem wood clearly have dropped once again in recent years.





	import	export
beech raw wood	37.553	1.010.492
beech sawnwood	56.078	384.613
total	93.631	1.395.105

Forestry and wood–science are working towards a revitalisation of the market for beech stem wood products, and are developing techniques for improving the beech wood characteristics.

German beech wood – in demand overseas

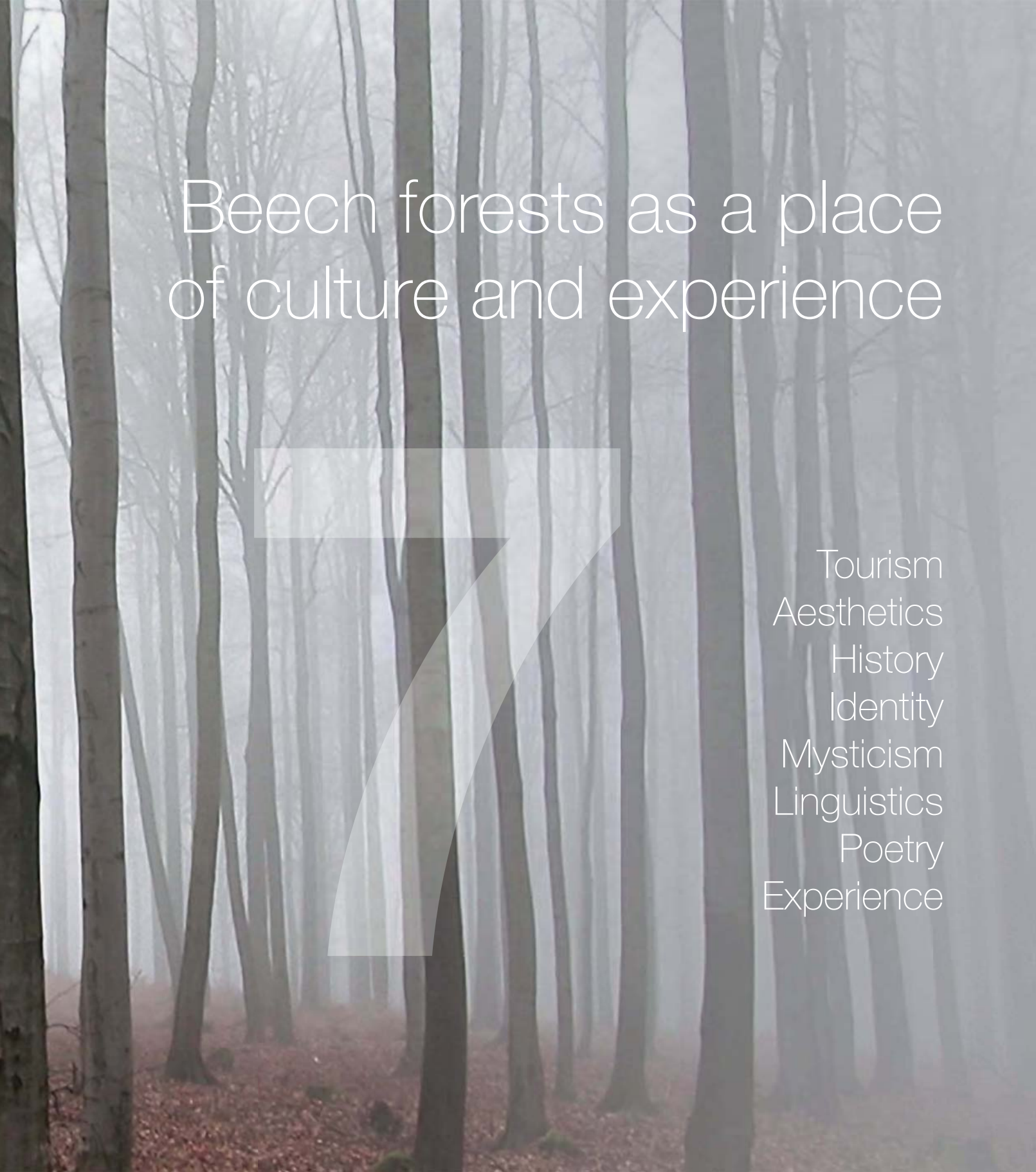
Germany is a net exporter of beech raw timber and beech sawn timber. In 2006, exports amounted to about 1.4 million m³, exceeding by far the imports. Whereas imports have decreased continually in the last five years, exports were maintained at an almost constant level. In 2006, Sweden, China, Austria, Italy and Denmark were the main importers of beech raw timber. The five most important countries targeted for sawn timber exports were China, USA, Poland, Spain and the Netherlands. The export market offers opportunities to increase the sale of beech stem wood, and thereby enhance revenue from the sales.
The worldwide use of beech wood from sustainably managed near-natural forests in Europe is a small contribution to the conservation of tropical forests.

Diverse uses

Until the mid 19th century, beech wood was used almost exclusively as firewood. Today it is the most versatile and most used native hardwood due to its favourable wood, and wood processing characteristics. The advantages of the pale beech wood are its fine, homogeneous structure, the hardness and toughness, and the considerable variation in its appearance. Moreover beech wood can be worked easily, and steamed beech wood can be bent into a variety of shapes. It is used in about 250 different areas ranging from the production of furniture, parquet and plywood, to interior construction. In Germany, an assessment of the end-use sectors of sawn hardwood, which are dominated by beech, shows indoor uses to be the most important, using more than 50 % of this product, followed by construction, at 30 %. Only 9 % and 5 % of the sawn hardwood is used in the packaging industry and for outdoor uses respectively. Currently, a number of research projects are working on developing innovative methods for modifying beech wood to expand opportunities for the outdoor use of the timber.

The research results already available are optimistic and possibly will open new markets for beech wood of sawn timber quality. Additional research activities are investigating the use of glue-laminated wood for load-bearing purposes. Aggressive marketing strategies show the first signs of success already, having created market niches for red heartwood, whose wood qualities do not differ greatly from the white beech wood.

interior usage	51,8 %
furniture industry	35,0 %
wooden strips/wooden plates/wooden toys	je ca. 5,5 %
architecture	30,2 %
parquet/floor	8,8 %
stairs	11,7 %
joiner/carpenter	6,1 %
packaging industry	8,8 %
exterior usage	5,2 %



Beech forests as a place of culture and experience

7

Tourism
Aesthetics
History
Identity
Mysticism
Linguistics
Poetry
Experience

Beech forests as a place of culture and experience

"Is the forest only 10 000 fathoms of wood or is it a green delight?"
What forests might Bertolt Brecht have had before him that prompted this question? We can assume, perhaps, that they were not beech forests because even the management to date has been very close-to-nature when measured against the natural dynamics of beech forest ecosystems. Especially current beech management, which promotes more structural diversity, provides an impressive example of how well the use, conservation and recreation functions of forests can be integrated.

The green heart of Europe beats in the beech forests. Even after the centuries of human influence, beech forests have preserved much of their original characteristics, and have continued to appeal to people over the years. In its traditional habitat, beech is described often as the "mother of forests". This also reflects the world of experience of our ancestors as well. Beech and forest are virtually one. Thus beech represents both the mysterious unknown and the established tradition.
Beech is unique. People with our cultural background are, consciously or sub-consciously, more closely linked to beech than to any other species.

Beech forests – tourist attraction

As merciless as the competition from beech towards it neighbours can be, largely due to its high shade-tolerance, it is very sensitive to weather in its early growth stage. It requires the protective canopy of mature trees more than virtually any other tree species. Consequently the management of beech forests has been based on natural processes for as long as we can remember. Thus beech forests are regenerated mostly naturally and not by clear felling. Depending on the type of management, the forestscape develops more or less structural diversity.
Every beech forest has its own unmistakable face, which appeals to the visitor, always offers something new, fascinates him and absorbs him.
Visitors to the forest are mainly seeking the experience of nature, and after that, the forest is found to be quiet place, a pleasant and desirable contrast to the flood of stimuli in the urban world. In the forest, harmony, balance and stability prevail.
Wood utilisation is found only occasionally to be disturbing as indicated by a recent survey of people walking in the forest; usually it is not even noticed. In the main, wood harvesting is perceived as a means of tending the forest, where by wood production is, to some extent, a by-product.
Therefore the experience of nature in near-natural beech forests is not contradictory to the value of the forests as an utilised resource.

"The most beautiful German forests deliver us beech, … Built with severe form, one like the other as slim, massive columns even distances apart, they join their crowns together to a high dome-shaped roof, which they weave over light branches with well-ordered leaves. A wonderful fine, faintly shimmering silver-grey, brightened by the gentle cover of lichens and moss, covers the long, well-rounded shafts, which carry those massive halls of unspoilt old forest stands. More than ever people are joined in reverence … "

Heinrich von Salisch (1846 – 1920)

Beech forests - aesthetic

The old single-layered beech forest resembles a natural temple with a vault of pointed arches and festive semi-darkness, and reminds one of a gothic cathedral. Several forest locations in Germany have been given the name “holy halls” (e.g., near Feldberg and Bad Freienwalde). The smooth bark and the cylindrical form enhance the column-like impression. Such stands seem unprecedented and overwhelming.

In every season, beech forests unfold their unique beauty, from which people virtually cannot escape. The spring coat of the beech is perhaps the most beautiful. The delicate green that reflects the sunlight is unsurpassed by any other colour. The leaves are still soft and flexible. At this time, the ribs and edges on the underside of the leaves are lined with long silky upright hairs, which give beech its characteristic silvery sheen.

The herbaceous layer of the beech forest has adjusted to its special light conditions. In April, before the leaves on the trees have opened fully, the life cycle of the spring flowers proceeds rapidly: the liverworts, violets, wood-anemones, lungworts and primroses respond with luxuriant growth.

In summer beech forests afford shade and refreshing coolness. This feature of beech surpasses all other tree species. In autumn the colour of the outermost leaves changes first, creating a unique blaze of colour as the yellow, orange, brown and green tones often all occur at the one time. The foggy autumn days give the beech forests a particular appeal, which reminds one of the legends and fairytales. In winter one is drawn by their clarity.

As the year proceeds, the beech forests reflect the biological lifecycle with particular clarity.

Beech forests – historical

For an eternity, the lives of people have been linked to the forest in many ways. The forest was, and is a habitat and basis of existence for humans.
Earlier, beech forests mainly provided firewood and charcoal. They were often the existential basis for mining, ironworks, glassworks and salt-works. Many historical occupations such as charcoal burner, tar and ash burners, glass blowers and travelling blacksmiths are closely linked to beech forests. Prior to the industrial era, the farmer's needs from the forest were foremost food (berries, mushrooms and forest honey), fodder (beech mast, forage, grasses and herbs), firewood and other resources (timber, tanbark and raffia). The proportion of wood used for firewood was still about 90 % into the 19th century, and higher still, especially in community forests. To satisfy these demands, mixed forests with a high proportion of mast bearing tree species were particularly suitable. With the establishment of a regulated well-controlled forest management, the shelterwood system gained acceptance in forests dominated by beech. The tall stands, which are also present in the natural cycle of virgin beech forests, are the result of the implementation of this system. Locally, primarily in northern Thuringen area, a beech selection forest management system developed. Today, this continuous forest management system largely corresponds to the current nature conservation ideal. Here the art of this form of management is linked closely to continual harvesting, as, without target-oriented tending operations, the character of beech forests, created by humans, would be lost quickly.

Beech forest - linguistics

Beech was described in Old High German as **buohha**, and in Middle High German as **buoche**. In the Germanic linguistic region, beech appears as **beech** (Engl.), **beuk** (Netherl.), **bok** (Swed.) and **bøk** (Dan., Norweg.), all of which suggest similar roots. These roots lead from the Germanic **bōkō** to the Indo-Germanic ***b^{h}āgós**, which also reveals the linguistic relationship to the Latin **fagus**, which means, "I eat". Beech was therefore "a tree with edible fruit".

Beech forest –creating identity

Beech forests develop a particular identity in every area, which is dependent on the character of the forest and the way in which it is managed. In many regions, beech forests are a symbol of home, history and culture.
Until today, the name "buchonia" denotes a regional description from Hessen, in particular East Hessen region, and thus illustrates the inner connection of the people with this historical region. In Germany alone, about 1500 place names can be traced back to beech. Known examples include Buchholz, Buchau, Buchenau, Bucha, but also Bocholt and Bochum.

Beech forests - mystical

Despite its wide distribution, beech plays a subordinate role in popular beliefs. Beech was omnipresent and self-evident. In heathen times, beech was preferred for the production of sacrificial bowls and plates. Copper beech trees, which have red leaves due to the lack of anthocyan break down, were regarded highly and were often sacrificial trees. The skulls and skins of the sacrificial animals were often hung up on them.

The so-called Süntel beech trees with their gnarled and distorted branches that grow in together and with very short, spiral-grained stems are known as “Hexenholz (witches tree)” or “Teufelsbuche” (devil’s beech).

In the Celtic tree circle, beech marks the time of the winter solstice. Thus it stands with oak, birch and the olive tree on one of the four stones marking the solar year.

Our Germanic ancestors used beech twigs to foretell the future. Priests cut mysterious runic characters in short sticks and scattered them on outspread cloths. The German word for letter, “Buchstabe”, originates from this use of beech sticks.

Beech forests simultaneously eventful and useable!

Beech forests have accompanied the people of Central Europe during the last four thousand years of their development history in the most diverse ways. Today, in addition to the use and protection aspects of the forest, the recreation value is becoming increasingly important. Beech forests show that utilisation, protection and recreation can be compatible on the one area. Even in the future, people will not be able to go without managing the beech forests.

Beech forests viewed economically

1000 ha beech forests =

260 000 € income
240 000 € expenditure
8 jobs

Beech forests viewed economically

The wood of beech is used for a variety of purposes: for furniture, parquet, pulp, chipboard and, last but not least, as valuable firewood for wood burning heaters in the home. Many people earn part of their income directly or indirectly from the forest. The closure of large areas of beech forest would therefore have a perceptible economic impact.

What a cubic metre of beech wood means for the individual cannot be estimated because the variety of products made from this species have vastly different market prices. What can be calculated, however, is the income from a cubic metre of wood sold in the forest.

Value of beech wood

The earnings from the sale of beech wood delivered to the roadside amounted to about 48 € per cubic metre, on average, over the last 10 years. In contrast, the costs of harvesting wood were about 26 €. Therefore the earnings, after deducting harvesting costs, for the beech component of the enterprise was 22 € for a cubic metre of beech wood cut and delivered to the roadside in the forest for sale.
Additional earnings are derived from the sale of standing, uncut wood to private small-scale wood buyers who bear the cost of felling and cutting the wood, and then, as a rule, sell it as industrial wood or firewood. In enterprises with abundant beech, about 20 % of the utilisable beech wood is readied for sale in this way. In the last 10 years, these assortments produced moderate earnings of 10 to 15 € per cubic metre.
If one considers the scheduled annual marketing amount, which was about 6 cubic metres per hectare in the past, one obtains the annual earnings after deducting harvesting costs of about 120 000 € per 1000 ha of beech forest.

All figures are based on an analysis of data from Baden-Württemberg. In this state, the number of enterprises in the test enterprise network of the Federal Ministry for Nutrition, Agriculture and Consumer Protection is large enough to analyse a collective of forestry enterprises dominated by beech. The basic structures of beech forest enterprises in Germany, however, can be classified as comparable in that the deviations of the mean values in the other states only rarely exceed 10 %. Yet for individual enterprises, the parameters can deviate markedly.

Income for the forest enterprise

Income is an important parameter for the whole forest enterprise. It represents the financial value of wood production.
The income from wood production in forest enterprises dominated by beech varies markedly. In the years 2003 to 2006, the annual income from all tree species was about 260 000 € per 1000 ha on average. Given the higher earnings from the coniferous component, which are present often in enterprises dominated by beech, one can assume that the portion of this income derived from the beech component of the enterprise (including sales to private small-scale wood buyers) is about 240 000 € per 1000 ha.

In addition to wood, other uses, primarily hunting leases, contribute to the production value so that, in beech component of an enterprise, a total income of about 260 000 € on an area of 1000 ha is achieved.

Expenditure in forest enterprises

Due to the favourable expenditure structures in forest opening up, forest regeneration and forest protection, the annual expenditure in enterprises dominated by beech is only about 150 000 € on 1000 ha.
The management costs are an essential additional component of expenditure, which are about 90 000 € per 1000 ha. A major portion is incurred in the form of fixed costs, for example for transport insurance, and for the maintenance of the protection functions. Consequently, these costs are only partially associated with wood production.

Gross profit

The gross profit of the enterprise, calculated as the income less the expenditure, fluctuates considerably in enterprises dominated by beech. In the years 2003 to 2006, the gross profit from wood production ranged between minus 20 000 € and plus 60 000 € per 1000 ha. From these values, the average annual profit is calculated as 20 000 € per 1000 ha. The financial status improved only in 2006 and 2007 after the price increase, particularly for beech industrial wood, such that the beech component of the enterprise finished with a profit in the order of about 50 000 € per 1000 ha.

Employment effects in forestry

Currently, there are about 2 forest workers regularly employed per 1000 ha in beech enterprises, amounting to almost 3 working hours per ha. This figure considers only the actual working hours spent on wood production, i.e., it excludes work for additional parties, or for protection or recreation functions.
Hired contractors and the private small-scale wood buyers also are employed for about 3 working hours per ha. This corresponds to about an additional 2 external workers per 1000 ha of beech forest.
In the beech component of enterprises dominated by beech, the amount of work for all of the forest labours employed for wood production is estimated at close to 6 hours per ha. This corresponds to 4 fulltime workers per 1000 ha. About an additional 1.5 workers per 1000 ha are also employed in administration.

Beech management does not end at the forest boundary

A large-scale closure of beech forests would mean, essentially, the removal of a sustainable raw material from management. In principle, an opportunity to use a sustainable, available, native and environmentally friendly raw material, and to act sensibly for the good of the national economy and environmental protection would be lost.

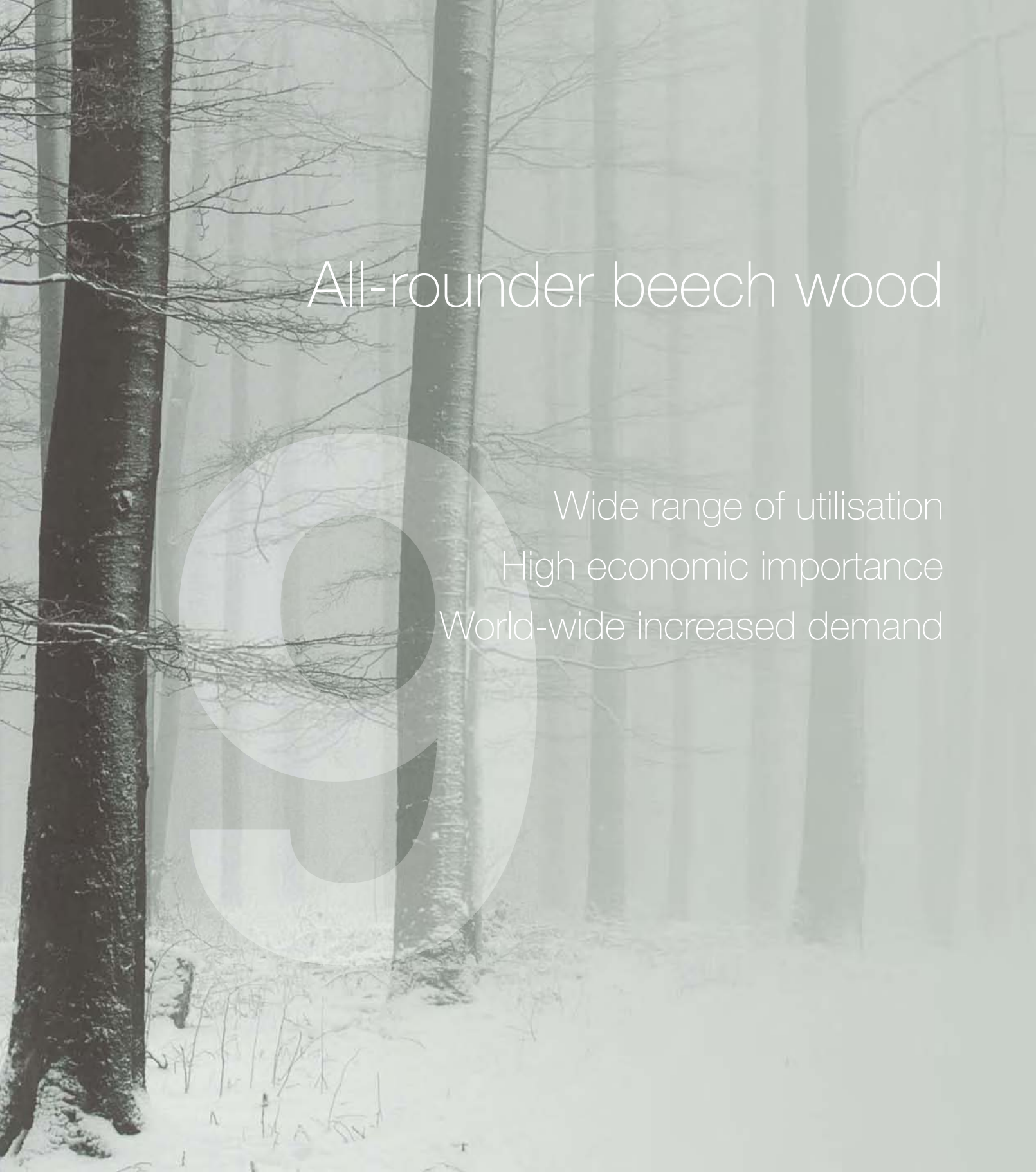
In the hardwood sawmill industry the value adding related to the use of the beech wood resource is estimated at about 77 000 € per 1000 ha beech forest. This corresponds to about 1.5 jobs.

The value-added in the wood-based panel and pulpwood industries is clearly even higher. These industries achieve 176 000 € per 1000 ha. Related to the wood from 1000 ha beech forest, this means 2.5 people are employed per 1000 ha forest in this branch of the industry. Moreover many of these jobs are in structurally weak regions.

At a glance

In addition to the undisputed and important ecological and social functions of beech forests, their considerable economic importance should not be overlooked. The increasing expectations that forests meet nature conservation objectives reduce the opportunities for employment and value-adding from forest and wood management in the long-term, and place the adequate supply of wood at risk. This tendency contradicts the conclusions and aims of the "wood charter", a political initiative of the federal and state governments and associations, which is committed to the sustainable production of the different wood products and their increasing use for the benefit of climate, energy, environment and resources.

Parameters	per 1.000 ha annually
Income forestry mid 2003–2006	260.000 €
Expenditure forestry mid 2003–2006	240.000 €
Gross profit mid 2003–2006	20.000 €
Gross profit mid 2006–2007	50.000 €
Jobs forestry (employees)	2,0 pers.
Jobs forestry (service providers)	2,0 pers.
Jobs management	1,5 pers.
Value-added sawmill and wood industry	253.000 €
Jobs sawmill and wood industry	at least 4,0 pers.



All-rounder beech wood

Wide range of utilisation

High economic importance

World-wide increased demand

All-rounder beech wood

Beech wood offers many advantages. Beech wood has an incomparably broad spectrum of uses in wood processing: flooring, children's toys, furniture and interior construction, as well as pulp and chipboard are only some examples.

Beech also produces finished products with different optical qualities, such as "select/clear", "rustic", "red heartwood" and "coloured" (by staining, varnishing or oiling). Yet what is perhaps the greatest advantage of beech wood? Beech grows in managed forests with globally unique structures that make it available sustainably and efficiently. The exemplary German forest management ensures that wood utilisation, nature conservation and recreation in forests are all possible on the same area. Long-term silvicultural practices make sure that the forest, together with all its valuable functions, will still be available for the coming generations. Annually almost 10 million m^3 of beech wood is harvested in Germany. About 1.2 million m^3 sawn timber is processed in the 230 hardwood sawmills, of which 400 000 m^3 is exported. An even colour is an important quality characteristic of sawn timber. Today, wood processors want boards of a similar colour for all board dimensions. With advanced technology, definite colour can be guaranteed in the processing of beech through a special quality guarantee system.

The wood moisture content is another relevant quality characteristic. Conventional sawn timber is dried often very unevenly. Consequently, high tension and problems with processing result, as well as costly refunds. In modern sawmills, the wood undergoes a technical drying and conditioning phase, which ensures the wood moisture content is homogenous; about 7 – 9 % through the cross-section of boards. This means that the tension in the beech wood is particularly low, and its endurance of further processing is high.

The global economic significance of the European hardwood forests will increase considerably in the future. About 25 % of the world-wide hardwood supply is grown in Central Europe. In contrast to the virgin forests and rainforests in Africa and South America, the forests in Germany demonstrate exemplary forestry structures with a long tradition of practising sustainable utilisation of this valuable raw material without detriment to the nature of forests. Countries such as, for example, China and India, or also countries in South America have either a negligible supply of wood of their own, or they are unable to use their own wood sustainably because the necessary forestry structures are lacking. Therefore they are dependent on wood imports in the long-term, in particular from Central Europe.

The increased world market demand for sawn timber products from Germany, and the gradually increasing demand in the energy sector means that wood utilisation makes both ecological and economic sense:

Wood utilisation creates employment and income, and provides jobs in rural areas.

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The diversity of, and the habitats in European beech forests are unique. These forests have contributed substantially to Germany's cultural and economic development over many centuries. The sustainable management ensures that the many functions of our beech forests can be fulfilled in the future.