



The Trail Planning Guide

An insight into the process
of planning interpretative trails



**Principles
and Recommendations**



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THE TRAIL PLANNING GUIDE

**An insight into the process
of planning interpretative trails**

Principles and Recommendations

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FOREWORD

Biodiversity is under serious threat from unsustainable exploitation, pollution and land-use changes throughout Central and Eastern Europe. Ecotourism while still at a relatively modest level of development in the region, provides opportunities as well as challenges for the sustainable use of biodiversity. Environmentally sustainable investments in the ecotourism sector could produce vital benefits to communities and provide an important and viable alternative to investments with negative biodiversity impacts.

The project "Conservation and Sustainable Use of Biodiversity through Sound Tourism Development in Biosphere Reserves in Central and Eastern Europe" will strengthen protection of globally significant mountain ecosystems in selected Biosphere Reserves of Central and Eastern Europe. The project is partly funded by the Global Environment Facility (GEF) of the United Nations Environment Programme (UNEP) and also supported by UNESCO. It aims at implementing the CBD Guidelines for Biodiversity and Tourism Development as well as UNESCO's Man and Biosphere concept.

This is being achieved through the development of new and innovative management systems with a special focus on tourism-related uses of the sites. Concurrently, awareness raising and capacity building systems are being developed and implemented, to ensure long term sustainable impacts. Tourism model initiatives and activities are being initiated to ensure distribution of returns for conservation purposes as well as to local stakeholders.

The "Trail Planning Guide" has been developed in the framework of the project. The document is a working document which will be used by the project partners as a guidance for a number of activities related to the design and construction of interpretative trails. At the end of the project, the project partners will compile a series of case studies on their experiences with the implementation of the principles and recommendations provided in the guide. The case studies will present practical examples of planning and design of interpretative trails in the environment of mountain areas in Central Eastern Europe.

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1 Introduction

1.1 About this guide

This guide was developed within the framework of the UNEP/GEF Project "Sustainable Tourism in Biosphere Reserves in Central and Eastern Europe" and contains information concerning the principles of planning for interpretative trails. It is not a detailed manual for technical guidance on trail construction, but a document which conveys some basic ideas about how to plan, design, construct, monitor and maintain interpretative trails.

The principles described in this document are only recommendations for key issues that should be considered when planning an interpretative trail. Each trail and its impacts on the natural environment depend on natural and social conditions, which differ according to the trails location as well as its purpose and how intensely it is used. It is, therefore, not possible to develop universal principles and criteria for every trail around the world.

Interpretative trails have many different purposes including information, education, recreation, safety and conservation of natural and cultural resources. Modern interpretative trails do not only provide information, but follow the concept of actively involving the observer in an interactive process of learning about and experiencing nature. Interpretative trails are characterized by their structured sequence of interpretative features. This sequence of features is carefully planned and based on a considerable amount of information provided through various means (tour guides, brochures, lectures, films, signs, displays, tapes, etc.). Interpretative trails are normally signposted and have information boards, numbered pegs with accompanying leaflets, interactive information stations or sensory stations. Interpretative trails may provide information on a wide range of topics (nature, history of civilisation, folklore, etc.). They are mainly found in protected areas but can also be placed in other areas, e.g. in an urban environment.

The information in this guide concentrates on trails in natural areas like forests and mountains and in particular on trails in protected areas. Modern interpretative trails, in these surroundings, aim to inform the user about the ecosystem(s) the trail is located in. They are a means to com-

The UNEP/GEF Project "Sustainable Tourism in Biosphere Reserves in Central and Eastern Europe" takes place in three Biosphere Reserves in Hungary, Poland and the Czech Republic.

Interpretative trails aim to raise the visitors' awareness for the natural surroundings of the trail as well as for environmental issues in general.

municate natural and cultural values and to raise the visitors' awareness for environmental conservation issues. Interpretative trails, especially those in protected areas, are designed to change the visitors' attitude towards nature by explaining the complex interdependencies of natural features, by pointing out environmental impacts of human activities in natural areas and by raising the visitor's appreciation for nature. In fact the overall aim of a trail system in protected and other natural areas is to regulate the use of ecosystems and natural resources in order to conserve biological diversity and to ensure the possibility for coming generations to experience nature. The development of interpretative trails in a region can also make it more attractive, therefore, retaining visitors for longer and improving the regions economic situation.

The requirements for trails in protected areas or other natural areas will differ depending on the type of area that the trail crosses, e.g. whether it is a national park, a Biosphere Reserve, a protected area or something else. The purpose of this guide is to provide principles for trail planning in natural areas, regardless of their protection status, which ensure that the natural environment is protected as well as possible and that the visitors' natural experience is enhanced.

1.2 Impacts of trails

One of the purposes of interpretative trails, as seen above, is to improve nature conservation, because of this trails should be planned carefully and in a way that minimizes their negative effects on the ecosystems as much as possible. If trail construction is not thought out carefully and its use is not managed properly, trails can have a number of negative impacts on the natural environment. A few examples of the impacts they can have can be seen in the list below:

- **The dissection of ecosystems**

Trails cut through ecosystems and habitats and by doing this disrupt plant and animal life. Trails are barriers for wildlife, for bigger animals as well as for smaller animals, e.g. reptiles, insects, etc. The effect of the impact of the barriers depends on the width of the trail, the width of the gap between the tree tops, the orientation of

Trail planning should consider possible negative impacts on the natural environment.

the trail (which determines the amount of sunlight and wind direction) and the material the trail's surface is made of.

- **The disturbance of hydrological conditions**

Trails increase the drainage of water from a territory. This can change the whole vegetative ecotype of a habitat, especially in ecosystems like wetlands and swamps. This increase in drainage also increases the risk of floods and the effects of dry seasons.

- **Erosion**

Water, as well as pressure from people walking on the trail, damages the soil, which in turn increases erosion, especially on hill-sides and along watercourses.

- **Change in the micro-climate**

Forest trails form gaps between the crest of the trees standing on both sides of the trail. Along trails, because of this gap, the range of temperature varies more than the temperature inside the forest. The higher levels of sunlight and the greater wind speed increase the dehydration of plants and soil. This can lead to a change in vegetation along the trails.

- **Direct damage to vegetation and wildlife**

Animals, especially small animals, can be trod on or run over and plants can be trod on or picked by trail users.

- **Increased danger of forest fires**

The increased dehydration of the forest makes forest fires more likely. These forest fires are caused for example not only through intensive radiation, but also by visitors' carelessness.

- **Pollution**

Nutrient input, litter and vehicle emissions pollute habitats. Noise from visitors can change animal behaviour.

- **A change in the vegetation**

Plants that favour habitats which are warm and sunny as well as pioneer species (species found at the edge of the wood) find fa-

vourable conditions along trails. Their dominance over other forest species can increase, which can in turn reduce the biodiversity of ecosystems.

- **Introduction of invasive species**

Trails are immigration routes for invasive species.

2 General aspects of trail planning

At the beginning of the trail planning a master plan has to be developed. This plan should define each different step of the development. This includes the trail design and construction, as well as the trail monitoring and maintenance scheme.

The development of the master plan is based on several preparatory steps: the inventory of the actual situation; the compilation of the legal framework; getting involved the local population, especially those who will be affected by the trail development; the identification of where the trails will be located and the completion of field research on the location's natural conditions. These steps are finally followed by the compilation of the master plan.

A SWOT Analysis may be helpful to prepare the master plan for the trail. The SWOT (Strengths, Weaknesses, Opportunities and Threats) is an effective tool for the preparation of planning processes. It helps to determine existing gaps, potentials and risks as well as to identify the desired options.

The planning and execution of the trail should be done professionally, in order to utilise experience gained from other projects. It is, however, also necessary and desirable to involve and interest the local population in the planning and execution of the trail layout so that they accept the idea, even welcome and understand the concept of the trail.

2.1 Integration into regional planning

Interpretative trails serve to enhance the visitors' natural experience and to communicate nature conservation concerns. To do this effectively, the

A SWOT analysis is a useful instrument for the planning process.

Planning of individual trails is integrated into regional management plans of nature conservation and tourism development.

whole trail network in an area should be taken into consideration when a new trail is planned and any interpretative trail development should be integrated into the context of regional planning, e.g. a tourism management plan. This plan should define concrete goals for the development of the region, identify the institution responsible for the planning and implementation of these goals and regulate the monitoring and inspection of the development's progress.

2.2 Trail networks

This guide does not look at trail systems as a whole entity but focuses on the planning of singular interpretative trails. Consequently, not all aspects of trail networks in natural areas are mentioned in the following section.

In many protected areas, the system of paths and trails, which were present before the area became a protected area, is usually taken over by the park administration and a new trail concept for the newly established protected area is often not developed. Old trails that were previously used for economic purposes (e.g. forestry trails) are often not suitable to be used for the purpose of nature conservation. They may also not be attractive enough to appeal to visitors. It is, therefore, recommendable to assess the existing trail network and to also consider the renaturation of trails.

Trails and other infrastructure, such as observation decks, can be used to aid visitor management. Visitor management aims to keep visitors on the paths and away from sensitive habitats. The more attractive the trails are; their surface, their tread width, the variety of landscape and the design and content of interpretation, the more successful they are at obtaining visitor management and therefore at stopping visitors from being tempted to wander off the trail. Nature-based activities like mushroom or berry picking, wild camping and rock climbing generally encourage visitors to leave the paths and need to be addressed in a specific way, e.g. through campaigning for a suitable behaviour when practising these activities or even, if not avoidable, to forbid them.

Planning for individual trails should consider the whole trail network of an area.



Image 1: Visitor centre at Babia Góra Biosphere Reserve, Poland, 2005

A common problem in natural areas is the concentration of visitors at a few "hot spots". These are attractive areas for excursions and often situated at locations which are easy to access. At these points the concentration of the number of visitors is normally high and their negative impacts often exceed the area's carrying capacity. On the other hand, however, the fact that the visitors are concentrated at only a few points of interest means that other areas receive less visitors and are therefore less disturbed. Unfortunately, there is no perfect solution to the problem of visitor concentration. It is, however, generally accepted that "hot spots" are tolerable (to a certain degree) if they are an acceptable distance away from the most vulnerable habitats.

Trail planning should consider the location of habitats of attractive species that are easy to access and can serve as exemplary observation models, so that other habitats can be left undisturbed. Trails, as well as all other infrastructure like parking areas, resting places and sanitary facilities should not be too near to sensible habitats. The density of trails in a protected area should also be considered. Enough space should be left between the trails to allow for some undisturbed habitats. The distance between the trails should be at least 1-1,5 km, depending on the characteris-

tics of the territory. The number of interpretative trails, hiking trails, etc. desired should be defined in the master plan for the trail network.

2.3 Preparatory Steps

The next sections look at the preparatory stages, which need to be completed before the master plan is started, in more detail.

2.3.1 Inventory

The first step, when planning a trail, is to decide on the topic of the trail, the communication methods and its general layout. To make these decisions, it is useful to take an inventory of the actual situation beforehand. This inventory should include information about the inherent natural features of the area, the required level of environmental protection and existing trails. Topographic maps and aerial photographs are useful sources of information for natural entities such as those mentioned above.

It is also important to identify potential users (hikers, bikers, cross-country skiers, etc.). To address the users' needs and at the same time regulate visitor flows effectively, information about the following aspects, *inter alia*, is needed:

- the type and number of visitors
- the distribution of visitors at different locations throughout the year
- which activities take place at which locations
- the visitors' expectations
- aesthetic and psychological aspects: how to attract the visitor's interest

The preparatory steps of trail planning are:

- *taking the inventory*
- *assessing the legal framework*
- *involving local people*
- *identifying the locality*

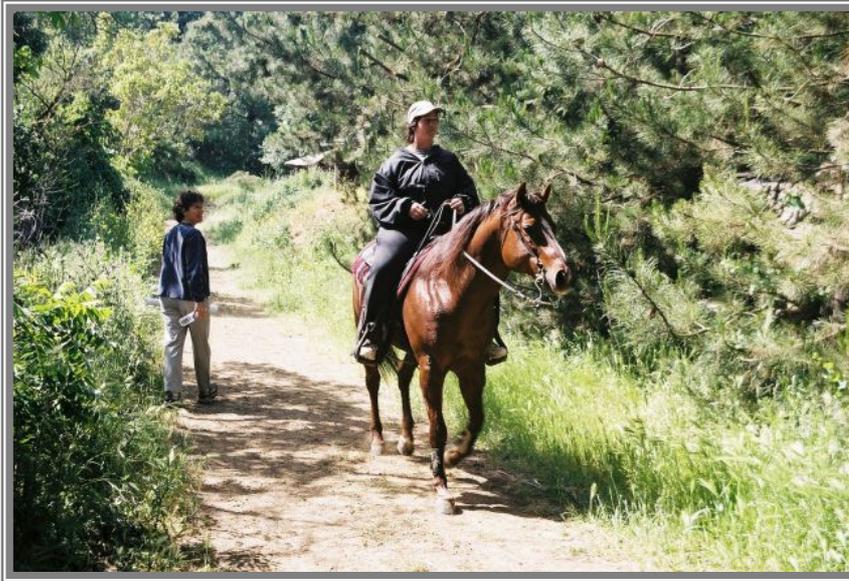


Image 2: Different types of users at a trail in Slovakia, 2005

Suitable methods for gathering this type of information for the inventory are visitor observations, visitor and stakeholder surveys or counting the number of visitors/cars at parking lots. The intensity of impact on a trail should also be examined and can be determined by looking at the purpose of the planned trail and the activities assumed to take place on it. These factors influence the carrying capacity of the path and also determine the design of the trail and the level of maintenance management that is necessary. It may be helpful at this point to look at best practice examples and lessons which have been learned in other protected areas. The construction and usage of each trail has an impact on the natural environment in wider surroundings (see introduction). Because of this when planning and designing a trail, all possible negative impacts within the wider territory along the trail have to be considered and should be mentioned in the inventory. Other entities which should be included in the inventory are: owner relations and the predicted demand for the trail in the future.

2.3.2 Legal framework and involvement of local population

Before starting construction the legal conditions, such as regional and national plans, laws and regulations as well as international guidelines, should be clarified. This is extremely important if conflicts with the owners, the local population and/or conservationists are to be avoided and includes legal restraints concerning environmental protection and regional regulations involving construction and ownership. In most cases written commitments from landowners will also be necessary to ensure that the area will be made available for visitors and that future development may take place.

Not only legal conditions decide whether or not a trail is viable. Local acceptance is also extremely important if the trail is to be planned and constructed successfully.

2.3.3 Choosing the locality

The locality of the trail depends on the natural conditions, which determine the possibilities for the design of the trail according to the construction techniques, the topic of interpretation, user groups and safety aspects.

Before choosing the location for a trail places of interest (e. g. sites with high biodiversity or rare natural elements) and sensitive, problematic or dangerous areas, should be determined. It is also extremely important to identify or determine the habitats of species that may be affected by a more intensive use of its territory. Favourable and problematic sites for trails are discussed in chapter 5.3.

After identifying an adequate locality, the carrying capacity has to be determined. This can be achieved by looking at the purpose of the trail and the activities which are planned on it.

In order to avoid conflicts within the course of the project, legal preconditions as well as the opinion of the local population must be taken into consideration.

2.4 Development of a master plan

2.4.1 Design, construction and maintenance

The design and construction of a trail are the most important parts of the master plan. They include almost every technical, aesthetic and interpretative factor, such as the topic of information, the method used for disseminating the information, the dimensions of the trail, the format of signs and boards, etc. These factors are all explained in more detail in the following chapters. Possibilities for interpretation topics and communication methods are presented in chapters 3 and 4. The technical, functional and aesthetic factors of trail construction will be specified in chapter 5 and the designing of signs and boards in chapter 6. Chapter 7 discusses the methods and the frequency of monitoring and maintenance.

All important features of the trail are specified in the master plan.

2.4.2 Financial calculation

Finances and their calculation are also parts of the master plan. It is necessary to calculate the finances for building, reconstructing, using and maintaining a trail before development begins. This calculation should include the costs of planning and preparation, materials and construction, maintenance and also the costs of environmental protection. Potential expenses for informative materials (information and advertising) should also be taken into account.

Trail designs and construction procedures that are considered to be environmentally friendly are usually more expensive than those that have negative impacts on the environment. It is advisable to wait and get suitable funding for environmentally sound techniques, than to start building, reconstructing, using or maintaining the trail in a way that is damaging to the environment.



Checklist: General aspects of planning

Steps of planning a trail:

- Compiling the inventory
- Checking the legal framework
- Considering other regional plans
- Considering the existing trail network
- Involving local population
- Choosing the locality
- Calculating the finances
- Developing the master plan

3 Topics of interpretation

3.1 Topics of interpretative trails

Trails can be developed on a theme basis with each trail playing a particular role in a park's overall interpretative program. Themes can focus on different aspects of the environment, for example, wildlife, plant life, man's effect on the environment, etc. Other trails can represent various ecosystems found within a protected area. A trail can illustrate pond life or forest succession or it can deal with the interpretation of complete biophysical units or patterns of these units, e. g. lowlands, uplands, alpine zones, etc.

Interpretative trails may also emphasize unusual aspects of the environment which are not usually taken consciously into account by visitors, e.g., the feeling of different types of vegetation, rocks and soils; or the sounds and smells of nature. Trails which communicate this type of sensory information are particularly rewarding for individuals with visual or hearing impairments.

Interpretative trails should address the widest possible range of visitors. Always keep in mind the fact that visitors are generally not experts and choose themes which:

- Interest a wide range of people
- Address both adults and children
- Can be understood without previous knowledge
- Concern the visitor personally

Interpretative trails are often most successful if they incorporate key features or highlights e.g. water falls or a specific species of tree. These create an initial impression of the trail, provide the visitors with a point of reference and stimulate curiosity and interest. Such features can often be enhanced through the use of man-made elements such as boardwalks and viewing hides. Trail names, e. g., "Fish Leap Trail" or "Giant Pine Trail", can draw the visitors' attention to these key features.

Planning of self-interpreting trails should include careful selection of media to ensure that the interpretative potential of the trail area is fully utilised.

Topics addressed in the trails should be in line with the overall vision of the protected area.

To attract the visitors' attention it might be helpful to emphasise unusual aspects of the environment, to integrate highlights or to give intriguing names to the trails.

3.2 Examples for topics

Interpretative trails cover various topics concerning natural or cultural heritage. Some of these topics are mentioned in this section.

- **General nature or education topics**

focus the visitors attention on scenery, history, geology, forest management, ecology, wildlife, wildflowers, flowering shrubs or landscape features such as bottomlands, uplands, swamps or wetlands.



Image 3: Interpretative trail in Aggtelek Biosphere Reserve, Hungary, 2005

- **Conservation topics**

highlight conservation work and issues in a protected area and also show good management of natural resources. Points of interest could include conservation tillage, grassed water-ways, contour farming, forest management sites, vegetation plantings, gradual mowing and prescribed burning.

- **Soil or geology topics**

identify unique or subtle changes in the landscape by taking hikers past soil pits or profiles, rock outcrops, vegetation changes, eroded areas, slope changes and land uses that are affected by soil prop-

erties that cause difficulties, such as stoniness, drainage, slope, soil depth and fertility.

- **Water or wetland topics**

explore the force and impact of water by following streams, brooks, creeks and rivers. The water theme can be linked to other topics, such as soil erosion, water quality, watershed protection, habitats, fisheries, vegetation, productivity changes, sedimentation control and best management practices.

- **Forest stewardship or ecology topics**

exhibit the history of forest management and succession, the differences between natural and planted stands, differences in site productivity, impact of fire control and fire use, lightning strikes and fire scares, cutting history, species diversity, the identification of trees or plants, stand maturity, seedling development, differences between hardwood and softwood stands and the different ways that various forest types are used by wildlife.

- **Historical topics**

highlight points of interest including evidence of old homesteads, ornamental and exotic plants, drainage ditches that are mechanically or manually dug, turpentine pits, sites that show evidence of farm and mechanical crop production erosion, liquor stilling sites, fish weirs, old mill sites, sawmills, sawdust piles, old dams, roads, railroad spurs, cemeteries, mines, wells, springs, fencerows, rock piles and chimneys.

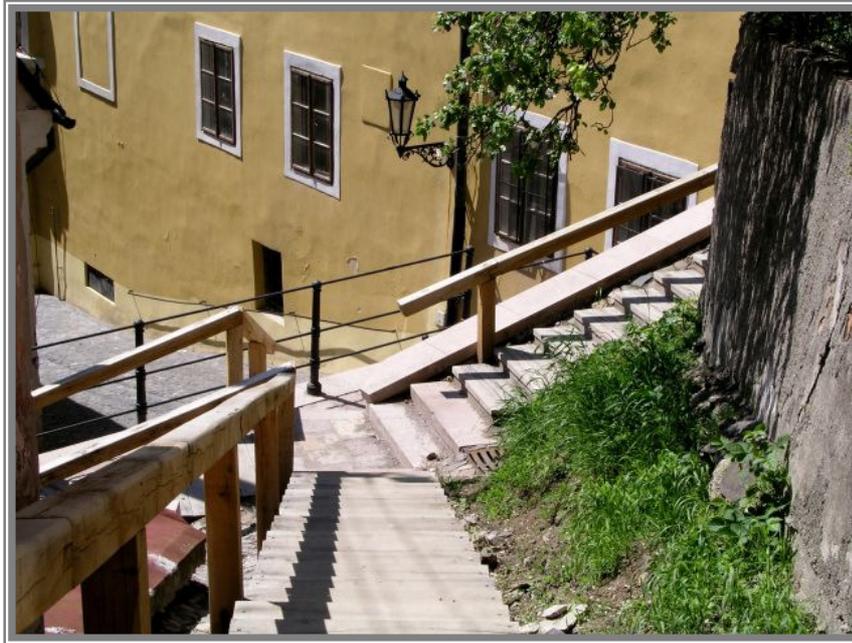


Image 4: Trail in the historic town centre of Banská Štiavnica, Slovakia, 2003

- **Wildlife management or wildlife observation trails**

explore animal tracks, dens, bird nests, artificial nest boxes and nesting structures, animals' homes, game bites, brush and cover piles, forest and field edges, vegetation plantings, prescribed burning areas, unique and critical habitat areas and wildlife tracks and routes of travel. Simple observation decks and hides can be erected to increase the enjoyment of the trail, especially around feeding areas. In these cases it is very important to consider the importance of nature conservation. In some cases it might even be better to substitute actual features with artificial copies.



Checklist: Topics of interpretation

Topics of interpretation should:

- focus on certain aspects of the environment
- interest a wide range of people
- address both adults and children
- be comprehensible without previous knowledge
- concern the visitor personally

Interpretative trails should:

- incorporate key features
- have a meaningful name
- emphasize unusual aspects of the environment

4 Communication methods

Choosing the method of communication is one of the most decisive factors in producing a successful interpretative trail. Communication methods for interpretative trails can be divided into descriptive, interactive and sensory ways of communication. The numerous types of interpretative trails also vary in their diverse and differing forms of execution and also in the way these forms of execution are combined. The most common communication methods and related tools used in modern interpretative trails are briefly described below.

4.1 Descriptive communication

Descriptive communication means transmitting information via text, graphics, tables, etc. One common type of descriptive communication trail are trails which use boards to convey information. They use information and diagrams and are structured in a way that is especially excellent for explaining how natural phenomena in landscapes, e.g. natural cycles, are interlinked. Information boards which are well thought out, can draw attention to themselves, communicate knowledge and stimulate the visitors

Communication methods can be:

- *descriptive*
- *interactive*
- *sensory*

Trails combining these methods are referred to as experience trails.

interest. Information boards are also advantageous because of their proportionately low costs and because of the fact that they are easy to maintain.

Numbered trails use a different type of descriptive communication. They are composed of different stations, pegs marked with numbers or symbols, which are placed at suitable points along the trails route. The various stations can be found with the help of a map in an information leaflet. This leaflet will contain the relevant information for each station. In most cases a leaflet can be a really useful addition to a nature trail. It can expand on the information offered by the trail and can also include material for which there is not enough room on the board. Leaflets can encourage visitors to get involved in other individual activities. In addition, different target groups can be reached on the same trail when specific leaflets are used. Leaflets, for example, with questions and puzzles for children can encourage real interaction with nature, while leaflets designed for the child parents, gives them more detailed information. Leaflets can be set out in various ways (specialised knowledge, suggestions for activities, directions for an experience-oriented nature trip, etc.). A well set-out guide can also be a real memento of an enjoyable hike.

It is very important to make sure that the visitor is informed about where they can obtain a leaflet. In some cases, for example, if there is no information centre close to the trail which is open regularly, another type of trail should be used. Another point to take into consideration with these trails is the fact that some people do not like to read, whilst they are walking.

The combination of information boards and numbered pegs and an accompanying leaflet has without doubt huge benefits. In this situation the most effective communication methods are being used simultaneously. On the one hand there are permanent information boards in place, which offer passing visitors basic information and on the other hand the accompanying leaflet can be tailored to show special features and to target different groups of people.

Descriptive communication transmits information via texts, graphics, tables, etc. They can be divided into

- trails with information panels and
- trails with numbered pegs.

Combinations are also reasonable.

4.2 Interactive communication

The information provided by interactive information stations on trails is not presented at first glance. Visitors have to be a lot more active to find out the knowledge they contain. This stimulates their mind and consolidates their knowledge in a more effective way than passive communication methods. A good example of an interactive information station is a board with flaps, where questions are posed, in order to arouse the visitors' curiosity but their answers are not revealed. The visitor should then look for the answers themselves creating a more active approach to learning than descriptive communication. The visitor can compare the conclusions he reaches with the actual solution simply by opening the flap. Interactive information stations can also be used in a way which gradually dispenses information with the aim at giving the visitors the information piece by piece. This keeps their interest and means that they do not get overwhelmed by a lot of information all at once.

4.3 Sensory communication

This type of communication incorporates the senses, which can increase the natural experience dramatically. Sensory stations, unlike the communication of interactive information, promote the theory that in order to increase your knowledge of the natural surroundings, a deeper understanding and experience of nature is necessary. As many of the senses as possible should be encouraged. The visitors hearing, for example, should be stimulated through the acknowledgment of different sounds, which are specific to the woods. By raising their awareness of sounds in the woods the visitors should learn to sharpen their ears and listen to nature. The sense of smell is noticeably underused in our civilisation. A scent station allows visitors to smell a range of natural smells and in doing so teaches them just how difficult it is to identify specific smells.

Trails following the interactive communication model offer their information either step-by-step, or in a way that calls for the active participation of the visitors.

Sensory communication models promote the direct understanding of nature by the use of all five senses: hearing, touching, tasting, seeing and feeling.



Image 5: Nature experience trail in Aggtelek Biosphere Reserve, Hungary, 2005

4.4 Experience Trails

The aim of an experience trail is to give information and to sharpen perception of the surrounding area. The experience trail consists of a combination of interactive information stations, sensory stations and information boards and uses the three ways of communication. The advantages of each type of communication are combined, so that the natural experience is experienced on many levels all at once and is therefore more effective.

The communication of information should be interesting and appealing and as interactive as possible. Every experience trail should have a central theme and should follow a standard creative line. A person should be able to gain a greater understanding of and a greater sensitivity towards his/her surroundings through the interactive communication of knowledge, sensory perception and beautiful images.

Experience trails combine all three elements of communication.



Checklist: Communication methods

Descriptive communication methods transmit information via text, graphics, tables, diagrams and pictures.

Interactive communication methods stimulate an active way of learning and lead the visitor to find out about things themselves.

Sensory communication methods incorporate the visitors' senses: seeing, hearing, smelling, tasting and touching.

Experience trails combine all three methods.

5 Design and construction of the trail

5.1 Factors influencing the trail design

The design of a trail, which encompasses not only technical but also aesthetic and interpretative aspects, is influenced by many different factors. The funding available for planning, construction and maintenance is one of these factors. It influences the choice of materials, the length of the trail and many other functional and aesthetic factors. The local population sometimes has a certain interest in the way the trail is designed. This interest can include all the stages of trail planning, from planning the trail's surface to designing the information board.

Ecological conditions, which affect the character of the environment, the possibilities for terrain adjustments, the biodiversity and the status of protection, also have a strong influence on the design of the trail.

Another important aspect are the type of user, their interests and their fitness. A trail, for example, for expert hikers, skiers etc. of whatever age will differ significantly from a trail intended for people with either little experience or ability or limited strength and endurance. If possible, a variety of trails with differing conditions should be provided. These should include trails that are easy to use and also trails which have a high degree of comfort and safety.

Another difference which often occurs between users and that will also affect the trail design is the key interest of the people that use the trail. For some user groups this may be the physical activity which comes with using a trail, e.g. the challenge of rough hiking or the thrill of movements on a ski or bicycle trail. For other users the main interest may be interpretative and aesthetic aspects, e.g. learning about nature, viewing scenery or experiencing solitude.

Functional requirements are concerned with the ease of movement on a trail, the accessibility for disabled people and the comfort and safety provided by trails. These aspects determine e. g. the length and width of a trail, the radius of curves and the extent to which the surrounding vegetation is cut off.

The trail design may be influenced by:

- *funding resources*
- *ecological conditions of the area*
- *interests and abilities of the user groups.*

Aesthetic factors are also an integral part of the trail experience. Aesthetic requirements are connected to those aspects of trail use related to visual, emotional and intellectual stimulation. They are a very important part of the planning process because they are the main attraction for many people. Trails should; therefore, incorporate aesthetic requirements which are suitable for a number of different target groups. The success of every trail will depend to some degree upon the quality of the aesthetic experience.

While aesthetic considerations will be more important on some trails than others, this aspect should be given special attention in the planning of all trails. Even on service-oriented trails, i.e. trails linking facilities and activity areas, aesthetic quality will contribute to the visitor's experience.

5.2 Types of trail layout

This section deals with the different types of trail layout which can be used for an interpretive trail. When choosing a layout, careful assessments should be made to determine which type will best suit the particular needs of individual trails. The appropriate type will depend upon the visitors needs, as well as on the relief and natural features found along the trail. The following types are commonly used in trail design:

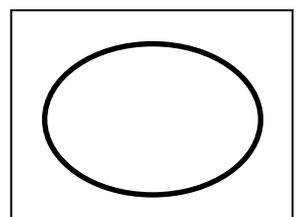
- **Linear type**

The linear type is commonly used for long distance trails for goal-oriented trails or for providing connections between facilities such as parking lots and swimming areas. Different sections or spurs can be added to linear trails to allow for a greater variety of experience. One way trails are recommended not only for safety reasons, but also because the information boards, generally follow one from one another thematically, so it makes more sense to guide the people in one direction only.



- **Loop type**

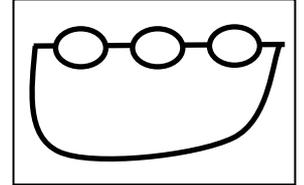
On recreational trails, where users will be led back to the original starting point of the trail (campground, parking lot, etc.), the loop trail is preferable. It is more attractive because users do not have to retrace their steps and also because less physical impact is felt



on the trail and its environment. This loop type layout is also the most suitable layout for self-interpreting trails.

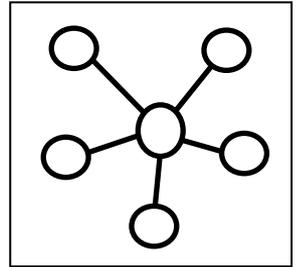
- **Stacked loop type**

This main shape of this trail type is a loop. Within this loop, smaller loops can be found which are stacked up next to each other. This arrangement offers opportunities for a variety of travel distances and terrain conditions.



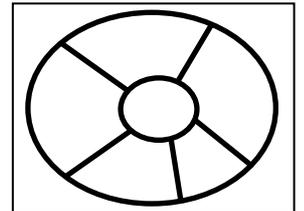
- **Satellite loop form**

This design creates a wide range of alternative trails. The central loop acts as a collector and the satellites are placed around this and can offer differing terrains, levels of solitude, interpretative themes, etc. Satellite loops also increase the likelihood that the trail will be used again because the alternate loops can be used on subsequent visits.



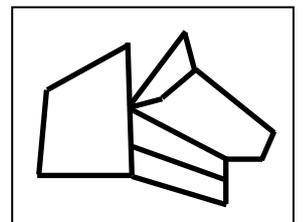
- **Spoked wheel type**

This type offers a wide range of alternatives for the trail distance. Users who become tired can use a “spoke” at a number of different places to turn back to the starting point.



- **Maze type**

This arrangement makes the maximum use of an area by letting people “explore” their own routes. A great variety of terrain conditions and distances can be provided with such a design. It is, however, important that such trails are well marked (names, directions, distance) to prevent people from becoming lost or from over-exerting themselves.



5.3 Location of trails

5.3.1 Sites favoured for trail placement

The following features and sites are important for choosing an appropriate trail location:

- Special historical, ecological and natural features
- Scenic views
- Natural clearing
- Natural contours, such as those along terraces
- Seasonal differences and experiences
- Access to and a view of water bodies or streams
- Light brush and vegetation conducive to easy travel
- Well-drained soils
- Natural drainage, such as side slopes and gently rolling terrain
- Safe road, railroad and power lines crossings
- Good access from car parks or for public transport
- Minimal conflict with existing land-use or management activities

5.3.2 View points along the trail

A trail should, where possible, provide different views from a variety of heights, which should be safe for the visitors. High positions, such as hill-tops and ridges can provide striking panoramic views and enable the users to orientate themselves to the overall landscape. Lower points increase the sense of enclosure and the users' attention becomes more focused on the details of the landscape.

Trail character and scenic interest are strongly influenced by natural elements found along the trail. These elements include:

- **Water:** streams, rivers, lakes, rapids, waterfalls (large and small), pools, etc.,

Trails should lead the visitors to natural highlights of the area without neglecting the safety of the visitors.

- **Vegetation:** outstanding specimen (size, form, rarity), interesting bark textures, leaf colours, etc.;
- **Land:** landforms, geological features, cliffs, crevices, caves, rock outcrops, etc.
- **Scenic views:** where a trail approaches a feature of interest it is more effective if several views are offered.

When designing a trail another aspect to consider is the interdependence of the visual stimulation and the interpretative aspect of the trail. As often as possible the information points of the interpretative aspects of the trail should be placed at locations where there is a good view, thus combining the two experiences.

5.3.3 Problematic sites

For safety, environmental and economic reasons try to avoid locating trails at:

- **Localities with a tendency towards erosion**

The trail shall not cross localities that have a tendency towards erosion, nor shall they be built in places where they cause too much erosion. If it is not possible to avoid these areas, however, it is necessary to drain surface water (from melted snow, rain, etc.) away from the trail so that it does not destroy the topsoil and increase the trail's depth. Trails which are, unwisely, built on steep slopes can end up becoming a channel for surface water, which erodes the topsoil and damages vegetation. Methods of trail design and maintenance to avoid erosion are described in chapter 5.

Trail constructions in areas vulnerable to erosion should be avoided. If not procurable, stabilising measures have to be taken.



Image 6: Erosion at a trail at Sitno Mountain, Slovakia, 2005

- **Rivers, streams, lakes and wetlands**

The trail should not run along the banks of streams, lakes, wetlands, frequently flooded bottomlands, areas which are wet and flat with poor drainage constraints etc. This avoids the disturbance of rare riparian biotopes and the erosion of banks. Instead natural corridors that are further away from the bank should be used.

The trail should be separated from the water by a strip of vegetation of appropriate width. Direct access to the water should be made possible by using turns from the trail adjusted for this purpose and at resting points or special sites created for watching the wildlife.

The trail should only cross rivers/streams, lakes or wetlands if it cannot be avoided. A suitable crossing should then be located at an appropriate place. A bridge/ford should be placed vertically across the river at its thinnest point, not in curves or places with unstable banks and the way leading to the bridge/ford should be adapted to the mode of travel and the speed of the users. The number of crossings can be reduced by the appropriate routing of

Because of water flow (erosion) and sensitive habitats, trail constructions along watersides should be avoided.

a trail (e.g. several loops on both sides of the stream with one bridge).

The trail may pass through an area that becomes flooded when the water level is high. In such cases, this fact should be taken into consideration and the construction of the trail should be adjusted a



Image 7: Trail crossing a creek in Šumava National Park

If it is absolutely necessary to take the trail across swampy areas, footbridges and wooden paths should be placed above the surface level.

- **Steep slopes**

The trail should not be built at vertical and/or acute angle to contour lines. This will avoid steep descents or ascents. Serpentine or stairs should be used if steep inclines are unavoidable.

Serpentine decrease the incline ascent but make the trail longer. The radius of the curves should differ depending on the mode of travel on the trail. The curves should be placed at stable places (with suitable topsoil and vegetation) along the trail and should be created in the flatter places. Wooden steps (separate stairs) can be built into serpentine to reduce the incline and also the likeli-

hood of erosion. The construction of stairs can just involve placing simple stone steps on the ground or more complicated stairways with railings placed on pales above the ground. They should be constructed from natural, if possible local material. The disadvantages of stairs are the costs of construction and maintenance, that they can be eyesores, etc.

Barriers (rocks, stones, logs, girders, wooden fences, etc.) can be useful for preventing shortcuts. Benches and interpretation panels can also be placed in curves; motivating the user to come right up to the curve where they can take a rest, learn something new or admire the view.



Image 8: Wooden construction and stone stairs on a trail at Sitno Mountain, Slovakia, 2005

- **Valleys and slopes**

When building a trail the bottoms of valleys, especially those containing watercourses, should be avoided so that their important and sensible habitats are protected. Trails should run along one

side of a valley only. This allows animals to retreat to the other side if necessary. Trails shouldn't run diagonally across slopes or along the ridge of a hill for a long time, only for short stretches when access to view points is necessary. Hillsides serve as hiding places for animals and they often use the upper areas of slopes as resting places.

- **Trail crossings**

Trail crossings with public and other roads must be clearly visible and safe. Appropriate traffic signs should be placed on the road, and the intersection itself should be clearly marked.

The trail shall be located in a way that allows minimising intersections with other roads. If an intersection is necessary, it should not be located in a curve, on a descent or at the end of a descent and the crossing angle should be vertical. The trail's route onto the crossroad should be adjusted to the mode of travel: the higher speed transportation means (bicycle, cross-country skis) is used, the earlier it is necessary to clear vegetation off the area along the trail, to widen the trail, to notify the user in an appropriate way (signs, warnings) or to get the user to slow down (by using natural or artificial barriers).

- **Others**

- Areas of heavy vegetation which require excessive clearing, pruning and maintenance
- Areas with fragile vegetation or rare and sensitive habitats
- Archaeological sites, except when they are featured as a part of the trail
- Places where visitors may have adverse effects on wildlife or other resources
- Timbered areas subject to blow down, falling limbs or lightning.

5.4 Starting and ending point and direction of the trail

The starting/end points of a trail should be located at an area which is large and flat. This area is the perfect place for infrastructure (benches and tables, information panels, parking places etc.) of a sufficient capacity, which is required for visitors.

No steep ascents or descents should be placed or at least not visible at the beginning of the trail because visitors could be discouraged from taking the trail. At the starting point an information panel with a schematic outline of the trail, showing ascents would be appropriate.

The direction of the trail may be indicated by marking or numbering the interpretation panels, but also by laying the trail and its infrastructure in an appropriate way. Natural barriers, shapes of curves and crossroads, invisibility of difficult sections, etc. can help to lead the trail user in the right direction. The trail should also be equipped with schematic maps showing the visitors' position - "You are here". The presence of signs on the trail containing the distances (km) until the end is also a good idea.

Starting points of the trails should be carefully planned to optimise the distribution of visitor and to provide the necessary information about the trails.



Image 9: Resting area with a geology exposition close to an information center, with information displays at Sumava Biosphere Reserve, Czech Republic, 2005

If the trail is planned for quicker means of transport (such as bicycle or cross-country skis) and if the physical setting allows it, the trail should be build with two lanes. This will reduce the chance of collision.

5.5 Trail measurements

5.5.1 Trail length

At the starting point the length of the trail, as well as the time needed to complete the trail should be clearly marked. The optimum length for a trail will depend on the type of activity carried out on the trail, the level of interest in the topic, the abilities of its users and the conditions of the terrain. Bicycle and ski trails designed to take one day, should be longer than walking trails designed for one day. Trails for experienced hikers should be longer than trails for people who are less experienced or serious about their sport. Trails over rough terrain should be shorter than those over easy ground because travel will be slower and more tiring.

Shortcuts can make the trail more attractive for various groups of users (families with children, seniors, physically handicapped, etc.). The shortcuts should be convenient, clearly marked and should follow the same principles which apply to the entire trail, otherwise the visitors might create their own shortcuts which do not take the principles into consideration.

5.5.2 Grades

The grade or slope of the trail is the most important factor to consider in the design and layout of a trail. It influences the length of the trail, its level of difficulty and its drainage as well as its maintenance requirements. The ease of movement along a trail and the comfort and safety of trail users will be also be affected by steepness of grades as well as the length of sustained grades and by the proportion of uphill, downhill and level sections of the trail. If these factors are not considered carefully the trail use will be less enjoyable than it should be and in some cases it may be unsafe.

In general it is advisable to avoid creating long sustained grades. Variation of gently sloping sections between steep climbs will give the user relief. Where slopes are very steep it may be more suitable to provide switchbacks, and steps or ladders on steep descents to protect the terrain against erosion.

The length of trails needs to be conform to target groups, terrain, and trail activities.

Grades are decisive regarding length, difficulty, drainage and maintenance requirements.

Switchbacks are the parts of a trail where the alignment of a trail traverses a slope in one direction and then abruptly "switches back" toward the opposite direction. Switchbacks are often used to run a trail up a steep slope in a constrained location. Although switchbacks are often the only solution to the problems such as rock outcrops and steep slopes, they should be avoided where possible. Switchbacks present an irresistible temptation to shortcut the trail and erosion is caused.

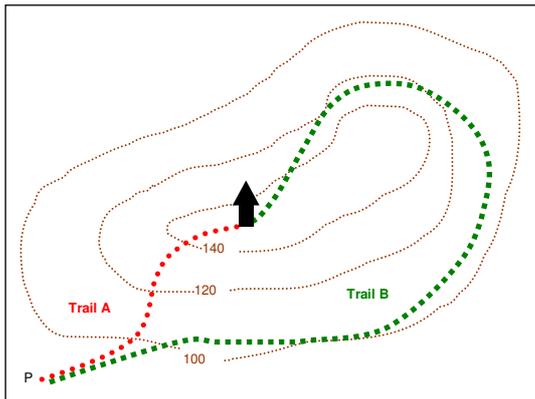


Image 10: Trails running perpendicular (A) or parallel (B) to the contours

It is recommended that the trails' slope follows a line that is more parallel than perpendicular to the contours. A contour is a virtual line of points that are at the same elevation. When a trail runs perpendicular to the contours, water runs down the middle of the trail, causing trenching. This occurs even with a 10% gradient. On a slope that runs parallel to the contours, less erosion takes place.

Requirements for grades, whilst planning the trail, can be set out as in the following example:

Desirable range of grades:	0 to 5 percent
Maximum sustained grade:	12 percent
Maximum grade for short pitches:	20 percent up to a maximum distance of 30 m

The trails' slope and inclination should ensure that water is directed away from the trail as soon as possible.

To determine these requirements, consideration must be given to the overall situation of the trail. If there are few steep trail sections it may be feasible to increase the maximum grade limit. If the trail is traversing the slope, the rate of its extent depends upon the slope's inclination as well as on the soil and vegetation conditions.

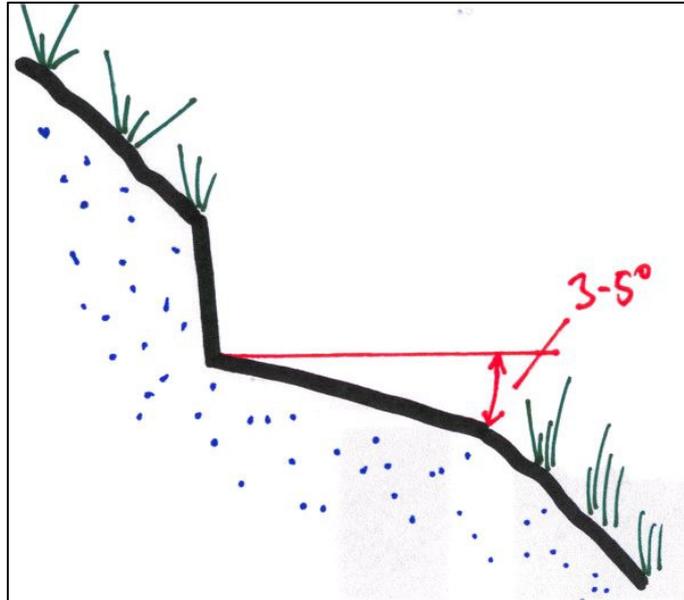


Image 11: Trail profile with downhill outslope of 3-5°

There are two variants for the way the trail is cut into the slope: full profile (full-bench) or the partial profile, where the trail is cut and extended to the full profile by using the cut material (cut-and-fill). Stones, logs or roughly plained timber are good for use in building supporting walls, where needed. It is important that these walls allow the out-flow/through-flow of water so that the water does not accumulate or so that it is not directed in the wrong way (mainly along the trail). Moderate deflection from the slope (3-5°) is important so that the water can flow away from the trail. This is the outslope of the trail. It is easiest to construct an outsloped trail if the original trail alignment traverses the natural slope.

5.5.3 Tread width

Tread width should be selected on the basis of the type of trail, the amount it is used, whether travel is one-way or two-way, the trail's appearance and field conditions such as topography, vegetation and the sensitivity of environmental resources. Bicycle trails for example, should

Tread width varies according to type and frequency of use.

be wider than hiking trails because of the greater speed of travel along them and the extra room needed for passing. Interpretative trails where tours take place, because of the size of the groups, should be wider than those which involve self interpretation. Wilderness and backcountry hiking trails should be narrower than casual walking trails to minimize the disruption of the natural conditions. Forest trails should be as narrow and as natural as possible. Narrow trails disturb the micro-climate less than broad ones and they are a smaller barrier for small animals. The nature experience is greater on narrow, natural trails.

Tread width should not always be the same. In rough terrain the tread may be narrow whereas in areas with fewer constraints (open woods, meadows, etc.) it may be wider. This variation is more economical and the trail experience also becomes more interesting.

In general, trails should be at least 0,5 to 1,5 m wide. Widths of 1,5 to 2,5 m are needed for pleasure walking and in areas with steep drop-offs. Trail width should also be appropriate to the slopes that the trail transverses. Multiple-use, natural tread trails and trails with two tracks should be designed as two-way paths. New cycling trails need 3 m of sealed surface. Paved sections of a multiple-use trail should have an optimum width of 3,5 m with a central stripe and flush gravel shoulders or clear space on either side of the trail of at least 0,5 m.

5.5.4 The clearing of vegetation

Vegetation should be cleared to enable safe and unimpaired movement along the trail but it should be kept to a minimum. Clearing should be supervised by persons with a sound knowledge of plants so that only species whose growth is likely to block the trail are removed. Clearing should be determined on a case to case basis. This method takes special natural features and nesting periods into account. All hazards adjacent to and above the trail should be cleared. On narrow trails, for example, branches that may droop and block the trail, especially when weighed down by rain or snow, should be cleared back. On wider trails this is of less concern because there is more room for users to make their way between branches.

Clearing should follow the rule: as much as necessary but as little as possible.

The clearing width should be at least 1 m along the trail or 0,5 m on either side of the trail. In protected areas where fallen trees remain on the ground, just the piece of tree which lies on the trail should be cut out to demonstrate the fact that it is not a managed forest.

Small plants, turf and surface soil material should be left in the tread area when surfacing is not going to be applied, because they help to protect underlying soils and give a more natural appearance to the trail. Low growing shrubs and ground cover plants should also be left right up to the edges of the tread. Wherever possible, trails should be routed around large trees and shrubs or plants which have special values. On trails used by school groups, small clearings (turnouts) should be made adjacent to points of interest so that group instruction becomes possible. In these cleared areas all brushy vegetation should be cut flush with the ground.

Vegetation should be cleared to a height that will allow unobstructed head-room. For trails which are mainly used for walking at least 2 m is recommended and 2,5 to 3,5 m for bicycle trails. These measurements take the fact that branches will sometimes droop with the effects of the wind and rain into consideration. The predicted snow level should also to be taken into account for appropriate clearing.

Some arching branches over the trail should be left. If these are all cleared increased penetration of sunlight will encourage plant growth at the trail edges and extra maintenance will be necessary. Periodic maintenance and monitoring at different times of the year will be needed to, for example, prune drooping and ice- or fruit-laden branches.

5.6 Material of surface

In areas of heavy use, trail surfacing may be required. The natural surface of the trail (mainly earth) should be used to the maximum extent. At places which are critical, other appropriate natural material may be added (gravel, stones, wood, etc.).

The material used for building the trail should be local material, such as wood chips, bark or mulch. Natural and roughly-finished materials are best suited for use in natural environments and natural colours should be used. If feasible, recycled materials should also be used for the construction of

Trail materials should correspond to those of the area, so that the trails fit well into the natural surroundings.

trails. Opportunities should be looked at which allow the design variety, within constraints of the user requirements and the costs. Each bridge, stairway and section of surfacing, for example, need not be done in exactly the same way along a trail. Trail surface appropriate to the intended use should also be selected, which minimises runoff and erosion problems.



Image 12: Board walk on a trail going through peat lands at Sumava Biosphere Reserve, Czech Republic, 2005

If the surface needs to be hardened (e.g. for the use by physically disabled), solid but porous material (e.g. stone cover with sufficient space between stone pieces, gravel-grass surface, crushed rock such as limestone) should be applied. A classical asphalt surface is not recommendable in natural surroundings. Asphalt does not only impair the visitors' natural experience but asphalt trails also heat up more quickly, change the water drainage and are a hard barrier for small animals.

Materials used to cover areas of high-traffic and those which are sensitive will probably need to be replaced or replenished periodically. To discourage the hikers' trails for bikers, rough surface with stones etc. at the beginning of the trail are suitable.

In wet areas with seasonal or standing water, surfacing is generally not feasible. In these areas it will be necessary to use boardwalks, catwalks,

decks or log bridges to allow visitors to pass over, to provide access to the area and to minimise disturbance. Always provide handrails in deep-water areas and where the boardwalk height is greater than 0,5 - 1 m. Building detours either enlarges the trail or parallel routes are added, which means that the trail may intrude into surrounding biotopes, the top soil or vegetation may get damaged, etc. Sometimes it is better to drain the water or to lift the trail to the required height. Stones or beams may be used for this purpose. Gravel, wooden boards, footbridges, etc. may also be considered.

5.7 Trail infrastructure

The infrastructure of a trail can make it more attractive and enable it to cope with more users. There are two types of infrastructure needed for trail planning and construction. Firstly, there are the structures that are needed to make the way passable. These include: bridges, stairways and barriers, chains and ladders. Secondly, there are the service infrastructures, such as benches, sanitary facilities etc.

The same rules and regulations used for the trail design and its construction also need to be applied to the infrastructure: its design and construction. This means, for example, that the infrastructure should be built from natural and local materials.

- **Bridges**

The construction of bridges depends mainly on the width, depth and the rapidity of the water flow and also on the purpose and intensity of trail use, the mode of travel used on the trail and maintenance and financial possibilities. Bridges can be simple (planed girder placed over a stream) but also more complicated constructions (bridges with high loading capacity placed over wide rivers). If it is not possible or it is too difficult to firmly anchor the bridge into the ground, smaller bridges and foot-bridges can be tied at one end to a firmly standing tree. This also means that they can get be dragged by high water but not destroyed. Building bridges over large rivers should be constructed by a professional company.

Two types of infrastructure are necessary:

- *basic infrastructure (bridges, stairs, etc.)*
- *service infrastructure (benches, sanitation facilities, etc.)*



Image 13: Trail bridge in Cierny Balog, Slovakia, 2005

Service structures

- **Drinking Fountains**

Drinking water fountains should be installed on longer trails (at least every 8 km) and a sign should be placed at the entrance to every trail when potable water is not available, reminding users that they should carry their own drinking water.

- **Sanitary Facilities**

Sanitary facilities should be located at all trail access areas. The facilities should all be placed in a way which minimises maintenance costs and time and uses environmentally friendly techniques. Based on anticipated types of use and their volumes, sanitary facilities should be located, where necessary, along trails. The sanitary facilities should be fully accessible for handicapped people.

- **Benches**

Benches should be provided at regular intervals. These should be located at places with pleasing aesthetic qualities, e.g. viewpoints, and particularly at the end of any long uphill climbs.

- **Safety**

In addition to the various design factors that affect user-safety, such as steepness of grades and width of the trail, consideration should also be given to natural hazards that exist within the vicinity of the trail, e.g. cliffs, fast-running rivers and avalanche zones.

Suitable measures should be taken to reduce potential danger. This can be done by providing necessary safety features (barriers, railings, secure surfacing etc.) and by the careful location of the trail route. The planning team should carefully assess how serious the hazards could be to determine the necessary level of safeguards. Measures adopted should be adapted to the trail users' abilities and attitudes. Safety standards do not need to be applied to every trail. Wilderness trails or other trails for use by experienced people, for example, do not require the same degree of safety as trails that are intended for people who are less capable. Experienced backcountry hikers do not want to be pampered with "tame" trails.

Care must also be taken not to introduce too many safety features on trails meant for users with less experience. If there are railings and fences everywhere the character of the natural environment can be significantly downgraded. The user's common sense must be relied upon to a certain extent.

Along trails located outside of public parks and trails that pass through more remote areas or private land, consider installing solar-powered emergency telephones at regular intervals.

5.8 Recommendations for work on trails

If working on a trail:

- Try to use local materials as well as local workers and companies for building or reconstructing the trail. By doing this, the amount of transportation is decreased, protecting the environment from pollution and disturbance and stopping the income of vegetation that is not native, and also more money flows into the local economy (this is especially good for poorer rural areas).
- Include old paths where possible (good value, no new inroads into the landscape) and build new paths only when necessary (leading directly to objects worth seeing; minimizing damage caused by traffic through the forest).
- Occupy the smallest area possible for work. Before starting, outline (maybe even mark out) the area in which the work should be carried out and make sure that the workers do not go beyond it (route of trail, etc.).
- Use hand tools (axes, saws, shovels, hoes, scythes, etc.) instead of machines for building, cleaning and maintaining the trail. The use of heavy machinery should be limited to places and time periods where/ when as little damage to the environment is caused as possible, e.g. sites with stable soil, not on steep slopes, not after strong rains or in spring when snow melts, etc. Smaller machines adjusted to travel on uneven surfaces are considered appropriate.
- Do not work in the evening or at night. The light needed for work disturbs the animals that live in the area.

Construction work should be as nature-friendly as possible.



Checklist: Design and construction

When designing and constructing the trail:

- choose the appropriate trail layout
- choose favoured localities
- search for suitable view points
- avoid problematic sites
- select appropriate starting and ending points
- consider the right trail length and width
- choose the right balance of grades
- clear only as much of the vegetation as necessary
- use natural surface where possible
- for surfacing, use local, natural material
- install the necessary technical infrastructure (bridges, stairs, barriers, etc.)
- provide the appropriate service infrastructure (drinking fountains, sanitary facilities, benches, safety measures)
- avoid disturbance and negative impacts on the environment when working on the trail

6 Signs

6.1 Function and types of signs

Trail signs have different functions which are described in the following. The different types of signs do not need to be used separately. Information can also be brought together on one signboard.

- **Identity signs**

Identity signs portray information which includes: trail name, the type of trail, e.g. interpretative, hiking (overnight, day-use), bicycle, etc., distance to staging areas, intersections with other trails and points of interest along the trail route and the level of expertise required on difficult trails where access is not supervised. Identity signs should be located at all staging areas, interpretative trail intersections, intersections with other trails and at intersections with roads.

- **Use signs**

Use signs portray which types of trail use are appropriate, and which are permitted or prohibited on the trail, identify accessibility conditions, educate trail users about respective private property along the trail route and/ or any other special land use considerations, prohibit smoking, the use of matches or lighters and any other forbidden activities. Information about keeping the trail clean from rubbish should be placed at the access points. Use signs should also be placed at each trail staging area.

- **Safety signs**

Safety signs display warnings of underpasses, street intersections, blind curves and vertical clearances which are coming up, they provide information about water availability along the trail, advise trail users when they need reduce speed or dismount their bicycles or horses, warn of danger for wildlife, identify any use restrictions and explain the right of way among trail users. Safety signs should be located where they are needed.

Signs are the most important feature of interpretative trails.

There are different types of signs and many possibilities for the design, material and layout of signs.

- **Private property signs**

Private property signs should be posted at regular intervals as appropriate, in conformance with legal requirements, to remind the trail user not to trespass.

- **Interpretative and protective signs**

Interpretative and protective signs indicate natural resources, historical points of interest and sensitive areas. They identify specimen habitat types and are educational because they describe resource characteristics and values.

- **Direction signs**

Direction signs posted at strategic locations direct traffic to staging areas and away from neighbourhoods, which may have trail access points but do not have sufficient parking to accommodate such use.

The signposting should be done in the following ways:

- In a way which only uses as many signs and markers and provides only as much information as is necessary to ensure the convenience and safety of trail users.
- Direction arrows should always be used at intersections and possibly shortly after them (as a check that it is the right route).
- Posts are, as a rule, set up on the fork in trail which is to be taken.
- At signposts the sign with the longest distance in km should be at the top.

The distance between boards should not be fixed and will vary due to the natural circumstances. The quantity of boards should depend on the length of the trail and the target visitor group.

6.2 Design of interpretative signs

6.2.1 Information on the board

Information given through interpretative signs should be dispensed in a way which maintains the trail user's curiosity, e.g. through a short sensitive text, a question which will be answered at the next stopping-point and the avoidance of information overload.

The writing of the text demands not only a deep understanding of the subject but also the ability to communicate facts to the visitors in a way that they understand. Avoid scientific explanations and make sure that the text can be easily understood.



Image 14: Trail board at Babia Gora Biosphere Reserve, Poland, 2005

It is necessary to adjust the quantity of information, the language (colloquial vs. scientific; single, bilingual or multilingual boards) and the illustrations to the user group. It is also important to emphasize the main message of the particular board, e.g. bold typed words or expressions. Nice simple pictures and/or clever schemes, diagrams, etc. can emphasize and structure the information given. When using illustration, however, it is not necessary to repeat what the visitor can see with his/her own eyes – additional information content is necessary.

Information for the visitors should be provided:

- *in an understandable way*
- *up-to-date*
- *according to the attractions in the adjacency*

The information on the board should relate to its surroundings. Objects typical or specific of the area should be presented and processes or entities which are remarkable but often overlooked should be described.

A new trail can communicate new and interesting facts and does not have to radiate the dubious charm of years gone by. The information of older trails should be checked and actualised.

Boards which show a range of fungi from the area or indigenous songbirds do not attract a lot of interest and are therefore not meeting their purpose. These boards are mostly much too overcrowded and expect those who look at them to take in too much information.

6.2.2 Layout of the board

Layout standards should be adopted for the information boards of all interpretative trails. The same style and design can be used in one region or even throughout the entire country. If there is a net of trails in a region, the boards of these trails should be marked with a special emblem, giving them a special identity and differentiating the routes from other local trails. Symbols (plants, leaves, flowers, animals) should be used for signposting respective educational trails.

The primary aim of the board's layout is to get the reader or observer to stay longer. A poor board layout does nothing to promote an information trail. Ultimately the observer will not like looking at it and won't take the content seriously.

The legibility of text is determined by many factors. If the text is line-justified and has no indents, it can look too long and doesn't encourage anyone to read it. Short bits of text should be readable, as one might say "in passing" (like headlines and newsflashes in newspapers). If it is too small, continuously in upper case (capitals), in italic script or written in negative (i.e. white on a dark background), legibility is severely reduced. There are many useful books available about the rules of typography.

At the planning stage not just the durability of the board and the supports should be taken into consideration but in also the durability and the non-fade properties of the information shown.

The layout of information boards should grab the visitor's attention.

Short comprehensible texts are better than lengthy scientific essays.

Environmentally friendly, weather resistant colours, which do not bleach after a short amount of time, should be used. Fading occurs above all on boards produced using print technology. On these red generally fades to yellow and green to blue.

Typographically reproduced mass-produced standard boards or amateurishly-made copies from a poor original can never reach the standard of individual hand-painted versions.



Image 15: Information board at Sumava Biosphere Reserve, Czech Republic, 2005

6.2.3 The material of signs

Information boards should be made from natural materials. In the forest they should be made entirely from wood or at least they should be as far as possible constructed from raw materials which fit in well into the surroundings (the amount of weight borne, etc. should be taken into account).

Wooden boards have proved to be the best type of board, e.g. in the Bavarian Forest National Park. They are virtually vandal-proof, can be amended later on by sanding down and re-cutting the information, when covered have a life of about 15 years and fit well into the woodland environment. Also relatively fine characters can nowadays be cut into the lime wood because of the high quality of the cutting machines. After a layer of

Natural material for signs are more suitable for interpretative trails in nature areas.

Durability and costs of material have to be considered, too.

blue protective paint (e. g. sadolin) the characters on the signs could get a layer of varnish in various shades e.g. “light oak“ or “teak“.

Wooden signs should be installed vertically, should be covered over and should be higher than the snow line. Only then, can they be used in the winter in the countryside. Small signs with pictures and flaps should be installed at an angle and on a low part of the board, to ensure that children can easily read them too.



Image 16: Information board on a nature trail at Sumava Biosphere Reserve, Czech Republic, 2005

A selection of different information board materials with their advantages and disadvantages can be seen in the following table.

Information board materials

Material	Advantages	Disadvantages
Wood	environmentally friendly material long-lasting and not easily damaged amendable	relatively expensive easily scratched (by people carving the wood) susceptible to weather damage
Safety glass, Silk screen printing	long-lasting good combination with wooden supports recyclable	reflective surface
Plexiglas (board, heat-sealed on both sides)	convenient quick and easy reproduction	prone to damage and the effects of severe weather only moderately resistant to fading
Original covered in laminate	very convenient easily changed can easily combine text, photos & drawings	relatively short life unattractive overall appearance
Plastic (printed, silk screen printed)	silk screen printing lasts a long time without fading lots of suppliers available	susceptible to damage not environmentally friendly
Steel or aluminium sheet metal board (printed, engraved or etched)	convenient long life	easily scratched not environmentally friendly
Scotch-print method (photo-adhesive film on any flat surface)	highly cost-effective resists fading and is easily reproduced	easily scratched few suppliers available
Enamel	very attractive and appealing lasts a long time, not easily weather-damaged	relatively expensive susceptible to damage and theft
Cera-print method (glass ceramic)	very attractive and appealing extremely long-lasting and durable	very expensive risk of theft



Checklist: Signs

Signs are used for:

- portraying the trail's characteristics
- providing maps and displaying the trail network
- showing distances and directions
- listing points of interest
- educating about appropriate use and behaviour
- identifying use restriction and prohibited activities
- displaying warnings
- communicating topics of interpretation
- indicating sensitive nature areas and habitats

When designing interpretative boards:

- catch the visitors' attention
- avoid overloaded boards
- choose readable typography
- use simple, short descriptions
- avoid scientific language and complex explanations
- adjust the information to the user group
- relate the information of the board to its surroundings
- check and actualise information regularly
- choose natural material
- consider durability and costs of material

7 Monitoring and maintenance

At the planning stage of trails the fact is often forgotten that an interpretative trail needs more intensive regular maintenance than other trails. Natural processes are constantly shaping and altering the trails and their natural environment. On badly maintained trails the quality of the visitors' experience is reduced and their safety may even be affected. Most importantly, insufficient maintenance can have negative impacts on the natural environment.

Trail maintenance is of vital importance for the enduring success of the trail.

7.1 Monitoring and maintenance management

The purpose of trail management is to prevent most trail deterioration and to minimize maintenance costs. Monitoring and maintenance management provides the framework to plan, prioritise, schedule, and track monitoring and maintenance work on trails. It ensures the appropriate day-to-day upkeep as well as the smooth and safe functioning of a trail. It consists of a specific listing of all functions, frequency of tasks, quality standards, and estimated unit costs and/or staffing requirements.

A successful monitoring and maintenance management is based on the following principles:

- Good maintenance management begins with sound planning and design.
- Its purpose is to protect life, property, and the environment.
- It promotes and maintains a quality outdoor recreation experience.
- The management plan is reviewed and updated annually with tasks, operational policies, standards, and routine and remedial maintenance goals.
- It is based on quality control and conducts regular inspection.
- It maintains an effective, responsive public feedback system and promotes public participation.

7.2 Trail problems and their causes

It is important to note that just the use and the aging of a trail causes deterioration. This is, to some extent, unavoidable. Additionally, single events like storms or acts of vandalism can occur at any time, damaging the trail heavily in a short time. Both phenomena need to be managed in an appropriate way through monitoring and maintenance management.

The following problems occur on most nature trails:

- **Deep Trenching:** The trail is sunken to the point that hikers feel like they're walking in the bottom half of a pipe and equestrians drag their spurs.
- **Widening:** The trail has widened from a single or double track to an unsightly wilderness, a "freeway" of multiple parallel tracks, all trenched to differing degrees.
- **Short Cuts:** Knowing that the shortest distance between two points is a straight line, users create a web of non-official trails, mostly shortcuts, most of which are steep and erosive.
- **Tripping Hazards:** Regular use and erosion ultimately expose tree roots and rocks. These as well as cracks and holes in the trail are a danger to users.
- **Deterioration of signs:** Signpost, boards, direction signs and numbered pegs are damaged or vanish. The information can't be seen anymore, directions are unclear, visitors may get lost and do not enjoy the excursion.

The main causes for these problems are:

- **Weather Hazards:** The movement of water causes erosion and deep trenches. It also exposes tripping hazards. Frost, snow and ice as well as wind and storms damage the trail, the signs and foster erosion. Sunlight and heat can make boards unreadable.
- **Vegetation:** The growth and changing of vegetation damages the trail and sometimes the signs.

Trails are deteriorating in the course of time and through usage, but also because of single events like storms or acts of vandalism.

- **Vandalism:** Visitors write on or scratch the signs and boards and can even remove or destroy them. Visitors may also damage or remove technical parts of the trails like gates, part of bridges, etc.
- **Poor initial trail design:** The degree and the rate of trail deterioration, depends above all upon the design of the trail. Poor initial design can rarely be overcome, even by regular maintenance.
- **Inadequate or inappropriate maintenance** wastes valuable staff time and can sometimes increase trail problems.

7.3 Monitoring

Monitoring means the regular checking of current trail conditions. It determines whether or not trail management programs, including maintenance, reconstruction, education and use regulations are effective in addressing user conflicts and environmental impacts. Based on the results of monitoring, the maintenance program can be adjusted and executed.



Image 17: Litter at a trail at Sitno Mountain, Slovakia, 2005

7.3.1 Monitoring inspections

For trail inspections, the monitor must be comfortable with map and compass since they will be traversing property lines away from the trail and

other well travelled ways. Initial inspections may take all day, but once the monitor becomes familiar with the area, the inspections will take less time. Afterwards the monitor will only need to visit the "hot spots" regularly. Shortcuts along old logging roads can reduce travel time to a particular area. Types of inspections are the following:

- **Boundary hike**

Is the most comprehensive type of inspection and required for initial inspections. It is important to walk the entire boundary during one visit, if possible, and to gain the big picture of the area. This will aid the monitor in subsequent inspections, especially if a problematic site is discovered that will need constant monitoring. Extensive note taking and photography will support and document the findings.

- **Trail hike with some boundary walking.**

This type of monitoring is useful for sections that have a combination of high or medium priority boundaries and low priority sections. The monitor will follow the trail through the low priority sections and concentrate on sections threatened by outside use. It also allows the monitor to get a feeling for the interior of the corridor.

- **Trail hike**

In the winter, the monitor should observe the corridor up to 200 m on either side of the trail in deciduous forests. A simple trail hike may suffice for narrow corridors.

7.3.2 Monitoring methods

- **Trail logs**

Trail logs describe and record physical features (natural or man-made) either on or adjacent to the trail. These are recorded by noting the distance of the feature from the beginning of the trail, e.g. bench 3.4 km from the start of the trail. When any of these features are modified, replaced, removed or when other features are added, the log should be updated. Trail logs are useful for financial reasons, e.g. for determining the budget needed for maintenance, and

Only a continuous monitoring process allows for a long-term benefit from the trails.

also for keeping track of the important features on the trail, when they were last checked, repaired, replaced etc. How detailed the trail log needs to be should be decided upon by the relevant people before it is started.

- **Trail condition surveys**

Trail condition surveys document the condition of an entire trail, e.g. width and depth of ruts, state of benches along the route, cracks in the path which may seem dangerous etc., and can include an explanation of the work required to bring a trail to standard. These surveys can be performed upon all trails on a regular basis but particularly on those which already have maintenance needs or where maintenance needs are anticipated.

- **Observation of the trail through visitors and volunteers**

Enlisting the help of visitors in the process of monitoring, e.g. through getting them to indicate problems or features, which need to be repaired etc., to the owner/ maintainer of the trail (who's contact phone number should be available to the public) or by getting them to fill in evaluation forms about the state of the trail, is also a good way of finding out whether the trail is in order. Getting volunteers to walk the trail and record whether or not they need work done to them is also a good way of monitoring the paths. Volunteers can also help with the maintenance work.

- **Time management plans**

Time management plans specify the work that will need to be carried out on a trail during the trails' peak season. Documentation of work schedules is important (1) to ensure that high priority work is accomplished first, (2) to determine if all required work is being accomplished on time and (3) to provide a documented history of maintenance scheduling for future maintenance managers. The format of the time management plan should be adjusted to suit the particular needs of an area. To authorize scheduled work, formal or informal methods can be used.

7.4 Maintenance

The maintenance needed for a trail and how regular it should be carried out will depend upon the location of the trail, the soil, the climate, its installations (sign, boards, bridges, gates, etc.) and what it is used for.

Periodic maintenance helps to avoid major construction. Regular checks and the replacement of installations that have been damaged or rendered unusable, is unavoidable and must be scheduled at least annually. Extensive repairs, especially surface repairs, may be necessary every 5 to 7 years.

The maintenance program can be divided into short-term and mid-term activities:

Routine maintenance consist of the day-to-day regimen of picking-up litter, trash and debris removal, weed and dust control; trail sweeping, sign replacement, tree and shrub trimming and other regularly scheduled activities. It may also include minor re-pairs and replacements such as fixing cracks and potholes or repairing broken handrails.

Remedial maintenance aims at correcting significant defects as well as repairing, replacing, or restoring major components that have been destroyed, damaged, or significantly deteriorated during the life of the trail.

7.4.1 Maintenance measures

The most important precondition of maintenance is a well-thought trail design. The better the trail is designed, the easier it will be to maintain it. Well-designed trails deteriorate at a slower pace and therefore do not lose their attractiveness. The elements of a well-designed trail which are most important from the perspective of maintenance are the gradient, the relationship to existing contours, the outslope and the avoidance of switchbacks. Comments on these elements are discussed in chapter 5.

The key elements of technical trail maintenance are:

- **Maintaining the outslope**

To prevent that the trail loses its inclination, the outslope must be restored. This can be achieved by pushing the small berm which is growing along the trail side back into the trail tread. If this is done

Monitoring has to be accompanied by corresponding maintenance in order to continuously keeping the good standard of the trail.

on a regular basis, the trail can be restored easily and bigger reconstruction work should not be needed.

- **Install and maintain water bars**

Water bars divert water off a trail at controlled points along the it. Water bars are constructions made of rock or timber logs that lie across the trail and redirect the water from flowing down the trail to flowing away from the trail towards the downhill side. They can be incorporated into the original construction of a trail, or they can be installed later as a maintenance measure. Done well, a series of water bars can effectively eliminate erosion and stabilize a trail for years. Done poorly, water bars can accentuate trail erosion and become dangerous tripping hazards. Water bars need to be maintained regularly by flattening the soil and debris which builds up at the down slope end of the water bar.

- **Maintaining drainage dips**

A drainage dip is built into the original trail alignment and is a change in gradient (a "dip" in the trail) that dissipates and diverts water flow (it's like a built-in water bar). Like a water bar, it only remains an effective means of erosion prevention as long as regular maintenance keeps it unblocked.

- **Pruning**

Pruning vegetation is an essential and regular part of trail maintenance, especially in brushy chaparral areas. Pruning should be done carefully for not destroying too much of the vegetation. The aim of pruning should be to keep the trail looking as natural as possible.

- **Repairing constructions and signs**

Signs, boards, pegs and other infrastructures of the trail need to be checked, repaired or replaced on a regular basis. This doesn't only ensure the visitor's experience, but also ensures that users keep on the trail and do not create new ones.

- **Check dams**

Check dams are normally made out of wood timber and placed 90 degrees across a trail to slow down the water. They are not recommended because they do not redirect the water away from the trail and only slow it down for a short passage of the trail.

- **Import fill material**

A deeply trenched trail can be restored by importing dirt or decomposed granite, compacting it, and recreating a well-drained out-sloped trail. However, in most situations, this approach is usually both cost prohibitive and far too labour intensive.



Checklist: Monitoring and Maintenance

Monitoring methods:

- regular trail inspections
- trail logs
- trail condition surveys
- visitor/volunteer observations

Routine maintenance measures:

- removing litter
- controlling weed and dust
- trail sweeping
- tree and shrub trimming
- minor repairing of signs and constructions

Remedial maintenance measures:

- maintaining the outslope
- maintaining water bars
- maintaining drainage dips
- major pruning
- repairing/replacing constructions and signs
- restoring the trail's surface

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Aggteleki Nemzeti Park

Aggtelek Biosphere Reserve and National Park is situated in a vast karst area which belongs to the southern limestone foothills of the Carpathian Mountains, at the northern frontier of Hungary with the Slovak Republic.

Aggtelek Biosphere Reserve and National Park

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Babiogórski Park Narodowy

Babia Góra is the highest massif in the West Beskidy mountains which form part of the Western Carpathians, situated in the Southwest of Poland at the frontier with the Slovak Republic. With a peak of 1725 m, Babia Gora is a perfect example of plants zonation in European mountains.

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Správa Národního Parku Šumava

The Biosphere Reserve and National Park in the Šumava mountain range, situated along the southwest borders of the Czech Republic with Germany and Austria, covers a great variety of precious natural habitats, including remnants of primeval mountain forests, glacial lakes and extensive peat lands.

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The Institute, founded in 1992, aims to promote the idea of sustainable development by building understanding on the idea of sustainability and helping the practical implementation of sustainable development.

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Stowarzyszenie Przyjaciele Babiej Góry

The main goal of the Friends of Babia Gora Association is to support sustainable development of local communities living around Babia Góra through the development of the economic sector with simultaneous protection of its rich natural and cultural heritage.

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Ústav systémové biologie a ekologie, Akademie věd České republiky

The Institute, established in 1993, focuses on dynamic properties of biological and ecological systems at various hierarchical levels, from molecules to landscape. Scientific research and graduate education are its primary activities.

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Ökologischer Tourismus in Europa (Ö.T.E.) e.V.

The society, founded 1991, offers information and education about environmentally friendly forms of tourism. It carries out regional model projects designed to promote sustainable tourism as an element of sustainable regional development.

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