come expensive. Taking a one-week second-home holiday in Denmark costs more than a two-week trip to more remote destinations. Because of the huge number of second homes and tourists, second-home tourism has gained a negative connotation as a form of mass tourism. Landscape planners and managers must take into account the complexity and dynamism of tourism landscapes. Only by investigating tourists' perception and motivations along with tourism's impact can these challenges be faced.

7.6.11 Conclusion

When investigating tourist activities, landscape ecology research must apply a holistic approach. Landscape planning and management as well as the knowledge of solutions to the environmental consequences of tourism depend on the application of a **landscape concept that integrates physical and mental dimensions**. Only when specific landscape attributes that are attractive to tourists have been identified can there be understanding about what may need to be done to keep them attractive to tourists (Butler 2000). The landscape-tourism cycle can be used as a model in applied landscape ecology.

As tourism has become the world's biggest industry, the environmental consequences resulting from that business are of vital concern. Integrated landscape ecology studies in the field of tourism and recreation can contribute to successful landscape management. In planning, environmental, economic, and societal interests must be combined. Knowledge of the environmental impact and the motivations and expectations underlying tourist activity allows for a planning and managing process that respects different interests. Landscape planning (see Chapter 7.3) is then able to fulfill its task as a positive agent in landscapes and not as a reagent.

7.7 Nature conservation

7.7.1 Introduction

Nature conservation is calling for action. It has to make decisions and select areas for reserves, or has to choose among alternatives, when interferences cannot be avoided. Such decisions are based on assessments, which relate to values (see Chapter 5.3). Values are not constant and will be modified over time. Those changes are partly determined by the increase of knowledge but also by other processes, such as the political climate or social developments. As a consequence nature conservation will adapt and develop such new values. Nature conservation is a **normative discipline**. Its para-

digms and norms underlay social processes and as a matter of fact are changing constantly. The objectives of nature conservation are different today, than they have been 20 or 100 years ago. This is not a critique, but necessary to realize.

If we take a brief look into the **history** of nature conservation, we will see how its philosophy has changed. The conscious conservation of nature, and of parts of it, as a social aim meanwhile has a long tradition. It roots in the perception of negative consequences of human interferences with nature. This phenomenon became apparent during the industrial revolution. It was associated to the technical progress that began to leave its marks in landscapes and to threat picturesque sceneries.

Based very much on the romantic movement in Europe, since the beginning of the 19th century (see Chapter 7.6.9), the vulnerability and the value of landscapes have been realized more and more. Nature conservation concentrated on grand and magnificent landscapes. In his writings Goethe emphasized the right of nature to remain untouched. He portrayed "natural monuments", and questioned their origin. His holistic approach to nature, seeing natural elements as a whole and not segregating them into their parts, had repercussions on Humboldt and influenced European natural science and nature conservation fundamentally.

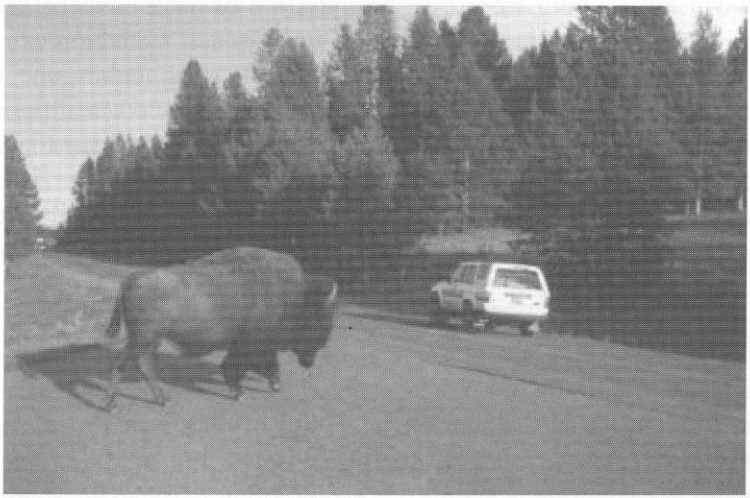

Figure 7.7-1: Yellowstone was the first national park founded in the U.S.A. in 1872 (Photo: O. Bastian 1991)

As early as 1836 in Germany the first natural monument was preserved by a local decree to protect a picturesque rock ("Drachenfels", Siebengebirge) against being destroyed by a quarry business. At that time, the ideas of conservation very much concentrated on extraordinary landscape elements.

In the United States the first national park (Yellowstone, Figure 7.7-1) was founded in 1872 based on a law enacted by the American congress. The philosophy still focused on extraordinary parts of nature, but the scale had shifted to landscapes. Many other parks followed. However, it took some time until naturalness per se became a major quality with the first Scandinavian national parks.

At the end of the 19th century (1880), Rudorff already spoke up for the protection of remnants of natural sites in Germany (Figure 7.7-2), some years later (1888) he introduced the German term "Naturschutz". He was opposing the increasing tourism and its consequences according to waste and constructions. In addition, he protested against traffic and industry.

This seems very modern, but definitely was not the common thinking at his time. During the 20th century, the **strategies** of nature conservation were continuously modified. It is remarkable, that the values and aims also differ widely between countries. Nature conservation had to adapt to circumstances linked to systems of economy and society. Various approaches developed parallel to each other.

Figure 7.7-2: Old and imposing trees can be an object of nature conservation: The ancient oak near Suckow (Isle of Usedom, Germany) (Photo: O. Bastian 2001)

Generally, nature conservation has to consider the environmental background and the history of different biomes, continents and landscapes. The political system had also a significant influence on the political side of nature conservation. The possibilities to utter ones opinion and to protest against pollution and against the destruction of natural habitats were obviously different during the 20th century as well, and of course also the administrative integration and importance of nature conservation.

The history and tradition of land use regulates strongly the composition of flora and fauna. The performance of wilderness and land use both are much related to landscapes and even to biomes. Highly valuable and rare biotopes in one landscape might be common in another one. However, as it is not possible to plan for whole landscapes where the interests of economy have to be considered as well, nature conservation concentrates on certain **areas of high value**. These are either rather natural or rather rich in species or hosting certain rare species.

During the second half of the 20th century biologists started to realize, that the restriction to such marginal reserves would perhaps not help to maintain the natural qualities they were interested in. Based on island biogeography (McArthur and Wilson 1967) and on population biology new concepts were developed. Strong influence came through the concepts of patch dynamics (Pickett and Thompson 1978), minimum viable population size (Shaffer 1981, Simberloff 1988) and by metapopulation dynamics (Hanski and Gilpin 1991, see Chapter 2.8.2). Such theories can be seen as the fundamentals of the design of a **network of reserves**, which is the common strategy today. However, this network again has to be related to the ecological complexity of landscapes. Only then it will be a success.

7.7.2 Nature conservation and scale

Nature conservation must refer to the context of the object that is under focus. This is true for large reserves, such as national parks, that have to be conceptually integrated into the matrix of their surrounding. Buffer zones will be necessary. The interests and the traditions of local people that live close by have to be considered. But, this is also true for endangered populations of rare plants. Conservation strategies then will have to relate to the plant community, to important functional groups, such as pollinators, to site conditions, such as soil and microclimate, and to the disturbance regime. Neighboring areas have to be screened according to their potential for the dispersal of the target species. The spatial distribution of other populations of the same species has to be mapped.

This is why nature conservation is very much settled at the **landscape scale**. Conservation strategies will only be effective and successful, when they learn to integrate local activities into the landscape matrix. The subjects of nature conservation, species, communities and ecosystems are compartments of landscapes, with certain spatial and temporal qualities, adapted to a specific environment and to specific disturbance regimes. Many species and most of the communities that occur in Europe depend on certain anthropogenic activities. At the landscape scale not only threatening processes take place, but also the driving processes.

However, nature conservation has to integrate **different qualities of nature**. This starts with the genetic diversity within species, and reaches from the preservation of varieties, cultivars, and subspecies to the protection of the biosphere. The preservation of species and populations was always a major topic and will continue to be, but it can only succeed when also communities and biotopes are conceptually integrated.

Another point is the preservation of **non-living compartments** (geotopes). The perception of rocks or specific relief elements is emotionally stirring. **Rocks and relief** (Figure 7.7-3) can be modified or even destroyed and then be lost as a habitat but also as an aesthetic quality from a landscape. Preservation strategies therefore have to be widened and integrate also non-living parts of nature.

New concepts should also integrate the **soil**. This compartment, which is of basic importance for almost all our ecosystems, is merely regarded as a resource. Its specific and in some cases local qualities, the rarity and endangerment of soil types for instance or the biodiversity in soils are of almost no importance to the public until now, because nature conservation is still concentrating on biological qualities of landscapes. This conceptual shift would lead to **new paradigms**, which perhaps would see the subject of nature conservation as ecological systems with a variety of ecological qualities, integrating the soil, the water and the air.

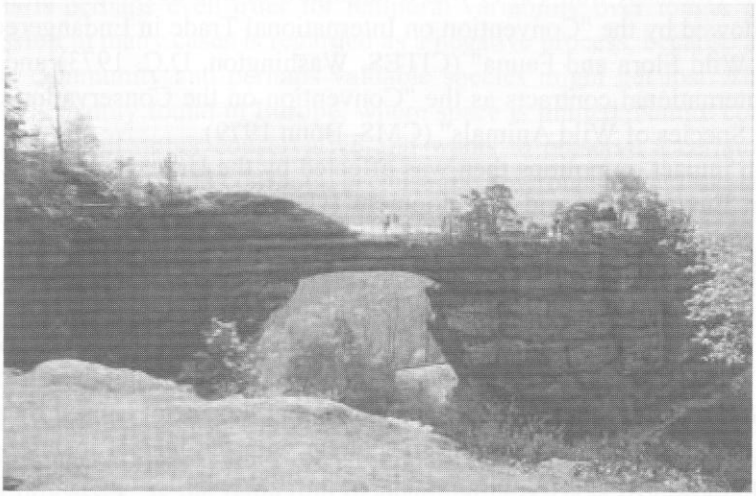

Figure 7.7-3: Rocks and relief can be modified or even destroyed, and then be lost as a habitat but also as an aesthetic quality of a landscape: The famous natural bridge in the Bohemian Switzerland (Czech Republic) (Photo: O. Bastian 1981)

One consequence of the realization of the restrictions of local action is the **internationalization** of nature conservation. Knapp (1997) distinguishes four phases in this development:

- initial phase (-1945): the thoughts of nature conservation were established,
- phase of institutionalization (-1970): most institutions were founded and laws were enacted,
- phase of consolidation (-1990): nature reserves, laws and instruments were further developed and integrated into social processes, and
- phase of emancipation (after 1990): following the deep-rooted political changes during the last decade a new time of cooperation started.

In nature conservation the necessity of international contacts and communication is obvious. It is simply not possible to preserve migrating species in one country alone. The design of reserves has to consider, how species are distributed. Trends of populations and of ecosystems have to be noticed. The control of invasive species (see Chapter 4.3.2) is another point. In addition to this, and in some cases having direct impact on the preservation interests, the economic interactions between countries became so close and intensive, that we can no longer look at questions of conservation in an isolated way.

Institutions and contracts are regulating the international information exchange. Since more than 50 years international programs and organizations, such as IUCN, UNEP, MAB, and non governmental organizations (NGOs), such as WWF, are working on a global scale. The "Ramsar Convention" on wetlands (Ramsar, Iran 1971) was a landmark in this development. Soon it was followed by the "Convention on International Trade in Endangered Species of Wild Flora and Fauna" (CITES, Washington, D.C. 1973) and many other international contracts as the "Convention on the Conservation of Migratory Species of Wild Animals" (CMS, Bonn 1979).

High impact on politics then was affected by the United Nations Conference on Environment and Development (UNCED), the "earth summit", in Rio de Janeiro in 1992. Among other influential contracts, there the "Convention on Biodiversity" was signed by 159 nations. This convention is the consequence of the fact, that we realize a "crisis of biodiversity", meaning a global loss of species, during the 1980's (Ehrlich and Ehrlich 1981, Wilson 1985). We are facing the 6th strongest extinction event during the earth's history (Gorke 1999), but this is the first time, that this is not caused by a large cosmic impact. This observation goes along with the fear of losing ecosystem functions when losing biodiversity. The convention emphasizes that the preservation of biodiversity is not only of concern in the tropics, but throughout the world. The new quality of this convention is that the contracting nations signed to identify components of biological diversity important for its conservation, to monitor these components and to find out processes and activities that have significant negative impacts on biodiversity (Article

7). There was consent to establish programs for research as well as for education and training in this field (Article 12).

The global changes of the environment show, that **nature conservation cannot be static** (Kerr and Currie 1995, Pearce and Perrings 1995). It has to react to the dynamics of the system it is interested in. Changes will occur according to natural site conditions, to species composition and to disturbance regime.

Temporal scales are also important when landscape history is concerned (see Chapter 4.1). The evolution of cultural landscapes went along deep changes in the composition and distribution of landscape elements. New communities established, other ones, that have been natural, vanished and were replaced by anthropogenic land use types. The planning and application of restoration and compensation measures has to consider this historical background. The creation of new elements that have not been native in the respective area before is problematic.

However, dynamic processes are important for ecosystems, communities and populations. Static conditions do not occur in nature. Temporal variability is a driving mechanism of evolution but for the maintenance of populations as well. Temporal niches are obvious, as the light gap for geophytes in European beech forests during spring, but until now management for annual temporal variability is not common generally adapted in nature conservation.

This is perhaps even truer for temporal variability over longer periods. **Succession** in many cases is regarded as a negative process, because it modifies the community and perhaps valuable species might get lost. This philosophy is mainly found in Europe, where space is limited. Nature conservation here is still rather conservative and wants to preserve a certain status quo. This causes logical conflicts, because the environment and the land use regime is not static, but is considerably changing.

A new direction in nature conservation focuses no longer on the protection or the connection of left over areas, which are of no economic interest, but claims the **preservation of processes**. Conservation strategies like this have been developed in Germany long time ago, but remained very week, aiming at the general preservation of landscape properties (natural parks, areas of landscape conservation, etc.) without powerful restrictions for the economic and infra-structural development. But, how to install or promote certain processes, as the reduction of quantitative aspects of nutrient cycles, how to encourage land users to act in a certain way. One approach to reach the goal of managing processes at the landscape level is contractual nature conservation. In this case, the users of the landscape, farmers and foresters, are paid for a certain land management. **Economic incentives** are used to direct the management and to reach desired effects. In addition, marketing initiatives are very promising, for instance to support ecological land use, or

to maintain agriculture in marginal areas. Such initiatives can contribute to preserve resources and maintain or even enlarge species diversity indirectly, even if the major target is the production of food.

7.7.3 Preservation of biodiversity

Today, many practical works deal with the preservation of biodiversity (Falk et al. 1996). In assessments on the environmental compatibility (see Chapter 7.4) biodiversity became an important criterion. In landscape planning (see Chapter 7.3) and in preservation management it is highly ranked as well.

Not all the species can equally be preserved. Target-, indicator- or key-species have to be identified to concentrate on. Besides specific species, communities or ecosystems, modern nature conservation tries to preserve biodiversity in general topic as well. However, concepts that acknowledge diversity per se as a value and integrate it into the planning of conservation strategies are rare (Noss et al. 1997). One reason for this is that the term **biodiversity** is not clearly defined and used ambiguously. It seems clear, that biodiversity not only addresses species diversity, although this is an important issue. Species are just one option to classify organisms, others may be more important for certain aspects of ecosystems (functional groups, growth and life forms, age classes). Then, organisms are only one category of levels of organization in nature. Others contribute strongly to the diversity of landscapes. The diversity of more complex landscape, such as communities or ecosystems, has to be taken into account as well. This is already reflected in the Convention on Biological Diversity (CBD), but is not general consent. In addition to this, not only the number of elements or units, such as species, is a criterion for biodiversity, but also their resemblance or dissimilarity. This differentiates biodiversity into quantitative and qualitative diversity. The most important aspect, however, then will be the third category, which is the functional diversity. This leads to biocomplexity and further on to **ecological complexity**, if one integrates abiotic ecological compartments (Beierkuhnlein 1998).

Nevertheless, the research mainly concentrates on the mapping and analysis of **species diversity**. But even there, the knowledge about real distribution patterns of biodiversity in normal landscapes is small. We know a lot about the hot spots of biodiversity, but the diversity of species throughout common cultural or natural landscapes is widely unknown. Special problems occur, when species are gradually loosing importance in an area. They may still be found at different places, but have changed significantly in their dominance patterns. This is hard to detect. However, such shifts in species

abundance or dominance might be important for the maintenance of ecosystem functioning.

The preservation of biocomplexity and perhaps more general of ecological complexity as well would be a new paradigm for nature conservation. To maintain the functioning of ecosystems and landscapes will be an important task in the future. The loss of species diversity might affect the ecological services that nature offers to mankind.

7.7.4 SLOSS

An important aspect in conservation practice according to biodiversity is the size and delimitation of preserves. Should nature reserves be large or small? Behind the acronym SLOSS, the crucial question: "**Single Large or Several Small?**" is hidden. What will bring more benefit: the design of only few but large sized areas or the protection of many but small reserves? A certain influence of size on species diversity of reserves is rather obvious, but other factors will modify this relation. **Edge effects** (see Chapters 2.3.2 and 2.8.5), for instance, will increase environmental heterogeneity. That is one reason why small isolated biotopes are so rich in species. Species that are closely tied to the characteristic environmental conditions of a landscape element, which are not to be found close to its edge, will prefer larger patches. Fragmentation (see Chapters 2.3.7 and 2.8.8) might reduce the portion of the central area strongly (Figure 7.7-4).

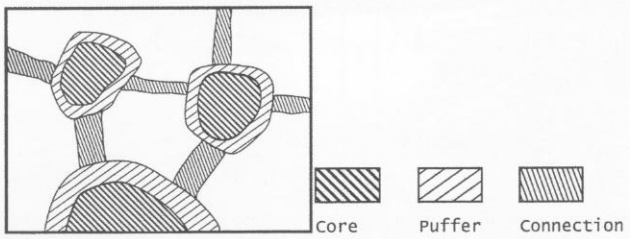

Figure 7.7-4: Fragmentation may cause much higher losses of interior habitats of specialized organisms than this becomes evident in the total loss of patch area. The total loss of area of a landscape element will perhaps be not large, yet the functional impact can be strong

Nature conservation tries to achieve a certain probability to reach its goals. One indication for this success would be a certain stability of the communities in focus. The assumption that **stability** (see Chapter 5.1.2) **and species richness** are connected has a striking persuasive power, but there is an intensive discussion going on since decades about this topic. Until now, species diversity is regarded as an indicator for persistence of communities.

Nature conservation is reduced in cultural landscapes to remnants of natural biotopes or of communities with high biodiversity, which are spread

throughout the landscapes and do occupy only a small area. This is not true in natural or semi-natural landscapes (Figure 7.7-5), which can be found in sparsely settled areas of high mountains, of boreal region, of tropical rain forests, in steppe landscapes or deserts. There conflicts with land use are less important and the design of larger reserve areas is possible. Local population in such **marginal regions** often is traditionally based on subsistence in agriculture and forestry and adapted to the natural conditions of their environment. Conservation projects ought to integrate human traditions and interests. Then, large reserves can be designed successfully and will last.

The theoretical background behind the question whether single large or several small areas should be protected, is the **theory of island biogeography** (McArthur and Wilson 1967, see Chapter 2.8.2). According to this theory, the size of an area strongly influences the number of species. A second aspect is the distance between areas. The third point, which is of interest, is the existence of stepping stones between a continental source and an island sink or target.

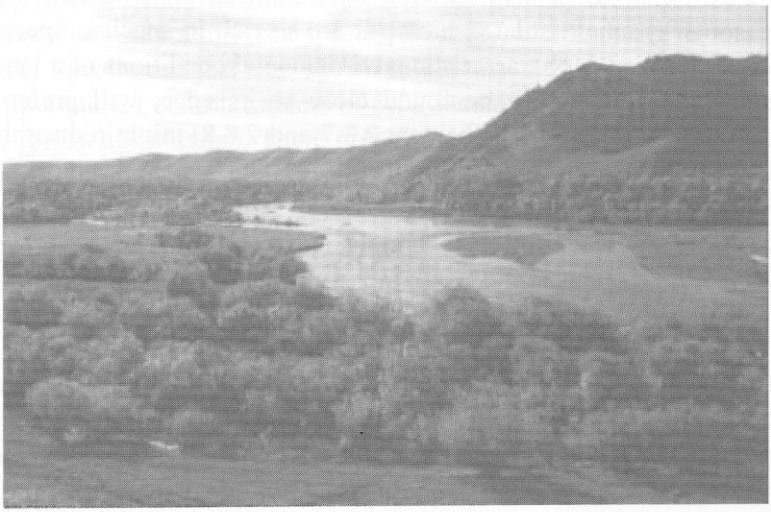

Figure 7.7-5: Remote areas with a more or less pristine nature are favorable to establish large protected areas: The Centej Mountaions (Mongolia) (Photo: O. Bastian 1994)

Boundaries and ecotones (see Chapter 2.6) are important for species, which require both, the site conditions of one and those of a neighboring landscape element. Nevertheless, these transitional areas are rarely mapped or protected explicitly. Paying attention to transitional zones makes management much more complicated. **Transitional landscape structures** should be considered also in the design of reserves. If the influence of the surrounding matrix of a reserve is found to be negative, if it has to be pro-

tected against detrimental processes, such as nutrient input or disturbances of animals, **buffer zones** have to be added to the reserve to enlarge the surface and to reduce the edge effects. This will make the reserve larger than its core area.

7.7.5 Networks

Nature conservation has to integrate spatial and temporal qualities of landscapes. In spatial patterns and mosaics besides the site conditions, the **disturbance regimes** are of a crucial importance (Pickett et al. 1996). Land use changes in general and mainly the abandonment of traditional agricultural land use, at low levels of technical and chemical intensity, are the major threats to species in Germany (Korneck and Sukopp 1988). Other functional impacts go along with the loss of connections and with the loss of stepping stones due to the growing uniformity of landscapes (Figure 7.7-6). The loss of a patch or a landscape element itself may be not severe according to the number of species or individuals that are directly affected. But, if this area was of functional importance within the landscape matrix for movements and migrations, for short-term establishment of small populations or as hiding place against predators within an open landscape. The effect of this loss will also influence the surrounding matrix and neighboring patches of a similar kind.

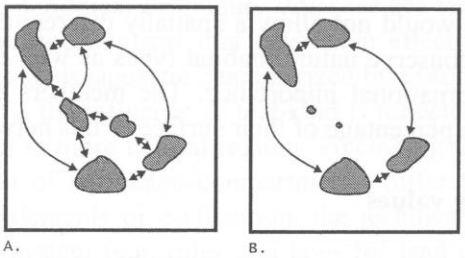

Figure 7.7-6: Temporal change in functional connection and network. At time A there is strong exchange between patches. At time B reduction of two central elements leads to the isolation or exclusion of small elements (e.g. populations) and a weak exchange (e.g. gene flow, individuals, pollination). Stepping stones loose their function beyond certain threshold values for minimum area

The functioning of landscape elements depends a lot on the **connectivity** (see Chapters 2.3.7 and 2.8.4) between patches of the same type. Connections can be spatial, temporal or just functional. A **system of biotope connection** must consider four decisive qualities (after Jedicke 1994):

- large reserves that function as a reservoir for species (this has to be designed on the basis of the requirements of the most demanding species),

- stepping stones between isolated habitats (they serve as temporal refuges during the migration of species),
- corridors to promote migrations and the transport of diaspores, and
- reduction of land use intensity within the landscape matrix.

The attraction of this concept appears to be somehow dangerous as well. It supports the impression, that we have sufficient knowledge to manage biodiversity and to preserve species. Perhaps networks will contribute to improve the population structure of certain species. Which one? That one that we will select? Do we really know enough to design such systems for the entire species pool of landscapes and regions? It has to be kept in mind that the capacity of vectors not only depends on spatial circumstances. Vectors may be spatially concrete (hedgerows), but not necessarily. They may also use certain media (wind, water) or other organisms (birds) that can easily trespass the distances between isolated patches.

The German Federal Agency of Nature Conservation (2000) has the political target to preserve approximately 10% of Germany for nature conservation networks. Within the European Union since 1992 the so-called **"Fauna-Flora-Habitat"-directive** of the council of the EU has to be implemented that concentrates on the establishment of a coherent ecological network of special areas of conservation ("Natura 2000"). The term "fauna-flora-habitat" is a little bit misleading, as the biological definition of habitat is always species-related, each species has another habitat that overlaps with others, so that this would not allow a spatially discrete planning. However, the network shall conserve natural habitat types as well as animal and plant populations of international importance. The members of the EU have to contribute a certain percentage of their surface to this network.

7.7.6 Competing values

Nature conservation as a normative discipline integrating societal needs and wishes. Aesthetic and ethical values play an important role in nature conservation. In addition to this economic aspects will influence nature conservation as well. The costs and the benefits of nature conservation have to be analyzed, but the economic value of nature itself is not already really known (Montgomery and Pollack 1996, Pearce and Perrings 1995).

At this point, we have to draw a clear line between natural sciences and nature conservation. Competence in this field is not restricted to scientists, when economic, ethic and aesthetic arguments count as well. Decisions have to underlay a democratic process. Landscape ecology can contribute facts for decisions and analyze consequences and success of conservation management. Nevertheless, it cannot make the decisions (see Chapter 7.2).

To be normative, is generally also true for other land using disciplines, such as agriculture or forestry. But, their norms are clearly economic and therefore easy to measure and to evaluate. In nature conservation a variety of different, and in some cases opposing, standards and value systems exist. One action or management technique might be beneficial to a specific aspect but detrimental to another one. Therefore, decisions require, even within nature conservation, communication and perhaps mediation to identify a common strategy. This field of evaluation is crucial for nature conservation. The conservation value might differ a lot depending on the selection of objects and criteria. The weighing of certain criteria, however, has to relate to the individual landscapes where they are applied.

The selection and the evaluation of specific natural qualities has to be done in a way that can be proved by others. As there will be never be absolute objectivity but only inter-subjective agreement about the decisions to make, this is an important fact.

7.8 Historical landscapes and landscape elements

7.8.1 Introduction

Landscapes are changing and have always been. These changes can be gradual or sudden, periodical or unique. What we see today, is the result of many processes and mechanisms that have been effective during different time periods. Thus, landscapes are characterized by historical influences (see Chapter 4.1). Today, the influence of mankind is reflected in agro-industrial landscapes but also in more natural regions. According to the degree of human transformation of landscape compartments, differentiating factors are the duration of settlements or civilization, the technical knowledge of the society, the social system (e.g. rules and laws for land ownership) and the economic standard of living (Simpson and Christensen 1997). Nevertheless, the contribution of historical human activities to recent conditions and landscape properties differs a lot between landscapes.

In former times, human influence was affecting landscapes and ecosystems at other spatial scales than today and than expected for the future. Pollution and globalization are affecting landscape processes with an increasing speed and magnitude. Besides problems in species adaptation, such processes often result in accelerated within-system turnover rates, as regards species composition, nutrient, water and energy cycles. System and landscape change is faster today, than this has been in the past (Figure 7.8-1).

Landscape evaluation has to be related to both the current and the historical background. This chapter concentrates on the historical influence of

mankind on landscape properties and on resulting implications for nature conservation. It will highlight various qualities of human impact and outline their historical role. Based on the understanding of historical processes and their effects on landscapes, we can detect and evaluate historical landscape elements and develop tools for landscape management and preservation.

Testimonies of historical land use forms and of human constructions are widespread in landscapes. Some of them are obvious and abundant, others are inconspicuous and rare. Some of them are still used and further developed, others are abandoned, ruined or decayed. When aiming at protection of historical remnants of land use or of other human activities, the major problem nowadays consists of defining the appropriate temporal scale of reference, and to identify modifications of a certain status that reduce its conservation value.

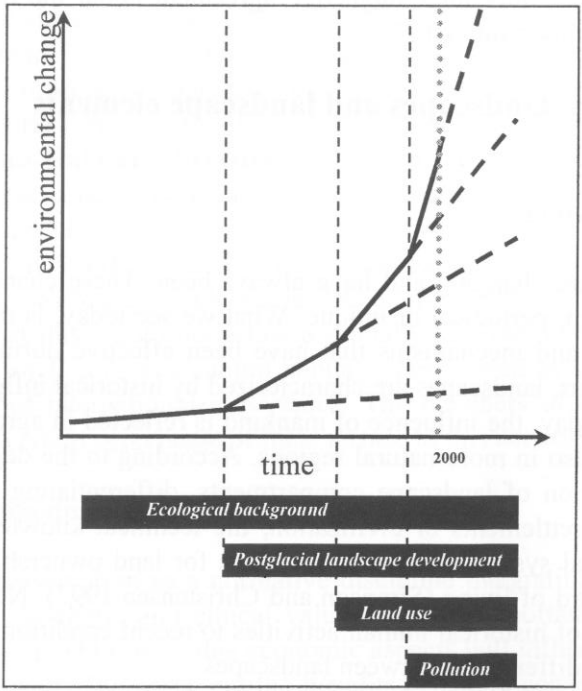

Figure 7.8-1: The velocity of environmental change has been modified by regimes of processes induced from the natural environmental background and by human impacts to the biosphere. Natural processes have been contributing to a much lower rate of change than anthropogenic processes

7.8.2 Relief and water bodies

Human have modified the surface of the land aiming at a better framework for land use, infrastructure and settlements. The change of land surface goes along with a redistribution of materials, such as substrate or stones.

Anthropogenic infrastructure has left traces in landscapes long ago, and relicts can be found even in forest areas with no current roads. Man always tried to find the shortest or most convenient way for travelling between villages. Speed was restricted by horses or cattle used for draught. Slopes were not completely avoided. The animals were strong enough to trespass them and other options would have taken up to much time. As a result, steep roads developed, that offered the starting point for channel erosion. These roads eroded consecutively deeper, until they were abandoned and re-established parallel to the former one. Today, we can find remnants of such infrastructure everywhere in hilly or mountainous areas across Europe. In many countries of the southern hemisphere such roads are still in use. Other infrastructure elements of historical origin, such as railroads and canals or ancient bridges, are more obvious in their impact on landscape structure. In many cases, old infrastructure elements are out of use, but have regained romantic attraction, which allows to integrate them into the concepts of tourism (Figure 7.8-2).

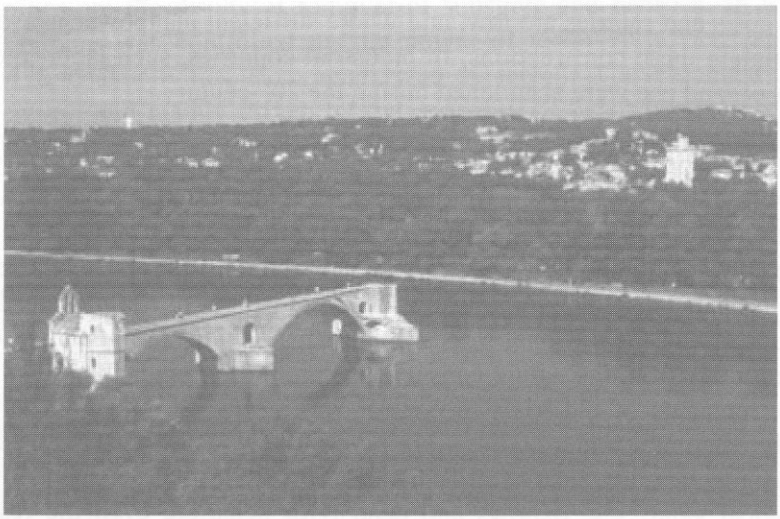

Figure 7.8-2: Old infrastructure elements can have a romantic attraction which allows to integrate them into concepts of tourism: The famous Avignon Bridge (France) (Photo: O. Bastian 1995)

Spatially more important are modifications of relief due to **agriculture**. They are correlated with tillage of substrate rich in skeleton and stones.

Ploughing of fields accelerates sheet erosion or wind erosion. Due to mechanical sorting during ploughing, stones are transported to the surface. To facilitate further cultivation, these **stones** were taken away and deposited at the margin of the field. Such margins developed frequently to hedgerows because this strip at the edge of the field could not be used. Nowadays, the relicts of former land use techniques, the deposits and hedgerows, became obstacles and were removed. This led to a loss of structural landscape diversity and to fragmentation. The creation of morphological variety was only a side effect of agricultural activities. Farmer were more interested in the compensation of morphological irregularities. At steep slopes, they tried to reduce the inclination to avoid soil erosion. This was leading to the development of **terraces** (Figure 7.8-3). In arid and semiarid regions, irrigation and the economic use of water was the major driving force for the construction of terraces with low or even no inclination at all. Another example for geomorphological effects of land use is the construction of **ditches** for drainage or irrigation. According to their function, ditches had different influence on the landscape. The drainage of mires and wetlands was the prerequisite for further cultivation. The reduction of soil moisture made these sites accessible. Some landscape elements, such as ditches for irrigation, required an immense effort for maintenance (e.g. "Wale" in Southern Tyrol, Italy). This was of minor concern in the past, and still is in developing countries, where labor costs and salaries are low, and where sufficient manpower is available to maintain these constructions. In industrial countries, such labor-intensive forms of land use were abandoned during the 20th century.

Other examples of historical landscape engineering are to be found in **riverbed regulations**. Smooth riverbanks were manipulated, natural dynamics were diminished, meanders disappeared. On the other hand, new constructions, such as wears and dams, were introduced, that reduced the landscape corridor function of rivers. These interventions did not only affect the river itself, but also the groundwater regime in valleys, the high water levels, the run-off and the seasonal floods. Such constructions are generally disapproved today from the nature conservation point of view. However, in some cases, remnants of old trials to control water flow are regarded valuable, mainly when new water bodies were introduced in connection with specific land use techniques, such as mill ditches. Some landscape elements of high ecological value, e.g. oxbows and dead river beds, are even the result of straightening and regulation of rivers.

Besides technical restrictions and high availability of manual work, also **ethnic and religious traditions** strongly influenced historical land use. In Central Europe, artificial ponds for fishery are concentrated in catholic regions, where the consumption of meat was forbidden during fasting periods. These ponds became important biotopes for water birds.

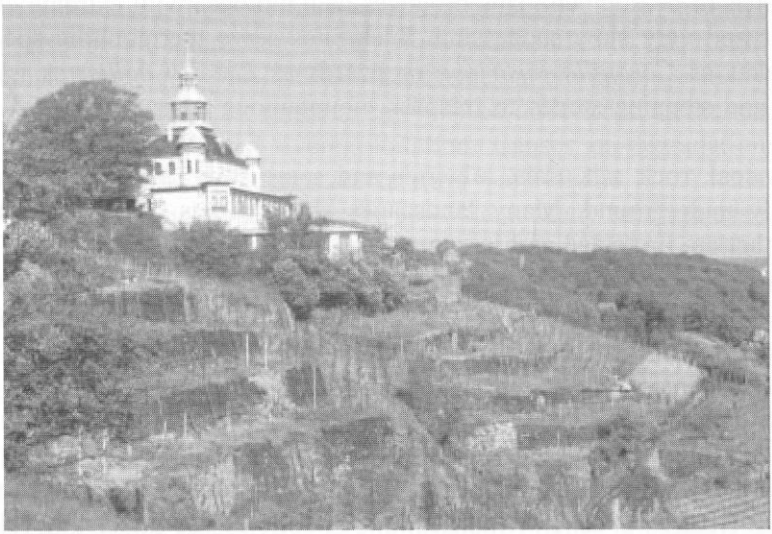

Figure 7.8-3: To compensate morphological irregularities, and to avoid soil erosion, terraces were developed: Vineyards at Elbe river valley slopes (Radebeul near Dresden, Saxony, Germany) (Photo: O. Bastian 1999)

In contrast to the redistribution of material, quarries, gravel pits and **open cast mines** are the results of removal of substrate and bedrock. In former times, mining was controlled by the power of technical advices and restricted to local activities. Here again, with the technical development of the 19th century, and mainly driven by the invention of vapor power machines and electric light followed by combustion engines, a new dimension of human impact was reached. Limits of accessibility and transport could be overcome and new landscape elements evolved. Open cast mining, for instance, led to a new dimension of anthropogenic landforms and biotopes. Some species found new habitats in such areas. Other could compensate the loss of natural habitats, such as gravel fields in braded rivers. The ascent of ground water is another factor that changes site conditions in open cast mines after the end of the exploitation. Lakes are forming and add landscape elements that were perhaps lacking in these areas (see Figure 7.11-2).

Quarries increase the ecological diversity in many landscapes offering habitats with extreme site conditions for various groups of species (birds, reptiles, amphibians). Depending on the composition of the bedrock and on exploitation technique, quarries may produce large amounts of debris and waste, which have to be deposited, scattered or piled up. Dumps of slate quarries are a prominent landscape element in the Central European metamorphic slate mountains ("Thüringer Schiefergebirge"). During slate exploitation, only a small portion of the bedrock can be used and 90% of the parent

material has to be dumped. This produces new biotopes with extreme environments and very slow succession. Such sites serve thermophilic species (e.g. snakes as *Coronilla austriaca* or lizards as *Lacerta agilis*) as island habitats and stepping stones to trespass mountainous areas with rough climate.

Hard coal, rock salt, ores, minerals and some sorts of rock are mined preferably underground. Many landscapes show **relicts of underground mining** that are protected and in some cases used as tourist attractions. The importance of such caves for winter quarters for bats is well known. Temperature and air humidity stay nearly constant throughout the year and offer frost free refuges for these endangered mammals.

7.8.3 Soil

Soils were also modified and reshaped by human activities. This is not as evident as changes in relief. Modifications of soils can be interesting relicts of former land use. We can deduce from soil profiles, which kind of historical land use has been applied, whether the site has been ploughed before, whether occasional burning occurred.

Most human activities that are documented in the archive of the soil were aiming to improve its fertility. **Fertilization** is mainly regarded negatively under the perspective of nature conservation, as it led to an eutrophication of ecosystems and landscapes. If the capacity of the soil to retain nutrients is low, then the input of organic matter (for instance as part of the historical German "Plaggenwirtschaft") will improve the cation exchange capacity. This import of organic carbon is combined with an export from other systems. In many cases, as a consequence, these sites will impoverish and degrade. Short distance transports within the field was practiced by the medieval ridge and follow management ("celtic fields", "Wölbäcker").

Even in the humid tropics, relicts of such management strategies with accumulation of organic matter in soils can be found. The anthropogenic "Terra Preta do Indio" soils are located in a matrix of infertile oxisols. These relictic soils can be managed in a sustainable way. They are very fertile although they are rather old (Pre-Columbian) and have developed under extreme tropical conditions (Eden et al. 1984). "Hot spots" of nutrient enrichment due to human activities can also be found in African savannah-ecosystems (Blackmore et al. 1990). Besides fertilization and the integration of organic matter, people tried to improve physical properties as well, such as infiltration, aggregation or compaction. Many of those activities are no longer practiced, but can be reconstructed by their effects documented in soil profiles. Soils that document these land use practices are of socio-cultural value.

In some cases, the **degradation** of soil functions and the loss of substrate may also be an interesting topic. Most heathlands are the result of non-sustainable land use. The "Lüneburger Heide" in Northern Germany, an area that is very attractive for tourists, can only be understood as the result of an ecologically non-adapted overexploitation. Causes of degradation are the export of biomass (living biomass or dead material and litter) without compensation of this nutrient loss to the ecosystem. Many land use systems concentrate on the cultivation of profitable crops on well suited arable land and on the improvement of such sites. Sites with low productivity then, are mainly used to take biomass and mix it with manure which is spread on more fertile ground. The long-term export of nutrients and carbon further degrades low productivity sites and emphasizes environmental differences.

Other causes of degradation are the induction of **wind and water erosion** by logging forests or removing vegetation structures. In dependence of relief and climate, different forms of erosion may predominate and create new landforms, which can have a certain aesthetic quality. This may be true for extreme degraded sites, such as badlands, but depends strongly on individual perception. Degradation generally restricts the options for future decisions and enhances specific land use types. Forms of use then may be adapted to reduced nutrient capacity or water retention of the soil. Again, such land use types, and the ecological knowledge that is reflected in them, can be landscape-specific and ought to be preserved.

In European landscapes, erosion was high during the late medieval time. From paleopedological investigations we obtain the information, that during approximately 50 years around the year 1350 excessive channel erosion occurred. This degradation went along with strong social and economic problems (Bork et al. 1998). As the eroded material has to be deposited somewhere, erosion creates new substrates. The thick layers of colluvial sediments of many European valleys were induced by human activities and corresponding intensive erosion within the catchments of the rivers.

7.8.4 Species, communities and ecosystems

Looking at species, and pondering about their role in historical landscapes, human influence becomes strikingly obvious. Species diversity in Europe is strongly connected with land use history and land use diversity. Plant communities developed as a reaction to regular agricultural activities. Some of these communities are depending on certain techniques and seasonal rhythms of land use. Even as early as in the 1960s, changes in the species composition of Central European plant communities on arable fields were noticed (Tüxen 1962).

The role that humans play for the **extinction of species** is an increasing one. This is not only true for Europe during the 20th century, but also for other continents and mainly for vulnerable island flora and fauna. For instance, the bird species diversity of Pacific islands was immense until the Polynesians reached the islands 4000 to 1000 years ago. A specific bird fauna had evolved on these archipelagos. Most birds were not adapted to predators. Despite its low technical standard, this civilization wiped out 15% of the global bird fauna (2000 bird species) (Steadman 1995). These historical landscape objects are lost forever.

The presence of man also plays a role for the **dispersal of species**. Traditionally, neophytes and neozoons are defined from an Euro-centric point of view with the discovery of the "New World" in 1492. Compared to pre-settlement species composition in Central Europe, much more species have been introduced from neighboring regions before and perhaps even after, as we do not have complete records on this process.

So, what are historical communities or species? Natives? Archaeophytes? Ruderals? And are certain neophytes, which have been introduced in former times, historical or not? In many cases, where the process of introduction is documented, we can distinguish between introduced species and natural species.

Introduced species are species which have been transferred from one region to another in a conscious and planned action. Introduced species may be seen as a problem, but on the other hand, introduced species may be valuable elements in historical landscapes (Abrams 1996) and correlated to specific land use types. Nearly all field crops and fruit trees are introduced. Here, the breeding of **ancient cultivars and varieties** is of interest which are replaced by more productive others. However, the preservation of intraspecific genetic variability is an important task for landscape conservation. This is also true for domestic animals, where local races became extinct in many cases (Figure 7.8-4).

Today, Central American pines (e.g. *Pinus radiata*, *Pinus caribea*) are widespread in tropical and subtropical regions of the world, if there is sufficient humidity. Eucalypt forests (e.g. *Eucalyptus globulus*) can be found everywhere in Mediterranean climates. Such introduced tree species replace natural ecosystems and strongly affect landscapes, communities, functions and processes of ecosystems. *Robinia pseudacacia* has become an integral part of the European forests. The species reproduces successfully and is a strong competitor under certain site conditions, altering soil conditions by its mycorhizal fixation of nitrogen. Many introduced species, which can be seen as a part of the local floras today, could be listed here.

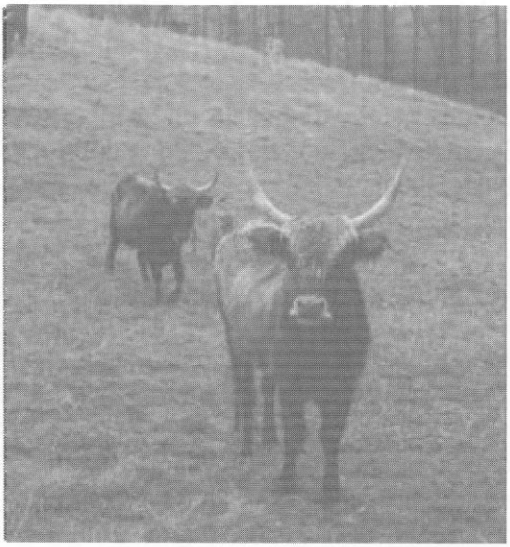

Figure 7.8-4: The preservation of old or local races of domestic animals belongs to the tasks of nature conservation, too: A cattle race similar to the extinct aurochs (near Döbeln, Saxony, Germany) (Photo: O. Bastian 2000)

7.8.5 Conservation of cultural landscapes and landscape elements

The specific traits of cultural landscapes are a high intensity and a long history of human influence (Haber 2001, Naveh 1995). Cultural landscapes, where social and economic interactions among people are reflected in the landscape context, exist in all regions of the world. They do not only include landscapes where resident human populations occur, but also landscapes with migrating nomads, when the influence of man is decisive for certain landscape conditions. One could ask, whether a landscape without human influence exists at all. Perhaps in some high mountain areas, in some deserts, in the Arctic, one will find landscapes, where humans did not change decisive qualities of the landscapes until now. Though, if one defines landscapes as regions with comparable environmental background and ecosystems and includes human activities into the concept, the term "cultural landscapes" becomes useless (see Chapter 1.1).

Changes in landscapes are directly correlated with the **development of human societies**. The preservation of a specific state is difficult to imagine, though. One could hardly select one certain time frame as historical, and suggest that this composition or structure ought to be restored. Modern approaches in landscape management rather aim at preserving natural variation within certain bounds.

Generally, the interaction between human influence and landscape pattern can be regarded as cause and effect. Then, human influence is interrelated with the occurrence of specific landscape patterns. Settlements for instance require drinking water, wind protection, arable soils, wood for burning, raw materials for construction and clothing. On the other hand, settlements influence landscape patterns, create specific anthropogeneous patterns and modify others. This occurs at different scales. We can regard anthropogenic land use as **disturbance regime** (Jentsch et al. in press). Such disturbance regimes have to be conserved for the protection of historic landscape elements or landscape structures.

The conservation of historical states in landscapes is an illusion, because the conservation of a certain status quo has to face global change. Neff (2000) has developed a deterministic model for vegetation dynamics in Mediterranean landscapes integrating perturbation and competition regarding space and light regime. Mediterranean landscapes are strongly modified by a variety of cultures over long time periods. Many sites can no longer reach former climax vegetation, because soil properties are degraded irreversibly. Also today, irreversible and reoccurring disturbances are part of these ecosystems. The diversity of landscape elements and species in managed landscapes is closely connected to the disturbance or land use regime (Szaro and Johnston 1996). If new disturbance regimes (or land uses) are introduced, species will need a certain time to react and to adapt. Under this assumption, the rapid changes of our recent landscapes have to be regarded critically. Then, the protection of historical structures is a tool to preserve species diversity and biotic resources in co-evolved ecological communities.

Birnbaum (1994) differentiates four types of landscapes according to **historical features**. The first landscape type can be associated with an historical event, a well-known person, or certain style of landscaping design. This category would contain parks, campuses, estates and recreation areas. The second category, the historic landscape or historic site, is a region that is associated with a significant historic event. Here, also battlefields and political locations would be attached. Historic vernacular landscapes are modified landscapes, where a certain tradition of land use or social behavior of certain groups of the society is practiced. This would address the largest parts of biosphere reserves, where traditional land use is an integral part of the preservation concept. Finally, ethnographic landscapes embody natural and cultural resources that an associated society or people defines as its heritage (e.g., sacred springs, mythological groups of trees, natural monuments).

Many landscape elements have a **special meaning to local people**. They are tightly connected to their mythology or history. Special trees or rocks (Externsteine in the Teutoburger Forest, Loreley at the slope of the Rhine Valley, Labyrinth of rocks at the Luisenburg in the Fichtelgebirge, etc.) at-

tract people and let them identify strongly with these landscapes. Even some national parks have been created, that focus on such extraordinary landscape elements (e.g. the national parks "Elbsandsteingebirge" and "Jasmund" in Germany, see Figure 4.1-2). The integration of archaeological sites of high value into concepts of landscape management is a further approach, that adds archaeotopes to valuable biotopes and natural monuments (Behm 2000, Figure 7.8-5).

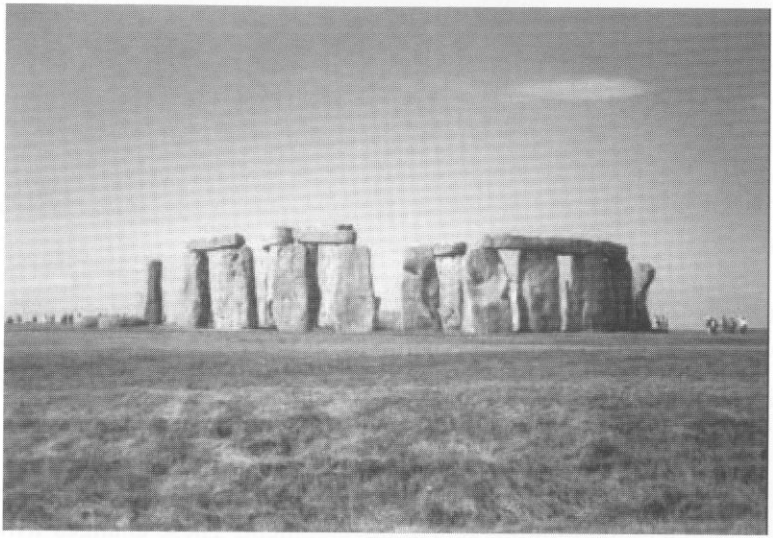

Figure 7.8-5: Landscapes can embody archeological and cultural sites being a heritage of the local people or even the mankind: The mysterious Bronze Age center of cult worship Stonehenge (England) (Photo: O. Bastian 1998)

The concept of historical landscapes, that consciously integrates the mythological importance of landscapes in peoples every days life, is considered a specific quality of protection in landscape planning (Hönes 1991). Recently, this approach has been extended to industrial landscapes (Kistemann 1998), that reached the conscience of the society mainly after the fall of East European socialist countries (Figure 7.8-6).

7.8.6 Conclusion

Human influence is all-pervasive in landscapes. It may not always be obvious, but it is rarely absent. If landscapes have evolved over long time periods together with human activities, these will be an integral and compulsory mechanism for the preservation of landscape functions and services. Human activities, such as landscape management and land use practices, affect and even create specific landscape elements. This is why the human factor can-

cannot be neglected in nature conservation. Mankind has contributed to the development of communities, ecosystems and landscape.

Figure 7.8-6: Recently, the protection of historical landscapes has been extended to interesting industrial areas: A conveyor bridge beat up in the closed lignite opencast mine "Bergheide" in the Lower Lusatian lignite mining region (Photo: O. Bastian 2001)

However, nowadays land use change is very rapid as a consequence of globalization and the rapid technical development. These changes will result in a loss not only of biodiversity, as most species cannot adapt as fast as necessary to the new environment, but also in a loss of land use types and techniques. This again, will change landscapes according to their aesthetic value and ecological function.

The conservation of certain historical aspects reaches a new dimension under this perspective. It is no longer a museum-like traditional and conservative approach (Behm 2001) but an important technique to support ecosystems and landscape elements with environmental conditions and disturbance regimes that respond to the species requirements, as most of our species have evolved in such systems. If we want to preserve our biotic resources, we have to manage landscapes not in a historical way, but integrate long-term evolved structures and elements.