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IUCN European Programme

# Tanks and Thyme

Biodiversity in Former Soviet Military Areas  
in Central Europe





IUCN European Programme

## **Tanks and Thyme**

**Biodiversity in Former Soviet Military Areas in Central Europe**

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**This One**



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## Introduction

Large areas previously occupied by Warsaw Pact forces were being vacated in Central and Eastern Europe after the political changes of 1989 and 1990. Experience in Western Europe has shown that such areas are potentially rich in natural resources and variety of habitats. Limited and scattered information about them is available. Competition for their exploitation was likely to be strong so the time seemed right for examining in detail their conservation value and taking the opportunity to identify the sites of national and international importance and make recommendations for appropriate degrees of protection.

The project "Ecological appraisal of areas previously used for military purposes" was implemented in four Central European countries: the Czech and Slovak Republics, Hungary and Poland, with funding from the Dutch Ministry of Agriculture, Nature Management and Fisheries.

Each country carried out mapping of the sites in order to make a preliminary assessment of their extent and then model sites were selected for more detailed analysis (two sites in each country). Teams of experts were created to do the necessary field research and data gathering.

National seminars were held to review the data and put forward recommendations for future use of these sites. An international seminar was held in Hungary in March 1995 to bring together the results and finalise recommendations and proposed management plans. Each country has since published a full version of the results of the project in their own language, with many maps and photographs and presenting detailed data. The reports contained in this publication are summaries of these national publications.

Although there were obvious and expected signs of environmental damage in all the sites, such as soil and surface and ground water pollution, it was clear that all of the selected sites were reservoirs of significant biological diversity and often served as havens for species that were severely endangered beyond the perimeter fences.

The recommendations resulting from this project have in some cases already been implemented and in other cases have served as a stimulus for further research. They will serve as a useful guide for all bodies responsible for determining future forms of land use in these areas.

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# 1. The Czech Republic

## 1.1. Introduction

One of the results of the extensive political and social changes that occurred in Central and Eastern Europe in the late 1980s and early 1990s has been the opening up of often large areas previously used for various military purposes. The training activities of troops and their long-term presence in the landscape could only with difficulty be regarded as environmentally sensitive.

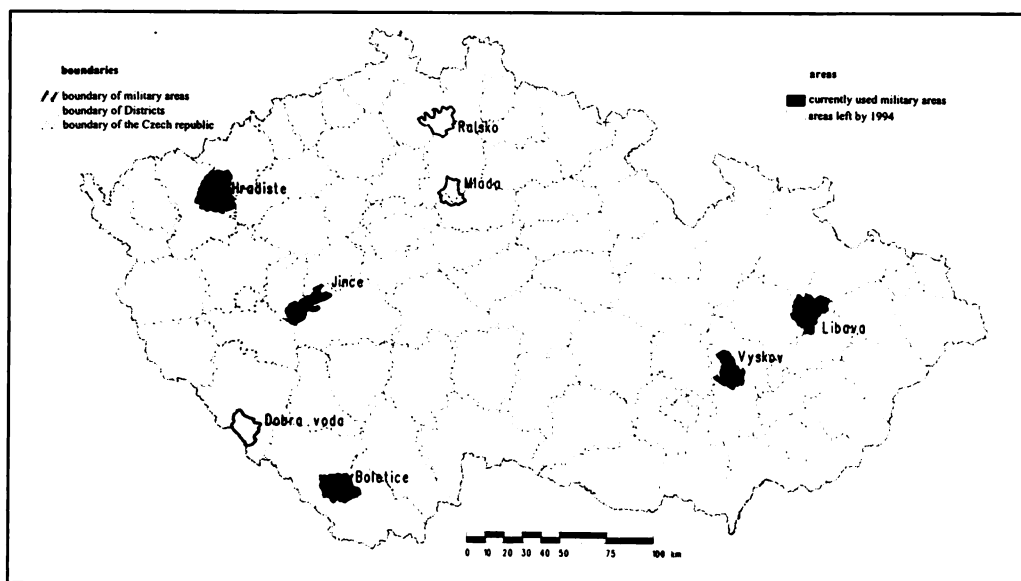
Within the territory of the Czech Republic, the former Soviet Army made use of 74 sites between 1968 and 1991. In 1989 there were eight larger military areas in the Czech Republic (see Map 1). Of these, three were totally or partially occupied by Soviet troops:

- The Mladá military area, also known as Milovice military area.
- The Ralsko military area, also known as Mimoň military area, after the most important human settlement nearby.
- The Libavá military area.

While the Mladá and Ralsko military areas were exclusively occupied by the Soviet Army, in the Libavá military area there were both Czechoslovak and Russian troops, under the command of the Czechoslovak People's Army.

Table 1 shows basic data on the eight large military areas in the Czech Republic. Of these military areas, three have been vacated by troops. In addition to the Mladá and

**Map 1. Czech Republic showing military areas and District boundaries**



**Table 1. Basic characteristics of the military areas in the Czech Republic in 1995**

<b>name</b>	<b>total area (km<sup>2</sup>)</b>	<b>area used for military purposes (km<sup>2</sup>)</b>	<b>percentage of the total area used for military purposes</b>
Mladá	59	0	0
Ralsko	250	0	0
Dobrá Voda	167	0	0
Hradiště	330	169	51.2
Boletice	219	83	37.9
Jince	259	30	11.6
Vyškov	158	22	13.9
Libavá	327	130	39.8

Ralsko military areas, the Dobrá Voda military area has also been totally decommissioned. This area was established in the 1950s in the District of Klatovy and covered 167km<sup>2</sup>. According to the Czechoslovak Federal Government Decree No. 514, this military base was abolished in December 1991. This area is situated in the centre of the Šumava (Bohemian Forest) Mountains, one of the best preserved wildlife areas in Central Europe due to the presence of the Iron Curtain. The Dobrá Voda military area has served as the keystone area of the recently established Šumava National Park.

When the Mladá and Ralsko military areas were occupied by the Soviet Army in 1968, radical changes occurred there. Whereas the intense military training activities of the Czechoslovak troops had previously been concentrated in central parts of the military areas, about 15% of the total area, the Soviet soldiers lived there permanently (e.g. there were 20,000 soldiers in the Ralsko military area alone; Šaroč 1995). They also introduced their way of life and attitude towards nature, an attitude fostered by their experience of the vast areas of 'wilderness' in the Soviet Union, and expressed in their slogans, which refer to the mastery of nature and command of the elements. For example, in the Ralsko military area almost 1,000 shells per 150km<sup>2</sup> were found in the course of a single year. From January to July 1995 bomb disposal teams from the Army of the Czech Republic removed more than 33,000 pieces of military ammunition in the Mladá military area alone (Šaroč 1995).

Since June 1993, the IUCN European Programme project "Ecological appraisal of areas previously used for military purposes in Central Europe: Czech Republic", funded by the Dutch Ministry of Agriculture, Nature Management and Fisheries, has been carried out by the Czech IUCN Country Office in close collaboration with the former Czech Institute of Nature Conservation (now the Czech Agency of Nature Conservation and Landscape Protection). Because most of the sites occupied by Soviet troops from 1968 to

**Table 2. Biological and landscape values of military areas in the Czech Republic**

	Mladá	Ralsko	Dobrá	Hradiště	Boletice	Jince	Vyškov	Libavá
			Voda					
% forest cover	50	70	80	50	70	85	90	50
% grassland cover	50	20	20	40	30	10	8	40
number of designated protected areas	2	19	15	0	26	11	11	5
proportion of whole territory's valuable nature conservation areas	LO	EX	EX	HI	HI	ME	ME	ME
proportion of whole territory's Important Landscape Elements	LO	ME	HI	HI	HI	ME	ME	HI

*LO: low, ME: medium, EX: extensive, HI: high*

1991 in Bohemia and Moravia were small facilities (urban barracks, small airfields, shooting-ranges for rifles and machine guns, ammunition dumps etc.), both Ralsko and Mladá military areas were chosen as model areas for more detailed research to evaluate their ecosystems prior to the preparation of management plans to promote their sustainable use. This project also looked at the potential impacts that would result from the threat of intensive industrial exploitation of the areas.

Table 2 gives biological and landscape values for the former military areas in the Czech Republic, whether decommissioned or still functioning.

## 1.2. Basic information on the former military areas under study

### 1.2.1. Mladá military area

*Area: 59km<sup>2</sup>. Districts: Mladá Boleslav, Nymburk.*

Situated in Central Bohemia, this was the oldest of the areas that had been systematically used for military purposes in the Czech Republic. A permanent military training base was

established there in 1904; indeed, a military camp near the village of Milovice was reported in the late 18th century.

The Mladá military area is situated 40km north-east of the suburban area of Prague, forming part of the Prague metropolitan area. The former army base is located near two important European highways: the E67 Prague–Wrocław and the E65 Prague–Legnica. Important railway lines connect Děčín to Kolín and Prague to Lysá nad Labem. Thus, the military land is easily accessible from Prague. The altitude of the flat or slightly undulating countryside is on average 200m above sea level.

Despite the relatively monotonous terrain, the vegetation of the non-forest biotopes at former training and shooting ranges is high in species diversity. Compared with other parts of Central Europe, the former army base makes up a surprisingly large area in which chemicals such as pesticides and fertilisers have not been used since the times of the Austro-Hungarian Monarchy's training area, i.e. for more than 90 years. About half of the military area is covered by dry short grassland while the other half is forested. Open landscapes are a particular feature of former military grounds, and have enabled the survival of several types of non-forest plant communities, the occurrence of which is at present unique in the Central Labe river basin. Primary deciduous forests have been preserved at a few sites only; most forests have been altered by the planting of pine or spruce monocultures.

Although a relatively large part of the Mladá area is built-up, there are no settlements inside the former military base. Near the village of Milovice is the former army airfield of Boží Dar, which has a runway measuring 2,500m in length and 80m in width, some 50km from Prague International Airport. Also near Milovice there are some former army barracks, with about 4,500 army apartments and 1,000 beds in army barracks. The camp of Milovice offers a complete social infrastructure – hospitals, schools, shops, services etc., although some of the buildings have not yet been completed.

Almost all of the land is in state ownership, except for a small amount owned by local communes.

### *1.2.2. Ralsko military area*

*Area: 250km<sup>2</sup>. Districts: Česká Lípa, Mladá Boleslav, Liberec.*

Ralsko military area is situated in the northern part of the Czech Republic, covering the area of an average administrative district in the country. As with the Mladá military area, the former military land was occupied by Soviet troops between 1968 and 1991. The military base was established in 1950 for use by the Czechoslovak Army. Inhabitants of 18 villages, mostly Czech farmers, were evicted from their houses between 1947 and 1950.

Ralsko is situated 80km north of Prague and is connected with the European and national state highway systems via road No. E65 (R 10) Prague–Turnov and railway line

No. 038 Litoměřice–Liberec. The area is also in close contact with the Euroregion NISA, a transboundary cooperative project between the Czech Republic, Poland and Germany.

In contrast with the Mladá military area, the area's altitude varies between 270m and 700m above sea level. Important natural resources are uranium and aluminium. In the northern part of the former Soviet military base, sulphuric acid has been used to extract uranium ore, leaving behind dangerous waste material. The area is also noted for its high-quality underground supply of drinking water, which is of importance on a Central European level. The paradox of uranium ore extraction waste being found alongside drinking water supplies is typical of the former military areas. Surprisingly, the uranium extraction waste seems to have produced minimal contamination in the groundwater.

While the Mladá military area could be briefly characterised as an area with a balanced combination of grassland and forest biotopes, the much larger Ralsko military complex is a more diverse biotope mosaic.

The Ralsko military area was situated in a part of the Ralsko Hills, with the exception of the eastern edge which belongs to the Jizera Plateau. The typical landscape of the area includes many fishponds, sandstone complexes ("rock towns"), eroded rocks and ridges with a network of canyons. At Pustý fishpond there is a peat-bog at probably the lowest elevation in Bohemia, 275m above sea level. The highest peak in the area under study is Mt Ralsko (696m above sea level), but undoubtedly the most famous and dominant landscape feature is the double peak of Mt Bezděz (604m above sea level) situated in the southern part of the military area (Lipský in prep.). While about 70% of the former Ralsko military base is forested, 20% is covered by open grassland biotopes.

In total, there are nine residential areas of various standards formerly used by the Soviet Army within the area. As in the Mladá military area, a former military airport, Hradčany, is situated in the Ralsko military area, with a runway 2,500m long and 80m wide for small and medium class aircraft. The area regularly used for training of Soviet troops was only 18.4% of the whole Ralsko military area.

### **1.3. Environmental damage and its rectification**

In February 1990 the Czechoslovak Federal Government accepted Decree No. 72 on "the consequences of the Soviet Army leaving". Actions were taken to identify, appraise and rectify damages to the environment made by Soviet troops in the Mladá and Ralsko military areas. The Joint Czechoslovak-Soviet Expert Committee was established to estimate both the damage caused by Soviets to ex-Czechoslovakia and the value of properties of the former USSR left on the territory of Czechoslovakia. It was assumed that the Soviets would pay sufficient compensation to improve the state of the environment in both former military bases.



However, further social and economic changes in the former Soviet Union and the approach of some Czechoslovak negotiators, including the Czech Ministry for the Environment, resulted in the so-called "zero variant". It was agreed that damage to the environment caused by Soviet troops at the 74 military sites in the Czech Republic were equal to the value of the property, namely equipment, in the main military lands (i.e. the Mladá and Ralsko military areas). In 1992, under the supervision of the Office for Solutions to the Consequences of the Presence of Soviet Troops on the Territory of the Czechoslovak Federal Republic, only the most urgent remedial measures were carried out in the Mladá and Ralsko military areas. An international competition to tender for the future use of the Mladá and Ralsko military areas was announced, and, unfortunately, the central bodies of the Czechoslovak Federal Republic and of the Czech Republic believed that the most significant step in the restoration process would occur when the winner of this competition was appointed (see section 1.4 below).

Remediation of environmental contamination is the first priority of economic development in the Mladá and Ralsko military areas. The damage to groundwater and to soil is considered to be the worst. Among the pollutants that have been listed are kerosene, petrol, diesel oil, detergents and polychlorinated biphenyls (PCBs). Dozens of toxic waste dumps have been found in both military areas. However, there is a clear difference between the two former military areas: at Mladá the environmental contamination is highly concentrated in a few places, while the contamination at Ralsko is more extensive. At one locality a kerosene layer 4m thick had formed at groundwater level. At the former military airport of Hradčany, due to the negligence of Soviet soldiers, approximately 2,600 tons (equivalent to about 100 full train tankers) of aircraft kerosene have contaminated the soil. Clean-up operations at the locality will be finished in the year 2000 and will cost 600 million CZK (US\$22 million).

In order to appraise damage to protected species of plants and animals, the former Czech Institute of Nature Conservation prepared a methodology based on the legislation on nature conservation and environmental protection in the Czech Republic (the so-called tariffs of universal values of protected plant and animal taxa). Unfortunately, the only detailed research which had been carried out before the intervention of Soviet troops in August 1968 was on plant communities, in the early 1960s, so the methodology could only be applied to the flora (Kopecký 1985, Husáková and Větvíčka 1991a, b). By comparing the present situation with the past, or contaminated sites with neighbouring undisturbed ones, it has been possible to provide a financial expression of the damage done in the Mladá and Ralsko military areas. This amounts to 2,460,000CZK = US\$91,110 (Mladá military area 327,250CZK = US\$12,120; Ralsko military area 2,132,750CZK = US\$78,990). This figure represents only a fraction of the actual negative impact of the Soviet military presence. Further losses which cannot be expressed in numbers have been caused in the plant communities (there is no legal instrument for their expression in

figures) and in the genetic diversity of destroyed populations. Other unquantifiable damage is being caused by invasive species (see section 1.6.1 below). The massive expansion of invasive species is, together with the total destruction of vegetation, regarded as one of the greatest ecological injuries. This damage has been estimated at 25,000,000 CZK (US\$926,000) or more.

#### **1.4. Privatisation in the Mladá and Ralsko military areas**

After the departure of the Soviet Army from Czechoslovakia, the Czechoslovak Federal Government abolished the military training bases of Mladá and Ralsko and the Czech Government considered their future civilian management.

In October 1991, the Czech Government proposed that properties including forests and agricultural land in the former Ralsko military area should be given to local communes and state institutions. For the former Mladá military areas three alternatives were put forward:

- To offer the properties and estates to foreign firms.
- To establish a large scientific field centre with field stations etc.
- To privatise properties but to maintain the right to manage forests for the Army Forests and Estates.

Finally, in April 1992 the former Czechoslovak Government decided to issue public tenders inviting proposals for complex development projects for the two areas. It was a starting point for implementation of economic and technological activities which could be antagonistic to environmental, ecological and conservation interests. In October 1992 the Czech Ministry for the Environment announced an international competition for an optimal and complex use of both areas.

Fifteen Czech and foreign firms took part in the competition. There was no winner because according to the Czech Government, no firm was able to provide an overall solution to the complex problems found in both former military areas.

It was therefore decided by the government to prepare Obligatory Land Use Plans for all future users of both former Soviet military bases. Nevertheless, privatisation of all properties in the Mladá and Ralsko military areas is controlled by the government, which established the special institutional body PRIVUM as an executive institution of the Czech Ministry of Economic Affairs for this purpose. In addition to the delay caused because the privatisation of thousands of buildings and other equipment had been stopped by the end of the competition, this non-standard privatisation method is very slow, which could create serious problems in the future (IUCN 1994). In addition, privatisation has dealt only with buildings left by the Soviet Army.

Due to this delay in privatisation, annual damage to the properties in both the former military areas is estimated at 100,000,000 CZK (US\$3,700,000). Czech Army guards

have not been posted at all the properties in the former military zones since they were transferred to the standard civil state services.

## 1.5. Nature conservation in the military areas under study

### 1.5.1. Mladá

No part of the Mladá military area had protected status while it was in military use. In 1993, during the current project, two former tank and shooting ranges, Traviny and Pod Benáteckým vrchem, were declared as temporary protected areas because they are excellent examples of semi-natural grasslands (see Table 3).

#### Pod Benáteckým vrchem Nature Reserve

Protected area status was proposed for the site after a detailed botanical survey. (Kopecký 1985). After further examination, a temporary protected area was established across the whole territory of a former infantry shooting range in July 1993.

The area is a plateau without forests at 190–234m above sea level. It is situated between the village of Milovice and the former military airfield of Boží Dar and Kateřina and Alexandrov forests.

In 1991, immediately after the halting of military exercises, most of the training range was without vegetation and the soil severely disturbed. From 1991 to 1995 ruderal plant communities developed, and at present vegetation covers about 30% of the site. The succession of plants has resulted in extensive semi-natural and relatively

**Table 3. Features of proposed protected areas in the Mladá military area**

name	category	significant features
Traviny <sup>1</sup>	NR	subxerothermic grassland plant communities with <i>Bromus erecti</i> and endangered animal species ( <i>Triops cancriformis</i> , <i>Branchipus schaefferi</i> , <i>Bufo calamita</i> , <i>Hyla arborea</i> , <i>Miliaria calandra</i> )
Pod Benáteckým vrchem <sup>1</sup>	NR	subxerothermic grassland plant communities with <i>Bromus erecti</i> and endangered animal species ( <i>Maculinea alcon</i> , <i>Miliaria calandra</i> , <i>Saxicola rubetra</i> )

<sup>1</sup>: declared as Temporary Protected Area, NR: Nature Reserve

stable subxerothermic grass/herb communities with *Bromus erecti*. About 5% of the area is covered by shrubs. Signs of the Soviet Army's activities are apparent in the old trenches, man-made earth banks and small buildings or other military equipment still found here.

The critically endangered butterfly *Maculinea alcon* was found during the project (Matouš *et al.* 1994; see section 1.7.2). The birds *Miliaria calandra* and *Saxicola rubetra* prefer ruderalised tall herb communities, so a part of the proposed protected area should be kept without management. These birds are considered as critically endangered in the Czech Republic, and are specially protected species under the Czech National Council Act No. 114/1992 Gazette on Nature Conservation and Landscape Protection, and the Czech Ministry for the Environment Decree No. 395/1992.

### **Traviny Nature Reserve**

Adjacent to Traviny Nature Reserve was an even more valuable site for plants, Benátecký vrch. However, by special decree of the Czech Government in 1995 a modern large capacity waste processing plant was built. As establishing a protected area at Benátecký vrch had failed, diaspores of rare plant species (e.g. *Dorycnium herbaceum*, *Gentiana cruciata*, *Gentianella amarella*, *Thymelaea passerina* etc.) were transferred to the Traviny site. The latter locality was declared a temporary protected area in July 1993 to protect land which had formerly been used for tank ranges.

In addition to valuable grassland communities of the alliance *Bromion erecti*, animals inhabiting the proposed reserve included the critically endangered crustaceans *Triops cancriformis* and *Branchipus schaefferi*, threatened amphibians *Bufo calamita* and *Hyla arborea* and the critically endangered passerine bird *Miliaria calandra*.

In common with the Pod Benáteckým vrchem temporary protected area, after the halting of military activities the site was almost without vegetation cover. Tank trenches and craters from ammunition explosions were functioning as water reservoirs, at least for part of the year. Although dry grassland plant communities are very similar to those in the Pod Benáteckým vrchem temporary protected area, succession towards bush/scrub formations is more advanced.

Both Pod Benáteckým vrchem and Traviny temporary protected areas have been included into a regional biocentre, part of the regional Territorial System of Ecological Stability (Petříček and Wild in prep.).

On the basis of detailed botanical research, as well as biotechnical experiments which were conducted during the project (see section 1.9.3), appropriate management measures have been proposed, especially to maintain this rare stage of ecological succession (for more details see section 1.9.3). In addition, under the Czech National Council Act No. 114, some important landscape elements have been registered there.

### *1.5.2. Ralsko*

In contrast to the Mladá military area, nature conservation at Ralsko has quite a long history, and has had a considerable influence, alongside military training and chemical uranium extraction. The first proposals to protect sites of rare vascular plant species were put forward as long ago as the late 18th century, before establishing the first protected areas on the territory of what is now the Czech Republic.

In 1933 an extensive Doksy Area and Kummer Mountains nature reserve was established, which included the Hradčany Sandstones, the Hradčany and Břehyně fishponds and Mt Pec, a volcanic hill. Since the protected area preserved a large variety of ecosystems characteristic of the Ralsko Hills, it should be considered as a predecessor of the current protected landscape areas (PLAs, IUCN category V Protected Landscape). After the national inventory of protected areas in 1962, the above-mentioned nature reserve was divided into two smaller parts, but these were still quite large: the Břehyně-Pecopala Nature Reserve of 903ha and the Hradčany fishponds of 145ha.

The Ralsko Nature Reserve, declared in 1939, covered 266ha on the volcanic hill of the same name. Nevertheless, in the 1962 national inventory it was affected much more heavily than the Doksy Area and Kummer Mountains, and its area declined from 266ha to 18ha at the top of the hill. After World War II the Malý Bezděz Nature Reserve was established before the constitution of the Ralsko military area, to protect habitats for one of the few populations in the country of the longhorn beetle *Rosalia alpina*.

In the 1970s, when uranium extraction was rapidly developed, the State Nature Conservancy identified areas of interest within the northern part of the former military base. After the departure of Soviet troops, the former Czech Institute of Nature Conservation, in close collaboration with the Departments for the Environment of the District Offices of Česká Lípa and Mladá Boleslav, started a completely new inventory to prepare a fully representative network of small protected areas (see Table 4). In addition, both temporary protected areas and important landscape elements were to be established. Under the Czech National Council Act No. 114 all the proposals were submitted through the Czech Agency for Nature Conservation and Landscape Protection to the appropriate State Nature Conservancy authorities, dependent on the category of protected areas (i.e. Departments for the Environment of District Offices, and Czech Ministry for the Environment).

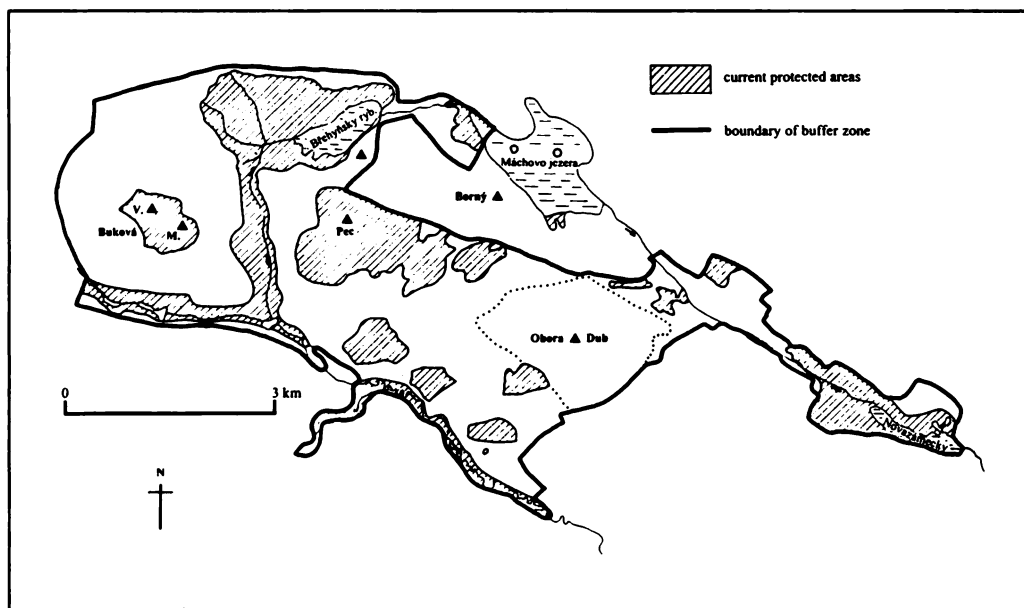
Because only a small percentage of the sites most valuable for biodiversity maintenance had been specially protected special attention was given to these target habitats. The expert team proposed a protected area should be established to include all the important biotopes, i.e. sandstone complexes ("rock towns") on the Hradčany Plateau, the best preserved parts of the Ploučnice river meanders, the Hradčany fishponds, the Břehyně fishpond with its surrounding peat-bog, the Malá Buková and Velká Buková Hills and the Novozámecký fishpond. The proposal includes all the geological and geomorphological

**Table 4. Features of proposed protected areas in the Ralsko military area**

name	category	significant features
Černý rybník fishpond	NM	pine forest in a peat-bog
Čertův Žleb Valley	?	beech and alder forest in a deep valley
Děvín and Ostrý Hills (Hamerský Špičák Hill)	?	double neovolcanic hill, fir/beech to oak/ hornbeam forests, relict flowering pine forest
Divadlo Sandstone	NM	important sandstone feature, relict pine forest
Dlouhý kámen Hill	NM	sandstone feature, relict pine forest
Hamerský rybník and Děvinská louka Meadow	NR	part of a fishpond, reedbeds, bent-grass growths, peat-bog meadows
Horecký rybník fishpond	?	peat-bog meadow
Chrastný Hill	NR	neovolcanic hill with flowering beech and pine forests, subxerothermic grasslands
Jelení vrch Malý and Velký Hills	NR	double basalt hill, flowering beech forests, fragments of subxerothermic grasslands
Kozi hřbety Hill	?	
Lysá hora Hill	NR	neovolcanic hill with an abandoned quarry, beech and oak/hornbeam forests, fragments of subxerothermic grasslands
Ploučnický potok Stream	?	alder forest, fragments of wet peat-bog grasslands
Radechov Velký	NM	basalt hill, flowering beech forests, fragments of subxerothermic grasslands
Rašeliniště near Kundratice peat-bog	?	peat-bog alder forest
Slatinné vrchy Hills	NM	neovolcanic hill with flowering beech forests and beech forests with <i>Luzula</i> community
Stohánek Hill	NM	sandstone with relict pine and pine/oak forests
Široký kámen Hill	NM	sandstone hill, relict flowering pine forests, rock peat-bog, oligotrophic beech forests
Špičák Hill	?	flowering beech forests

*NM: Natural Monument. NR: Nature Reserve.*

phenomena of the Ralsko Hills, i.e. sandstone complexes, volcanic hills, naturally meandering rivers and streams and wetlands with a fishpond system originating in the Middle Ages (Map 2).



**Map 2. Doksy Sandstones and Wetlands National Nature Reserve**

Consequently, the protected area proposed should effectively protect an extensive range of natural and near-natural ecosystems present in the area (i.e. peat-bog pine and spruce forests, aquatic and wetland communities, relict acidophilous and calcareous pine forests and flowering and non-flowering beech forests). Thus, the National Nature Reserve would maintain all the specially protected vascular plant species under the Czech Ministry for the Environment Decree No. 395 (15 critically endangered, 18 severely endangered and 22 endangered species). The total area protected, originally called Polomené hory Hills, now Doksy Sandstones and Wetlands, is 23km<sup>2</sup>.

To achieve the above proposal, the following steps should be carried out:

1. The exclusion of the whole territory of the proposed National Nature Reserve (NNR), including fishponds, from the privatisation process.
2. The prevention of clear-cutting in old growth forests within the NNR.
3. The immediate control of numbers of ungulates (excluding the chamois *Rupicapra rupicapra*) in the proposed protected area, so that populations are within the carrying capacity limits for forest ecosystems and so that the very high densities outside existing game enclosures are reduced.
4. The immediate limitation of free access to the Koží skalky Plateau in the Hradčany Sandstones, where unique thermophilous communities have been damaged by uncontrolled tourism.
5. The inclusion, as a priority, of the Hradčany stream and fishponds into the "Programme of Revitalisation of River Systems in the Czech Republic", carried out by the Czech

Ministry for the Environment to repair damage caused by the presence of Soviet troops.

These principles have been included not only in the official proposal submitted by the former Czech Institute of Nature Conservation but also in the Obligatory Land Use Plans for both so-called "large area units" accepted by the Czech Government, and are relatively independent of the establishment of the National Nature Reserve. It is supposed that the NNR will be managed by only one authority and should have a warden service.

In addition, 18 other small areas which include valuable habitats on the territory of the former Ralsko military area have been proposed for protected area status (see Table 4).

The Ralsko military area's natural values are among the most significant in the country, in spite of the fact that its core zone is covered by uniform pine stands, and this former military base is of at least Central European importance for its natural heritage.

Since 1991, the Břehyně and Novozámecký fishponds have been listed as Wetlands of International Importance (a joint Ramsar site), under the Convention on Wetlands of International Importance Especially as Waterfowl Habitat. In addition, both fishponds were also declared by the International Council for Bird Preservation (ICBP, now BirdLife International) as Important Bird Areas in Europe (IBAs ČR-06 and ČR-07 respectively). Since the Ralsko military area constitutes an important part of the regional and national ecological stability system, it has been proposed as a supraregional biocentre of the Supraregional Territorial System of Ecological Stability (TSES, No. 42 Břehyně-Pecopala). The area has also been chosen as a core area (keystone area, Central European/European biocentre) of the European Ecological Network (EECONET) and the related Central European Ecological Network (CEECONET, No. 9 Polomené hory Hills). In addition to the Blanice river valley (South Bohemia), the Břehyně fishpond and its vicinity has been included in the European Network of Biogenetic Reserves, declared by the Council of Europe.

## **1.6. Flora in the Mladá and Ralsko military areas**

### *1.6.1. General patterns*

Table 5 shows basic information on the flora of the Mladá and Ralsko military areas. From the botanical perspective, the Mladá military area is extremely valuable because of its high proportion of dry grasslands. On the other hand, the much more extensive Ralsko military area could be characterised by the high proportion of forests in the total area and the surprisingly high biodiversity caused by its biotope mosaic and diverse geomorphology.

For both the military areas, reconstruction maps of natural vegetation have been prepared by the Institute of Botany, Academy of Sciences of the Czech Republic at Průhonice near Prague.



**Table 5. Botanical characterisation of the Mladá and Ralsko military areas**

	military area	
	Mladá	Ralsko
Area (km <sup>2</sup> )	58	250
Number of sites under study	53	143
Number of plant species found	473	693
Number of specially protected species found	20	54
Number of plant communities found	27	88
Proposals for specially protected areas with respect to flora	4	11

A significant part of the vegetation in both the Mladá and Ralsko military areas is ruderal growth in habitat severely affected by human activities. This includes areas used for the long-term presence of troops (accommodation and management zones) and training grounds. Although the ruderal vegetation occurs almost exclusively at small sites, there are nitrophilous herb growths with *Urtica dioica* (class *Galio-Urticetea*). In the military grounds, where both caterpillar and wheeled vehicles trained, and also along temporary roads, communities of the alliance *Polygonion avicularis* were common: nowadays, after the departure of the Soviet troops, they have disappeared. Moreover, the ruderal communities have formed either transition types together with the other grassland communities or they have interchanged with the latter forming a growth or stand mosaic. In the Ralsko military area this landscape pattern also includes bushes or clusters of trees.

Aggressive (agonistic) invading plant species present a great threat to valuable habitats in the Mladá and Ralsko military areas: 44 such species have been identified, mostly ruderal species with some from various grassland communities. The expansion of invasive species has been extremely dangerous to the semi-natural non-forest vegetation of both the former military lands since management for military purposes has stopped. Invasive species have penetrated into semi-natural and natural non-forest vegetation (rarely into forest vegetation), or they have invaded denuded sites, damaged by both water and wind erosion, forming communities with low species diversity. The invasive species can be characterised by their abundant diaspore production, high vegetative regeneration ability, rapid growth and large biomass production, resulting in great energy demands. Plants such as *Lupinus polyphyllus* and *Sarothamnus scoparius* not only replace the original herb species but also enrich the soil with nitrogen in an undesirable way. In some deciduous forests in the Mladá military area, seriously affected by man, the most dangerous invasive plant species are *Impatiens*

*parviflora* and *Urtica dioica*. The biotopes most vulnerable to invasive species include meadows, grasslands in training grounds and wetland communities.

The level of inter- and intra-specific aggression in the invading species differs substantially in various communities. Nevertheless, the species have seriously damaged the process of natural succession. This massive expansion of invasive species is, together with the total destruction of vegetation, regarded as the biggest of the ecological problems in both the Mladá and Ralsko military areas. Consequently, the management schemes for vulnerable biotopes, namely grassland and sandy biotopes, should deal carefully with mowing or grazing (see section 1.9.3 below), including at some sites the thinning out of woody species and disturbance of the soil surface at sandy localities. For this purpose, locating source populations of invasive species, and taking measures to reduce them, should be carefully assessed as part of the management techniques for the Mladá and Ralsko military areas.

#### 1.6.2. Flora in the Mladá military area

Vegetation types close to their natural state include oak forests with a heavily reduced herb layer in habitats of oak/hornbeam forest and fragments of hornbeam and subxerophilous oak forests. Among the most common woodland types, there are anthropogenic pine and spruce cultures and birch stands.

The Red List of threatened vascular plant taxa in the former Mladá military area includes 28 plant species which are endangered or threatened at various levels (Table 6). Of these, *Dactylorhiza majalis* and *Triglochin palustre* are found outside the former Soviet military base but close to its boundaries. The importance of both the existing protected areas should be confirmed by the fact that in the Pod Benáteckým vrchem and Traviný temporary protected areas there are 11 (39.3% of the total number found in the military area) and 10 (35.7%) threatened vascular plant species respectively.

The semi-natural or natural sub-Atlantic to sub-Mediterranean xerothermic grassland plant communities, belonging to the alliance *Bromion erecti* and less commonly to the order *Koelerio-Pleion phleoidis*, are extremely valuable. The former are associated with the communities of *Trifolion medii* ev. *Geranion sanguinei* and *Berberidion* ev. *Prunion spinosae* respectively (*sensu* Moravec *et al.* 1994).

#### 1.6.3. Flora in the Ralsko military area

##### **Plant species and communities in the Ralsko military area**

Forest growths with a structure close to their natural one have been preserved especially at sites with suitable geomorphological and hydrological conditions. Nevertheless, in a large part of the former Soviet military training area anthropogenic pine cultures predominate. In the eastern part of the study area, there are spruce monocultures. Tree species composition

Table 6. Red List of threatened vascular plants in the Mladá military area

taxon	status	P	T
<i>Aira praecox</i>	C III		
<i>Anemone sylvestris</i>	C III	O	+
<i>Armeria elongata</i>	C III		+
<i>Arnica montana</i>	C II	O	
<i>Astragalus danicus</i>		O	+
( <i>Carex davalliana</i> )	C III	SO	
<i>Carex hosteana</i> ?	C II	SO	
<i>Centaureum erythraea</i>	C III	+	+
<i>Centaureum pulchellum</i>	C III		
( <i>Dactylorhiza majalis</i> )	C III	O	
<i>Dorycnium herbaceum</i>	C III	+	+
<i>Festuca psammophila</i>	C III		
<i>Filago minima</i>	C III		
<i>Gentiana cruciata</i>	C III	O	+
<i>Gentianella amarella</i>	C III	SO	+
<i>Gentianella ciliata</i>	C III		
<i>Hypericum humifusum</i>	C III		
<i>Juniperus communis</i>	C III		
<i>Orchis morio</i>	C II	SO	+
<i>Platanthera bifolia</i>	C III	O	+
<i>Rosa gallica</i>	C III	+	+
<i>Senecio vernalis</i>	C II	+	
<i>Teesdalia nudicaulis</i>	C III		
<i>Tetragonolobus maritimus</i>	C III	+	+
<i>Thymelaea passerina</i>	C III	+	+
( <i>Triglochin palustre</i> )	C III		
<i>Valeriana dioica</i>	C III		
<i>Verbascum phoeniceum</i>	C III	O	+

C I to C III: threatened taxa (sensu Holub et al. 1977)

SO, O: categories of the Czech Ministry for the Environment Decree No. 395/1992

Gazette (SO: Severely Endangered, O: Endangered)

?: unconfirmed

(taxon in parentheses): occurs outside the military area

+: occurs in the proposed "Pod Benáteckým vrchem" (P) and "Travný" (T) nature reserves

Table 7. Red List of threatened vascular plants in the Ralsko military area

taxon		status	D
<i>Abies alba</i>		C III	+
<i>Aconitum variegatum</i>		C III O	??
<i>Aconitum vulpara</i>		C III O	
<i>Aira praecox</i>		C II	
( <i>Allium angulosum</i> )		C II SO	
<i>Allium strictum</i>		C III SO	+
<i>Alyssum saxatile</i>		C III O	
<i>Alyssum gmelinii</i>	n		??
<i>Andromeda polifolia</i>		C III O	??
<i>Anemone sylvestris</i>		C III O	
<i>Aphanes arvensis</i>		C III O	
<i>Arctostaphylos uva-ursi</i>		C II SO	+
<i>Armeria elongata</i>		C III	+
<i>Arnica montana</i>		C II O	+
( <i>Arnoseris minima</i> )		C II	??
<i>Arum maculatum</i>		C III O	
<i>Asplenium adianthum-nigrum</i>		C I KO	??
<i>Aster amellus</i>		C III O	+
<i>Aster alpinus</i>	ex	C I KO	
<i>Astragalus arenarius</i>		C I KO	+
<i>Biscutella laevigata</i>		C III O	+
<i>Botrychium lunaria</i>		C III O	
( <i>Botrychium matricariifolium</i> )		C I KO	
<i>Calamagrostis varia</i>		C III SO	
<i>Calla palustris</i>		C II O	+
<i>Cardaminopsis petraea</i>		C II SO	??
<i>Carex appropinquata</i>		C II	??
<i>Carex davalliana</i>		C III SO	+
( <i>Carex diandra</i> )		C III	??
( <i>Carex dioica</i> )		C I KO	+
( <i>Carex hostiana</i> )		C II SO	??
<i>Carex lasiocarpa</i>		C II SO	+
<i>Carex lepidocarpa</i>		C II SO	+
<i>Carex pediformis</i> ssp. <i>macroura</i>		C III O	
<i>Carex stenophylla</i>	n	C I KO	

.../continued

Table 7. (continued)

taxon		status		D
<i>Centaureum pulchellum</i>		C III		
<i>Cephalanthera damasonium</i>		C III	O	+
<i>Cephalanthera rubra</i>		C II	SO	+
<i>Chenopodium vulvaria</i>	n	C II		
<i>Chimaphila umbellata</i>		C I	KO	??
<i>Coeloglossum viride</i>	ex	C III	SO	
<i>Corallorhiza trifida</i>	ex	C II	SO	
<i>Comarum palustre</i>		C III		+
<i>Dactylorhiza bohemica</i>	E	(C I)	(KO)	+
<i>Dactylorhiza fuchsii</i> ( <i>longebracertata</i> )		C III		+
<i>Dactylorhiza incarnata</i> ssp. <i>serotina</i>		C I	KO	+
<i>Dactylorhiza maculata</i>		C I	KO	+
<i>Dactylorhiza majalis</i>		C III	O	
<i>Dactylorhiza</i> × <i>vermeuleniana</i>		(C I)	(KO)	+
<i>Daphne cneorum</i>	n	C I	KO	+
<i>Daphne mezereum</i>		C III		+
<i>Dianthus gratianopolitanus</i>		C II	SO	
<i>Dianthus seguieri</i>		C III	O	??
<i>Diphasiastrum complanatum</i>		C III	O	+
<i>Diphasiastrum issleri</i>		C III	SO	+
<i>Diphasiastrum zeileri</i>		C III	O	+
<i>Drosera rotundifolia</i>		C II	SO	+
<i>Dryopteris cristata</i>		C I	KO	+
<i>Eleocharis mamillata</i>		C III		??
( <i>Eleocharis quinqueflora</i> )		C II	SO	??
<i>Epipactis atrorubens</i>		C III	O	+
<i>Epipactis palustris</i>		C II	SO	+
<i>Epipactis purpurata</i>		C III	O	+
<i>Equisetum hyemale</i> ( <i>Equisetum variegatum</i> )		C II	SO	
<i>Festuca psammophila</i>		C I	KO	
<i>Festuca psammophila</i>		C III		+
<i>Gentianella amarella</i>	n	C III	O	
<i>Gentianella campestris</i>	ex	C I	KO	

.../continued

Table 7. (continued)

taxon		status		D
<i>Gentianella germanica</i>	n	C I	KO	
<i>Gentianella uliginosa</i>	?	C III		
<i>Gratiola officinalis</i>	n	C I	SO	
<i>Gymnadenia conopsea</i> ssp. <i>conopsea</i>		C III	O	+
<i>Gypsophila fastigiata</i> ssp. <i>fastigiata</i>		C II	SO	+
<i>Hammarbya paludosa</i>		C I	KO	+
<i>Helichrysum arenarium</i>		C II	SO	+
<i>Herniaria hirsuta</i>	n	C II		??
<i>Hierochloa australis</i>		C III		+
<i>Hottonia palustris</i>		C III	O	+
<i>Huperzia selago</i>		C III	O	+
<i>Hydrocotyle vulgaris</i>		C III	O	+
<i>Hypericum humifusum</i>		C III		+
<i>Hypochoeris glabra</i>			KO	
<i>Iris sibirica</i>		C II	SO	+
<i>Isolepis setacea</i>		C III		
<i>Juncus acutiflorus</i>		C III		??
<i>Juncus capitatus</i>	n	C II		
( <i>Juncus subnodulosus</i> )		C II	KO	
<i>Juniperus communis</i>		C III		+
<i>Laserpitium pruthenicum</i>		C II	SO	??
<i>Lathyrus heterophyllus</i>	?	C II	SO	
<i>Ledum palustre</i>		C III	O	+
<i>Leucojum vernum</i>		C II	O	
<i>Ligularia sibirica</i>		C I	KO	+
<i>Lilium martagon</i>		C III	O	+
<i>Liparis loeselii</i>		C I	KO	+
<i>Litorella uniflora</i>		C II	KO	
<i>Lunaria rediviva</i>		C III	O	
<i>Lycopodiella inundata</i>		C II	SO	+
<i>Lycopodium annotium</i>		C III	O	+
<i>Malaxis monophyllos</i>	ex	C I	KO	
<i>Melampyrum arvense</i> ssp. <i>semleri</i>		C II		
<i>Melittis mellisophyllum</i>	n	C III	O	

.../continued

Table 7. (continued)

taxon		status		D
<i>Menyanthes trifoliata</i>		C III	O	+
<i>Minuartia caespitosa (verna)</i>		C I	KO	+
<i>Moneses uniflora</i>		C II	SO	??
<i>Najas marina</i>		C III		+
<i>Najas minor</i>		C I	KO	+
<i>Nasturtium officinale</i>		C II	SO	+
<i>Naumburgia thyrsiflora</i>		C II	SO	+
<i>Nymphaea candida</i>		C II	SO	+
<i>Ophioglossum vulgatum</i>			SO	+
( <i>Orchis morio</i> )		C III	SO	
<i>Orchis ustulata</i>	n	C II	SO	
<i>Orobanche arenaria</i>	n	C II		
<i>Oxycoccus palustris</i>		C III	O	+
<i>Parnassia palustris</i>		C III	O	+
<i>Pedicularis palustris</i>		C II	SO	+
<i>Pedicularis sylvatica</i>		C III	SO	
<i>Phyteuma orbiculare</i>		C II	SO	
<i>Pinguicula bohemica</i>	E	C I	KO	+
<i>Platanthera bifolia</i>		C III	O	+
<i>Polypodium interjectum</i>				
<i>Potamogeton alpinus</i>		C II	SO	??
<i>Potamogeton friesii</i>		C I	KO	??
<i>Potamogeton perfoliatus</i>		C III		
<i>Potamogeton praelongus</i>	n	C I	KO	
<i>Primula elatior</i>		C III		
<i>Primula veris</i>		C III		
<i>Pulsatilla patens</i>		C I	KO	+
<i>Pulsatilla pratensis</i>		C II	SO	+
<i>Pulsatilla vernalis</i>	n	C I	KO	
<i>Pyrola chlorantha</i>		C II		
<i>Ranunculus lingua</i>		C III	SO	
<i>Rhynchospora alba</i>		C II	KO	+
<i>Rhynchospora fusca</i>		C I	KO	+
<i>Sagina nodosa</i>	n	C II	SO	
<i>Salix repens ssp. rosmarinifolia</i>		C II	O	+

.../continued

Table 7. (continued)

taxon		status		D
<i>Scorzonera humilis</i>		C III		+
<i>Scorzonera purpurea</i>		C III	O	??
<i>Sedum villosum</i>	?	C I	KO	
<i>Senecio fluviatilis</i>		C II	SO	
<i>Senecio vernalis</i>		C II		+
<i>Sorbus danubialis</i>				+
<i>Sparganium minimum</i>		C II	SO	+
( <i>Spiranthes spiralis</i> )	? ex	C I	KO	
<i>Stellaria longifolia</i>		C III		+
<i>Stipa joannis</i>		C III	O	+
<i>Teesdalia nudicaulis</i>		C III		+
<i>Tetragonolobus maritimus</i>	?	C III		
<i>Teucrium scordium</i>	?	C II	SO	
<i>Thalictrum flavum</i> ssp. <i>lucidum</i>		C III		+
<i>Thelypteris palustris</i>		C III	O	??
<i>Tofieldia calyculata</i>		C I	KO	+
<i>Triglochin palustre</i>		C III		+
<i>Trollius altissimus</i>		C II	O	
<i>Utricularia minor</i>		C III		+
<i>Valeriana dioica</i>		C III		+
<i>Verbascum phoeniceum</i>	?	C III	O	
<i>Veronica longifolia</i>		C III		+
<i>Woodsia ilvensis</i>		C III	SO	

*C I to C III: threatened taxa (sensu Holub et al. 1977)*

*(C I): proposed status for rare species not listed in Holub et al. (1977)*

*KO, SO, O: categories of the Czech Ministry for the Environment Decree No. 395/1992*

*Gazette (KO: Critically Endangered, SO: Severely Endangered, O: Endangered)*

*E: endemic*

*?: unconfirmed*

*n: not found during 1990–1995*

*ex: extinct*

*(taxon in parentheses): occurs outside the military area*

*+: occurs in the proposed Doksy Sandstones and Wetlands National Nature Reserve*

*??: occurrence in the proposed Doksy Sandstones and Wetlands National Nature Reserve is highly probable*



for the whole of the Ralsko former military area is as follows: pine 64.4%, spruce 18.4%, other coniferous wood species 9.2%, beech 6.8%, oak 0.8% and other deciduous wood species 0.4%. Grasslands are represented by associations of the class *Molinio-Arrhonatheretea* and *Nardo-Callunetea*.

Among special vegetation groups, non-forest communities on poor sandy sites should be mentioned, since they have almost disappeared from the surrounding landscape, due to intensive cultivation and soil eutrophication.

The extraordinary importance of the Ralsko military area as a core area of at least Central European significance for plant communities (phytocoenoses) can be easily demonstrated by the very high number of species on the Red List of threatened vascular plant taxa found in the area (see Table 7). In total, 160 taxa (154 vascular plant species) are listed there. Among them, *Dactylorhiza bohemica* and *Pinguicula bohemica* are endemics while *Sorbus danubialis* occurs exclusively in Central and South Europe. As with the Mladá military area, a number of species (*Allium angulosum*, *Arnoseris minima*, *Botrychium matricariifolium*, *Carex diandra*, *Carex dioica*, *Carex hostiana*, *Eleocharis quinqueflora*, *Equisetum variegatum*, *Juncus subnodulosus*, *Orchis morio* and *Spiranthes spiralis*) occur outside the area examined in the course of the project but close to the artificial former boundaries of the military area.

Some formerly occurring species are known to have become extinct in the former military area, including *Aster alpinus*, *Coeloglossum viridae*, *Corallorhiya trifida*, *Gentianella campestris*, *Malaxis monophyllos* and probably also *Spiranthes spiralis*. Fifteen plant species have been reported from this part of North Bohemia in the past, but have not been confirmed recently, and special attention should be given to these species.

In the proposed Doksy Sandstones and Wetlands National Nature Reserve, a total of 81 (50.6%) of these threatened plant taxa have been found. In addition, there are an additional 21 taxa of higher plants which may occur in the protected area but have not yet been confirmed. It is therefore important that the expert team should define the boundaries for the proposed protected area.

### **Rare and threatened plant communities and species in wetlands near the Máchovo jezero fishpond**

In 1991–1995 plant populations and communities were studied in the wetlands on the shore of the Máchovo jezero fishpond, situated near the Ralsko former military area. The northern and eastern lagoons of the fishpond and the surrounding area were proposed as a nature reserve because of the presence of many threatened plants and plant communities. The following associations included in the Red List of former Czechoslovakia were identified:

*Potameto natantis-Nymphaeetum candidae* Hejný 1978

*Sparganietum minimi* Schaaf 1925

*Caricetum paniculatae* de Boer 1942, Hargittai 1942

*Phragmiti-Caricetum lasiocarpae* Rybníček 1984

*Sphagno subsecundi-Rhynchosporium albae* (Koch 1926) Rybníček 1984

*Rhynchosporium fuscae* W. Braun 1968

*Rhynchosporium fuscae* is the most important association because it was found only in a very small area of a transition bog. This may well be the only occurrence of this association in the Czech Republic.

The various oligotrophic biotopes are inhabited by many endangered and specially protected species of flora (*Rhynchospora fusca*, *Dactylorhiza incarnata* ssp. *serotina*, *Liparis loeselii*, *Nymphaea candida*, *Salix repens* etc.). These biotopes have been well-preserved in the study area. However, management should aim to prevent changes in the natural succession by undertaking reed-harvesting and cutting of some trees. Making shallow depressions at suitable sites to support the development of various successional stages and to increase species diversity is highly recommended (Turoňová and Rychtařík in prep.).

### **Causes of changes in vegetation on the Břehyně fishpond**

In 1994–1995 vegetation on the Břehyně fishpond was examined in detail. It was found that, despite the great importance of the protected area, there have been negative changes in the plant populations and communities, caused mainly by expansion of *Carex gracilis* and *Phragmites australis*. Some plant associations (e.g. *Eleocharitetum acicularis*, *Potametum obtusifolii* and *Caricetum limosae*) have definitely disappeared from the study area. On the other hand, uniform growths (monocoenoses) of *Molinia caerulea* and *Calamagrostis epigeios* have developed there because they replaced original forest communities.

The changes were caused by:

- Changes in water management at the locality, resulting in increased water levels in the pond.
- Increasing eutrophication of the artificial water reservoir, resulting from fertilisation of the pond.

Appropriate management measures would limit the expansion of *Carex gracilis* and *Phragmites australis*. These measures should include reed harvesting in late May and early June. This management was applied experimentally for the first time in 1995 (Stančík in prep.).

## **1.7. Target animal groups studied in the Mladá military area**

### **1.7.1. Crustaceans**

Between 1991 and 1993, a mass occurrence of the crustaceans *Triops cancriformis* and *Branchipus schaefferi* was seen in the former Mladá military area. This was the first time

such an abundance of these arthropods had been observed in the Czech Republic. Simultaneously, similar distribution patterns and numbers for both species were confirmed in the former Ralsko military area.

For example, thousands of specimens of *T. cancriformis* were reported at a tank training range at Lipník in July 1991 while, a month later, thousands of individuals of *B. schaefferi* were found in pools on the clay/sand soil surface in a tank training range at Mladá.

Optimal habitats for animals living in temporary pools were created by the heavy military machinery. In addition, the open flat landscape offers suitable habitats for forest-steppe and steppe animal species. Nevertheless, without appropriate management to create ground depressions containing sufficient water for temporary pools, both these invertebrate species (classified as critically endangered under the Czech National Council Act No. 114 and the Czech Ministry for the Environment Decree No. 395) will in a short time become extinct in the study area.

For a detailed list of sites where the above-mentioned crustaceans were found in the former Soviet military base and maps of their distribution, see Zavadil in prep.

### 1.7.2. Butterflies

The extraordinary importance of open grassland habitats for butterfly species assemblages was confirmed during the research on these insects in the Mladá military area, with 593 species found in five main habitats (Table 8).

Of these, *Maculinea alcon* is classified as critically endangered under the Czech National Council Act No. 114 and the Czech Ministry for the Environment Decree No. 395. Four other endangered butterfly species occur in the former Soviet military base: *Papilio machaon*, *Limenitis populi*, *Apatura iris* and *Apatura ilia*.

With respect to their biogeographical importance, 133 (22.4%) species are local and rare while 43 (7.3%) are very local and very rare (Matouš *et al.* 1994).

**Table 8. Number of butterfly species found in habitats in the Mladá military area**

habitat	number of species found	%
deciduous forest	203	34.2
coniferous forest	16	2.7
forest-steppe	163	27.5
steppe	204	34.4
wetland	7	1.2
<b>total</b>	<b>593</b>	<b>100.0</b>

### 1.7.3. Amphibians

In 1991–1994 amphibians of the former Mladá military area were examined. In total, 11 species of these relatively threatened vertebrates were found: *Triturus cristatus*, *Triturus vulgaris*, *Bombina bombina*, *Pelobates fuscus*, *Bufo bufo*, *Bufo calamita*, *Bufo viridis*, *Hyla arborea*, *Rana temporaria*, *Rana dalmatina* and *Rana ridibunda*.

Because there is no permanent water in the area examined both *Pelobates fuscus* and *Rana temporaria* are close to extinction. On the other hand, *Bufo viridis* and *Bufo calamita* are common, the latter being the most common amphibian in the area despite the fact that it is considered to be the rarest frog species in the Czech Republic (Moravec 1994). Because both species of the genus *Bufo* are perfectly adapted to life in periodic pools, their survival crucially depends on the presence of pools which regularly appeared in ground depressions caused by the movement of heavy military machinery (see also section 1.7.1 above). Unless specific management is undertaken to preserve or create new temporary pools to provide suitable breeding grounds, the

**The common or European toad (*Bufo bufo*) lives in temporary pools in depressions left by military vehicles in both the military areas under study  
(photo by Ludvík Hauser)**



sites preferred by amphibians will totally disappear in the Mladá military area (Zavadil 1995).

#### *1.7.4. Reptiles*

Alongside the amphibian study, distribution of reptiles was also studied in the Mladá military area (Zavadil 1995). The presence of three species was confirmed: *Lacerta agilis*, *Natrix natrix* and *Coronella austriaca*.

The lizard *Anguis fragilis* is also likely to occur in the study area. However, the lizard *Lacerta vivipara* has not recently been found in the Mladá military area, although it has been reported in the Pod Benátským vrchem temporary protected area.

Reptiles are less threatened than amphibians in the Mladá military area, because their habitats have not suffered the same degree of drastic change and fragmentation.

#### *1.7.5. Birds*

In 1989–1995, a total of 128 bird species were found in the former Mladá military area. Among them, 43 species are specially protected under the Czech National Council Act No. 114 and the Czech Ministry for the Environment Decree No. 395 in these categories: four species critically endangered, 21 severely endangered and 18 endangered (Zavadil *et al.* in prep.).

In the former Mladá military area, field work was done in May 1994. The line transect method was used, surveying a belt of 100m width in open landscape and 50m in woodland. In total, 49 line transects were monitored at 11 sites representing eight major environment types (see Table 9). Field work was carried out between dawn and 09:30 hours Central European Time and singing males were considered to indicate a breeding pair.

In the study area, dry grassland (wastelands or fallow land) are among the most valuable ornithological habitats. The bird community inhabiting this type of environment includes species which are considered rare within the Czech Republic and some which are declining in numbers. This is particularly true of *Miliaria calandra*, which reaches densities at Mladá unequalled elsewhere in the Czech Republic: 42–114 individuals per 100ha in various types of dry grassland and steppe to forest-steppe areas, averaging 65.7 individuals per 100ha and 17.8% of dominance. High densities have also been recorded in airfield grassland and in ruderal biotopes within the abandoned military town of Milovice: 23.1 and 35.4 individuals per 100ha respectively. At this time, there are only 700–1,400 pairs of *M. calandra* within the whole Czech Republic (Hudec *et al.* 1995). Wastelands and similar biotopes are inhabited by other rare bird species, e.g. *Sylvia nisoria* (maximum 4.6 individuals per 100ha), *Saxicola torquata* (maximum 36.8 individuals per 100ha and dominance

**Table 9. Location of line transects for analysis of bird communities in the Mladá military area in 1994**

locality	habitat	number of line transects	area (km <sup>2</sup> )
Traviny	dry grassland	10	2.82
Milovice	dry grassland/rural area	7	0.54
Milovice	dry grassland, scrub-covered rubbish heap	2	0.74
Milovice	dry/wet grassland	4	1.38
Milovice	meadow near former airfield	2	0.26
Milovice	abandoned Soviet military town with open areas	9	0.79
Milovice	abandoned Soviet housing estates with some vegetation	3	0.12
Milovice	densely forested wetlands near the abandoned town	2	0.07
Jiřice	mosaic of mature forest (pine, oak, spruce) and clearings	6	0.26
Traviny	mature oak forests	3	0.52
Milovice	mature deciduous forests	1	0.22
<b>total</b>		<b>49</b>	<b>7.72</b>

9.9%) and *Lanius collurio* (maximum 33.0 individuals per 100ha). Ruderal areas in the abandoned town are inhabited by other rare species, especially *Anthus campestris* (6.3 individuals per 100ha), *Galerida cristata* (15.2 individuals per 100ha), *Oenanthe oenanthe* (2.5 individuals per 100ha) and *Lullula arborea* (15.2 individuals per 100ha).

The bird communities richest in species are found in the abandoned town with its concrete and ruderal areas – 47 species – and in wastelands with overgrown tank training ranges – 43 species. These habitat types have more bird species than even the more ‘natural’ biotopes with a mosaic of mixed mature forest and clearings, with pine plantations of various ages.

A quite specific bird community inhabits the abandoned town’s concrete and ruderal areas and scattered vegetation. This community includes synanthropic species (e.g. *Delichon urbica*, density 141.8 individuals per 100ha, *Sturnus vulgaris*, 126.6 individuals per 100ha, most frequently nesting in street lamp domes, *Phoenicurus ochruros*, 50.6 individuals per 100ha), species inhabiting open biotopes (*Alauda arvensis*, density 54.5 individuals per 100ha, *Galerida cristata*, 15.2 individuals per 100ha, *Anthus pratensis*, 6.3 individuals per 100ha, *Carduelis cannabina*, 17.7 individuals per 100ha) and strictly forest species (e.g. *Lullula arborea*, density 15.2 individuals per 100ha, *Sylvia atricapilla*, 12.7 individuals per 100ha, *Columba palumbus*, 3.8 individuals per 100ha).

## **1.8. Target animal groups studied in the Ralsko military area**

### **1.8.1. Crustaceans**

In 1991–1994 crustaceans belonging to the orders Ctenopoda, Anomopoda and Onychopoda were examined in fishponds in the former Ralsko military area. In total, 31 water-flea species were found there. Among them, the occurrence of rare species of *Lathonura rektivostriis* should be mentioned (recorded in the Břehyně fishpond). For more details, see Štifter 1995.

### **1.8.2. Spiders**

In 1993–1994 spider fauna at selected sites in the former Ralsko military area was studied in detail. The localities examined represent two main habitats predominating in the area:

- Wetlands (vicinity of the Břehyně fishpond).
- Forests (the Pecopala area in the Doksy Sandstones and Wetlands National Nature Reserve).

Using standard methods, 2,982 individuals of 171 species were determined (Kůrka 1995).

As with the carabid beetles (see section 1.8.3 below), the spider assemblage in wetlands in the vicinity of the Břehyně fishpond is most valuable since two new species for the Czech Republic were found there: *Dipoena inornata* in a wet meadow and *Theridion conigerum* in a peat-bog. In addition, there is high species diversity in the spider community studied (101 species found). The relict species inhabiting mountain peat-bogs include *Pardosa sphagnicola*, *Haplodrassus moderatus*, *Heliophanus dampfi* and *Nuctenea silvicultrix*.

Unique relict spider communities were also found at the Pustý rybník peat-bog (33 species recorded) and Boreček wetlands (meanders of the Ploučnice river; 89 species recorded). These communities indicate ecosystems which are relatively undamaged and it is recommended that negative changes to the biotopes are avoided at all three sites which have been studied.

At the Pecopala site in the Polomené hory Hills, 46 forest spider species have been found. Of these, three (*Cercicia prominens*, *Pardosa monticola* and *Saloca diceros*) are relict species.

### **1.8.3. Insects**

#### **Carabids**

Carabid beetles are often used to monitor environmental change (Desender *et al.* 1994, Bohac *et al.* 1995), because both the habitat demands and bionomics of these beetles are

sufficiently known and some of them exhibit a close relationship with particular habitat types. Since they are sensitive to changes in the environment they can be used to assess the quality of a particular biotope or area.

From 1992 to 1994 carabids were studied at 11 sites on the territory of the proposed Doksy Sandstones and Wetlands National Nature Reserve, and the former Ralsko military area. Distribution and numbers of these insects were determined by standard methods (for details see Vonička 1995).

In total, 111 species were determined: under the Czech National Council Act No. 114 and the Czech Ministry for the Environment Decree No. 395, five are classified as specially protected: *Carabus arcensis arcensis*, *Carabus problematicus problematicus*, *Carabus scheidleri scheidleri*, *Cicindela campestris campestris* and *Cicindela sylvatica sylvatica*.

The research confirmed the extraordinary importance of the Břehyně fishpond where 49 carabid species were found, among them some Nordic species which would normally only be expected in the Hercynian mountains in Central Europe.

### **Other beetles**

Of the other members of the order Coleoptera which were collected on the territory of the proposed Doksy Sandstones and Wetlands National Nature Reserve, special attention should be given to (Vonička 1995):

- *Melanophila formaneki bohémica* (Buprestidae); known from only three sites in the Czech Republic, including the Břehyně fishpond.
- *Ergates faber faber* (Cerambycidae); found at Staré Splavy, it is known from only two sites in the Czech Republic.
- *Rosalia alpina alpina* (Cerambycidae); found in the Slatinné vrchy Hills, the former Ralsko military area and its vicinity is the only occurrence of the species in Bohemia.

### **Crickets and grasshoppers**

In 1985–1994 the distribution of the order Orthoptera was studied in the former Ralsko military area, in the vicinity of the Hamerský rybník fishpond, using standard methods (Honcú 1995a). Thirty-eight species of these insects were found (54% of the known species in Bohemia), probably due to the fact that pesticides and other agrochemicals have not been used there for more than 50 years.

The orthopteran species at Ralsko include mountain and thermophobic species living at relatively low elevation (e.g. *Barbistes constrictus*, *Tettigonia cantans* and *Metrioptera brachyptera*). At the same time, thermophilous species (e.g. *Sphingonotus coerulans* and *Metrioptera bicolor*) occur especially in the south-eastern part of the Soviet former military base. Crickets and grasshoppers can therefore be used as indicators of biotopes that have been minimally affected by humans.



## **Dragonflies**

In 1980–1994 dragonflies were studied in the former Ralsko military area. In 1994, special attention was given to the territory of the Doksy Sandstones and Wetlands National Nature Reserve. To date, 29 members of the order Odonata have been found there (Honců 1995b). Three of these – *Calopteryx splendens*, *Cordulegaster boltonii* and *Sympetrum pedemontanum* – have been listed in the Red Book of rare plant and animal species in Czechoslovakia (Škapec *et al.* 1992).

### *1.8.4. Amphibians*

In 1991–1995 amphibians were studied in the former Ralsko military area using these methods:

- Direct observations.
- Determination of frog calls.
- Determination of clutches of eggs and larvae in the field.
- Capture of amphibians by small nets during the aquatic phases of their ontogenesis.
- Pit-fall trapping.
- Questionnaire.

In the course of the study ten amphibian species were found: *Salamandra salamandra*, *Triturus vulgaris*, *Triturus alpestris*, *Pelobates fuscus*, *Bufo bufo*, *Bufo calamita*, *Hyla arborea*, *Rana dalmatina*, *Rana temporaria* and *Rana ridibunda*.

The occurrence of five other species, *Triturus cristatus*, *Bombina bombina*, *Bufo viridis*, *Rana arvalis* and *Rana esculenta*, is disputed. These species were either reported from the area under examination in the past and have not been recently found, or have been reported occurring outside the former Soviet military base.

Further information and distribution maps for amphibians can be found in Zavadil and Vitáček in prep. As amphibians are often used for monitoring changes in the biota, further examination would be useful.

### *1.8.5. Birds*

During the ornithological research, a total of 105 bird species were found in the area (Šťastný and Bejček in prep.).

In May 1993, bird communities of the Ralsko military area were examined by the point census method (Svensson 1977) modified by Šťastný *et al.* (1990). In the course of the research, birds were counted at 230 sites (21km<sup>2</sup>). The census points were located so as to include all the habitats in the Ralsko military area and its vicinity (Table 10). Field work was carried out between dawn and 09:30 hours Central European Time and singing males were considered to indicate a pair.

**Table 10. Proportion of habitat types in the study plot for analysis of bird communities in the Ralsko military area**

habitat	proportion (%)	area (ha)
mixed forests	24.12	497.04
pine forests	20.58	423.20
other coniferous forests	13.67	281.76
open clearings	7.29	150.24
coniferous plantations	6.37	131.25
grasslands	5.00	103.03
spruce forests	4.02	82.87
tank ranges	3.24	66.74
beech forests	3.24	66.74
meadows	2.65	54.65
reedbeds	2.59	53.31
dispersed greenery	2.17	44.79
mixed plantations	1.09	22.40
built-up area	0.67	13.89
deciduous plantations	0.63	12.99
pine bush	0.59	12.09
deciduous forest	0.50	10.30
birch growth	0.48	9.85
tank trails	0.41	8.51
alders	0.26	5.38
peat-bogs	0.22	4.48
spruce bush	0.11	2.24
weekend-cottage built-up area	0.07	1.34
fishponds	0.04	0.90

In total, 84 bird species were found, only four of which (*Fringilla coelebs*, *Phylloscopus trochilus*, *Alauda arvensis* and *Sylvia atricapilla*) had a dominance measure of over 5%, indicating a high level of species diversity. Forests and clearings were found to have a higher species diversity than grassland and tank ranges. However, the latter are extremely important because they are significant habitats for species rare in the Czech Republic, e.g. *Lanius collurio*, *Saxicola* spp. and *Miliaria calandra*. Grassland and tank ranges need to be very carefully managed since they are in an early successional stage. They include habitats of a temporary character, so changes due to continuing succession must be expected to occur.

The most valuable parts of the area under study for birds are situated along the shores of the Břehyně fishpond and in open grasslands and fallow land near the village of Kuřivody. Around the Břehyně fishpond there is a mosaic of forest and wetland biotopes, where three important bird species are found: *Tringa ochropus*, *Grus grus* (only three breeding sites in the Czech Republic) and *Haliaeetus albicilla* (only three breeding sites in the Czech Republic and a globally threatened bird species) (Collar *et al.* 1994). In addition, clearings and coniferous plantations within large forests are an important element in the landscape because they are inhabited by *Lullula arborea* and *Phoenicurus phoenicurus*. The dominant birds of the beech forest fragments are *Dryocopus martius*, *Columba oenas* and *Ficedula* spp.

**In the Czech Republic the globally threatened white-tailed eagle *Haliaeetus albicilla* breeds successfully in only two areas; one of them is the former Ralsko military area and its vicinity (photo by Josef Hlásek)**



## **1.9. Management principles in the Mladá and Ralsko military areas**

### *1.9.1. Guidelines for environmentally sensitive management*

#### **Forests**

In the proposed Doksy Sandstones and Wetlands National Nature Reserve, it is necessary to aim for the natural state of growth corresponding to the respective forest types using revitalisation and some control measures. This principle should also be applied to forest stands which are able at least partially to be self-regulated or to regenerate naturally. In the longer term, forestry interventions should aim to support spontaneous natural regeneration processes, in line with the goal of maintaining an example of the natural forest community for the corresponding ecotype.

Both in the National Nature Reserve and its buffer zone non-native species should be prohibited, as should stands of unsuitable wood species, e.g. spruce and pine in deciduous/mixed forests.

To support the ecological stability of the forests and to decrease the possible level of pollutants in the landscape, so-called pest species should be controlled biologically rather than chemically wherever possible.

#### **Grasslands**

The dry open grasslands which have developed over parts of former shooting and tank ranges in both military areas represent unique habitats containing rare plant communities, and should be kept as natural as possible. Active management is required to prevent trees and bushes from over-growing these open biotopes. Appropriate measures for achieving this have been suggested by research carried out at Mladá military area during the current project. In addition, this research paid special attention to developing methods which are as inexpensive as possible (see section 1.9.3 below).

#### **Agricultural lands**

To maintain a high level of employment among inhabitants and at the same time to preserve the cultural and landscape structure of both areas, farming should not be excluded. Indeed, at the Mladá military area especially, there are excellent conditions to begin environmentally sensitive organic farming (e.g. ecological meadow management, cattle grazing at sites which should be kept open, etc.). It is proposed that arable land should be confined to marginal parts of both areas.

The concept of organic or alternative farming may also draw on local knowledge of traditional agricultural methods. In the early 1990s, the former Czechoslovak Federal Government invited people of Czech origin from the Tchernobyl area of the Ukraine to return to former Czechoslovakia. Many of these people have experience of

using very traditional farming practices (e.g. hand-mowing, use of manures rather than fertilisers etc.).

### **Water management**

Since all the wetland ecosystems in both the former military areas are of significant natural value (e.g. well-preserved river and stream systems, medieval fishponds, rare and vulnerable wetlands), water management should be limited. In order to reduce eutrophication, no fertilisers should be applied to fishponds.

### **Ecotourism**

For various reasons, both the Mladá and Ralsko military areas are regions where some forms of ecotourism as well as agrotourism should be developed.

- Both areas, and especially the Ralsko military area, are very attractive for sensitive tourism because of their significant natural beauty.
- Access has been unavailable for many years (Mladá 1904–1991, Ralsko 1950–1991).
- They are relatively easily accessible, and are not far from Prague, which is visited by most foreign visitors to the Czech Republic.
- Close to the southern edge of the Ralsko military area, there is one of the greatest tourist centres in the Czech Republic, the Máchovo jezero fishpond. At some sites, pressure by tourists on nature and landscape is clearly unsustainable (e.g. Doksy and Staré Splavy). Thus, establishing suitable equipment and infrastructure in the Ralsko military area, fully respecting the capacity of the region, should lessen the impact of tourists on overexploited localities. Because development of tourism has been uncontrolled within the Ralsko military area, some parts have been damaged (e.g. the Hradčany Sandstones). On the other hand, the village of Hradčany has good conditions for environmentally sensitive tourism. Services for ecotourism and agrotourism are believed to be an important way to generate income in both military areas.

The above-mentioned principles were included in the Obligatory Land Use Plans for both so called “large area units”, and indicated on the maps.

#### *1.9.2. Special management requirements for active protection of bird populations and communities in the Mladá and Ralsko military areas*

In both the former military areas, the most threatened biotopes include grasslands (in the training grounds) and wetlands. These biotopes are particularly important for bird conservation. The future occurrence of rare or endangered bird species, particularly in the waste areas, tank training ranges, target areas etc., is dependent upon the continuing plant succession. Extremely invasive herbaceous species, e.g. *Lupinus polyphyllos*, *Urtica*

*dioica* and trees such as *Sarothamnus scoparius*, *Salix aurita*, *S. caprea*, *Betula pendula* and *Populus tremula* endanger the natural regeneration of grassy vegetation, compete with the semi-natural vegetation or spread over areas from which vegetation has been removed (Husáková *et al.* 1992). This process damages biotopes suitable for *Saxicola torquata* and *Saxicola rubetra*, for example, to say nothing of additional rare and protected species of other vertebrates, invertebrates and plants.

One possible way of periodically removing vegetation from at least part of the area is to keep suitable wild or domestic grazing animals which could replace, at least to some degree, the disturbance previously caused by military vehicles and exploding shells. However, it is necessary to keep in mind that many of the important bird species are ground-nesters (e.g. *Miliaria calandra*, *Saxicola torquata*, *S. rubetra*, *Alauda arvensis*, *Anthus pratensis*, *A. trivialis*, *Coturnix coturnix* etc.), so, for example, at the site Pod Benáteckým vrchem grazing should be permitted only in the centre of the proposed nature reserve. On marginal hillside biotopes undesirable shrubs and trees could be eliminated and grasslands mown once every few years, but never before late August, i.e. after the bird breeding season (for a detailed zonation of the proposed management scheme, see Marhoul in prep.).

It is necessary to maintain the species-rich and structurally varied landscape of the former military areas, which would be damaged if modern intensive agricultural practices or housing developments were allowed to take place (IUCN 1995). Instead, the areas should be utilised for environmentally-sensitive agricultural practices, sensitive tourism and health and recreation purposes outside the proposed complex system of small protected areas.

### 1.9.3. Special notes on the management of dry grasslands in the Mladá military area

In the course of the project, special attention has been paid to suitable management of xerothermic grassland plant communities belonging to the alliance *Bromion erecti*. To maintain the stage of advanced secondary succession in these habitats, it is necessary to remove old dead grass and to carry out the subsequent differentiated management through appropriate care of extensive meadows or pastures. Because of the positive influence of grazing on species diversity, this management measure is highly recommended (see Table 11). Alternatively, mowing can also eliminate predominant grass species from the biotopes but they would need to be mown at least once a year.

Severely disturbed sites created by the use of military vehicles need to be cleared and then sown with appropriate mixed seed of native species, with extensive management techniques applied to the newly formed cultural meadows.

Unfortunately this method of revitalising damaged areas cannot be applied at some sites in the Mladá military area, namely in the proposed protected areas with

**Table 11. Effects of management on dry grasslands with the alliance  
*Bromion erecti***

factor	grazing	mowing
<i>vegetation:</i>		
vertical distribution	formation and maintenance of structural diversity causing higher species diversity	uniform changes resulting in homogeneity
horizontal distribution	formation and maintenance of an increasing number of 'vegetation islands'	same
<i>soil:</i>		
microrelief	formation and maintenance of variation in relief, increasing activity of ants and European mole ( <i>Talpa europaea</i> )	flushing of the surface
nutrients	redistribution of nutrients supports stabilisation of biodiversity	no changes
soil cohesion	local differences	no changes

valuable communities of the alliance *Bromion erecti*. Also, mixed seed of native species is either unavailable or very expensive. Because these habitats have been seriously threatened by invasive undesirable plant species (e.g. *Bromus inermis*, *Calamagrostis epigeios* and *Cirsium arvense*), the traditional technique of promoting meadow growth by using parts of grass spikes and seed fallen from harvested hay is required.

In 1994–1995 an experiment was carried out in a plot covering 150m<sup>2</sup> in a ruderalised grassland (fallow-land) where the soil had been compacted by military vehicles. In April 1994 the experimental plot was ploughed. In late July and early August of the same year about a third of the experimental plot was covered with a layer of hay 5–15 cm thick. The hay had been mown from a habitat with a similar species composition. The hay was removed after the vegetation season: 100m<sup>2</sup> were used as a control area without interventions and disturbances.

In May and August 1995 both the experimental and control plots were geobotanically examined. In the former, growth dominated by *Bromus erectus* had developed. Compared with the control plot, higher species diversity was found because the proportion of undesirable grass species of the order *Arrhenatheretalia* was significantly reduced.

## 1.10. Conclusions

The long-term use of both the Mladá military area in Central Bohemia and the Ralsko military area in North Bohemia resulted in local degradation of the environment, in particular severe contamination of surface and underground waters. Paradoxically, these activities have affected fauna and flora to a lesser extent. The fact that these relatively large areas have for a long time been 'forbidden' zones has even had a positive influence, especially in comparison to the intensively-used agricultural landscape in their vicinity, which forms the landscape matrix for many plant and animal species and their assemblages and communities. Research carried out in 1990–1995 confirmed the presence of many very valuable natural features in both areas under study. Their conservation and maintenance in the near future depend mainly on establishing a really representative network of small specially protected areas and suitable management schemes.

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## **2. Hungary**

### **2.1. Introduction**

In response to the expected withdrawal of Soviet troops stationed in Hungary, and to the decrease in the national armed forces, in 1990 the Hungarian Defence Ministry allocated 75 shooting ranges and exercise areas for civilian use, covering a total area of 23,635ha. Since most of these former military areas are on poor (alkaline, sandy or rocky) soils of minor agricultural value, there has been little dispute over allowing nature conservation interests to take priority. This situation inspired conservationists to assess and evaluate the environmental condition and natural values of the former military areas, and find new uses for them in the framework of an environmentally friendly regional development.

The project reported here analyses the results of some basic surveys, including the “Iron Curtain Programme” of the Pedagogical High School of Szombathely and the Institute for Ecology and Botany of the Hungarian Academy of Sciences, Vácrátót, as well as the Status Report of Nature Protection Values carried out by the Nature Conservation Authority of the Ministry for the Environment and Regional Policy. Our own contribution is a national overview of the alternatives for civilian use of the former military areas, and a more detailed analysis of the local possibilities with reference to a case study. Most of the data collection and field work was done in 1994.

In comparison with the original objectives, set out in 1992–1993, the project’s priorities have undergone some changes. Only four former military areas, covering 4,434ha, had been put under nature protection by July 1995. The transfer of military installations to civilian use also slowed down in other areas. The causes of this are complex, and include the lack or unreliability of existing land registration data, high restoration and repair costs, financial problems of the local governments, and, last but not least, the army’s new found desire to retain as much territory as possible. In spite of this, some promising changes have been noted in the army’s environmental and conservation policy, so that efforts should be concentrated on this aspect in the project follow-up.

### **2.2. Military areas from the conservation perspective**

Military areas have attracted the attention of conservationists for some time, especially in Central and East European countries where extensive areas, including the border zones, were put under military control after World War II. Since 1945, a period remarkable for the rapid intensification of agriculture and forestry and later the development of recreational areas, military areas seemed to be almost the safest way to preserve natural resources, although these resources had often been little known, and, sometimes, overestimated. In

spite of this, the isolation and the suppressed economical use of these areas undoubtedly helped to prevent disturbance and maintain a more natural ecosystem structure, resulting in 'passive' nature conservation.

In recognition of their value for conservation, certain military areas were declared nature reserves from the very beginning of the official nature protection programme (Lake Baláta in 1942, Szentgál Taxus Forest in 1951, Uzsa Heather Forest in 1951, and Pákozd Wobbly Stones in 1951). This trend became more apparent in the 'heroic age' of the 1970s and 1980s when most of Hungary's national parks and protected landscape areas were established. The new design principles for protected areas (designating zones for differing degrees of protection, including the complete range of habitat types, provision of links between protected areas etc.) made it necessary to create larger and more heterogeneous units for protection. Certain kinds of military areas (exercise sites, shooting ranges, and the former Iron Curtain zone) fit well into this scheme.

Undoubtedly, the legislative process employed in this territorial protection had also been responsible for limited harmony of conservation and military policies. Protected areas on the national level were designated by the Minister for the Environment (before 1987 by the President of the National Authority for Environmental Protection and Nature Conservation), after the agreement and approval of the relevant authorities at the highest level: the mining and energy producing industries (with absolute priority and right of veto), water management, and agriculture. These authorities were often in strong opposition to protected area designation. The Defence Ministry mostly proved to be a supportive or neutral partner because such legal protection did not conflict with the traditional military use of the areas.

This relationship sometimes ran into problems. The repeated outbreaks of fire, e.g. in the Bugac Primeval Juniper Forest and Kiskunság National Park, were widely reported even in the mass media, but the background details remained less well-known. In fact, the leaders of the Soviet troops garrisoned in Hungary never intended to cooperate with the National Park Directorate about the timing of exercises, or the use of incendiary shot in the driest late-summer season. Finally, in 1987, the National Park Directorate took legal action against the Soviet Army for compensation, based on a symbolic value of the protected species completely eradicated. This judicial case remained unsettled even after the withdrawal of the Soviet troops.

After the democratic changes and departure of the Soviet Army, certain military areas were released and put under nature protection. The traditional dual responsibility for management of the existing nature-protected military areas continues. A prospect for the future could be an agreed system, which would cover not only the protected military areas, but also incorporate them into existing continental-wide land use frameworks like EECONET and ESA systems. The military areas considered to be of high natural value are listed in Table 1 and shown on Map 1 (following page 66).



### 2.2.1. Classification of the military areas

Areas managed and used by military organisations can be classified as follows:

1. logistic areas:  
barracks; institutions; institutes; housing estates; others
2. drill sites:  
shooting ranges; exercise areas
3. special bases:  
airfields

**Table 1. Military areas in Hungary with high natural value**

no.	name (settlement)	size (ha)	habitat type(s)	conservation importance	protection status	former user	present user
1.	Hortobágy	7,050	G,W	international	NP, s.p.p.	Su	Hu
2.	Orgovány	3,028	G,F,W	international	NP, s.p.p.	Su, Hu	KNP
3.	Dorog	1,421	G,F	national	*	Su	BTI, Hu
4.	Hajmáskér	1,200	G,F	national	*	Su	Hu
5.	Kunpeszér	1,024	F,G,W	international	*	Su	Hu
6.	Bócsa	901	G,F,W	international	NP, s.p.p.	Su	KNP
7.	Kecskemét	646	G	local	–	Su	Hu
8.	Pákozd	615	F,G	national	p.p.p.	Su, Hu	Hu
9.	Verpelét	451	F,G	local	–	Hu	Hu
10.	Tarany	414	G,F	local	–	Hu	Hu
11.	Kunszentmiklós	400	G,W	international	NP, s.p.p.	Su	Hu
12.	Vát	400	G,F	local	–	Su	Hu
13.	Ófehértó	370	G	national	–	Hu	Hu
14.	Nagyatád	303	F,G	local	–	Hu	Hu
15.	Ságod	266	G,F	local	–	Hu	Hu
16.	Martinka	264	F,G	local	*	Hu	Hu
17.	Gyál	250	G,(F)	local	–	Hu	Hu
18.	Túrkeve	203	G,W	international	PLA	Hu	KMTI
19.	Kisgyőr	202	F,(G)	national	*	Hu	Hu
20.	Hajdúsámson	201	G,(W)	international	*	Hu	Hu
21.	Nagyтétény	200	G,(F)	local	*	Hu	Hu
22.	Szolnok	186	G,(W)	local	–	Hu	Hu
23.	Aradványpuszta	172	G,F	local	–	Hu	Hu

.../continued

4. service bases:  
stores; repair bases
5. forest/game management estates
6. areas used for temporary activities

From the conservation viewpoint, two types of installation require particular attention: the drill sites and the forest and game management estates of the Ministry of Defence.

The drill sites cover a relatively large area. Shooting ranges are of the order of 10–100ha. The extent of exercise areas might range up to more than a thousand hectares. In the case of shooting ranges, the activity affecting nature values is concentrated in a

Table 1. (continued)

no.	name (settlement)	size (ha)	habitat type(s)	conservation importance	protection status	former user	present user
24.	Bátaszék	116	F,G	local	–	Hu	Hu
25.	Tamási	116	F,G	local	–	Su	Hu
26.	Szeged	103	G	local	–	Su	Hu
27.	Taksony	95	G,(F)	national	–	Hu	Hu
28.	Tab	80	F,G	local	–	Su	Hu
29.	Tolna	79	F,G	local	–	Su	Hu
30.	Zalaszentiván	79	F,G	local	–	Hu	Hu
31.	Jászberény	73	G,W	local	–	Hu	Hu
32.	Ivád	50	G,F	local	–	Hu	Hu
33.	Dombóvár	47	G,F	local	–	Su	Hu
34.	Sárbogárd	17	G,F	national	–	Su	Hu
35.	Cegléd	14	G	local	–	Hu	Hu

**habitat type(s)***G: grassland**F: forest and forest steppe**W: wetland, temporary wet  
grassland**predominant habitat given  
first; insignificant**habitats are in brackets***protection status***–: not protected**\*: planned for protection**s.: strictly protected**p.: protected**p.p.: pro parte (part of  
the whole area)**NP: National Park**PLA: Protected**Landscape Area***former and present user***Su: Soviet Army**Hu: Hungarian Army**KNP: Kiskunság National Park**BTI: Budapest Directorate for  
Nature Protection**KMTI: Körös-Maros**Directorate for  
Nature Protection*

definite part of the area. Activities in the exercise areas can be divided into infantry, artillery, tank, chemical defence or mixed. Special emphasis must be given to the safety areas, which assure natural, undisturbed states.

The forest and game estate managements of the Ministry for Defence administer large areas, including some protected areas (Lake Baláta PA, Pákozd Wobbly Stones PA, Szentgál Taxus Forest PA, Uzsa Heather Forest PA) and other areas that deserve protection.

Military use of non-military areas has caused conflict with conservation interests on several occasions in recent decades. In protected areas, precious grasslands (Pilis PLA, Fót Somlyó hill PA) have suffered erosion or fire damage, because of the lack of preliminary agreements on summer manoeuvres. However, at present there is no demand for military use of non-military areas.

The military areas under nature protection are usually included in the "strict protection" category, because they are closed to visitors. Conservation is taken into account in the operational regulations of the military areas which border on protected areas, or have increased importance for nature.

This study does not deal with the conservation of shooting ranges belonging to the Ministry of the Interior. The extent of these areas is much less, and the reasons for their protection are the same. We only mention in passing the former Austrian and Yugoslavian border, which ceased to be under military control in 1991. The present ecological state is the result of management practices of the past 45 years. The natural state of the western border is discussed in a comprehensive study (Németh 1993). For now the Ministry of the Interior's remit is to guard the border, which does not affect natural habitats.

### *2.2.2. Biotopes and natural values*

With a few exceptions (such as peatbogs and mountain meadows) the whole habitat spectrum of Hungary is represented to some extent in military areas. The extent, relative share and conservation importance of these habitat types is extremely varied (see Table 2). Forests and grasslands are the most extensive and important types, and are therefore at the centre of protection considerations.

#### **Forests**

About 100,000ha of Hungary's military areas are covered by forests. In Central Europe, forest communities contain the greatest biological diversity, due to their high biomass and wide microhabitat range. Some 40% of native plant species occur in forest habitat complexes. For vertebrates the ratio is similar, while for lower plants and animals the ratio is even higher. The uniqueness (i.e. the relict and endemic character) of forest diversity is relatively low, since most of the species are widely distributed on the continental scale. The climactic forests (lowland hardwood forests, xerophilous oak forests, turkey oak-sessile oak and hornbeam-oak communities, beech forests) are richer, older and more

Table 2. Habitat types and conservation importance of the military areas

habitat complexes	proportion	habitat types	importance
wetlands	–	springs and creeks	+
		riverine habitats	+ – +++
		ponds and lakes	+
		marshes, fens, reed groves	+
		temporary wet meadows	+ – +++
grasslands, scrub	++	rocky pioneer grassland	+ – ++
		sandy pioneer grassland	++ – +++
		loessic pioneer grassland	++
		alkaline pioneer grassland	++ – +++
		steppes and meadows	++ – +++
		scrubby grasslands	+ – ++
		flooded groves	+ – ++
forests	++	ash and alder bogs	++
		lowland hardwood forests	++
		colline oak forests	+ – ++
		beech and hornbeam forests	+ – ++
		rocky and chasm forests	++
		white poplar - juniper forests	++ – +++
		birch - juniper forests	++
		coniferous forests	+ – ++
		adventive scrubs of <i>Ailanthus</i> , <i>Elaeagnus</i> , <i>Amorpha</i> etc.	–
		<i>Robinia</i> forests	– – +
ruderal area (‘waste land’)	+	nitrophilous vegetation	–
		devastated surfaces	–
		fallows, abandoned arable lands	–
		intensively cultivated forest tree plantations	–
		agricultural areas	–
		parks	– – +
artificial habitats	+		

**proportion**

–: insignificant

+: low

++: dominant

**importance**

–: negative or indifferent

+: local and occasional

++: national

+++: international

extensive, and such high levels of diversity have been recorded in many military areas. Even without a complete inventory, it is clear that military areas support significant, or at least relatively less threatened, populations of protected species such as *Cyclamen purpurascens*, *Erythronium dens-canis*, *Asphodelus albus*, *Taxus baccata* and *Daphne laureola* among the higher plants, and black stork *Ciconia nigra* and white-tailed eagle *Haliaeetus albicilla* among the birds.

More distinctive is the flora and fauna of certain relict habitat islands such as rocky and chasm forests. For example, populations of *Primula auricula*, *Ferula sadlerana*, *Cypripedium calceolus* and *Allium victorialis* have been found surviving in forests of military use, and rare predatory birds enjoy the tranquillity. In the late 1970s, when the Hungarian population of the falcon *Falco cherrug* was at its lowest level, army volunteers helped ornithologists guard the few known nests in the Gerecse mountains during the breeding season.

Further unique habitat types are the varieties of the Juniper *Juniperus communis* forests associated with white poplar *Populus alba* on the calcareous sand of the Kiskunság area, and with birch *Betula verrucosa* on the acid sand and gravel of Middle and Southern Transdanubia. To persist, these secondary forests require a certain level of disturbance, which is provided in the more extensively used exercise areas. Nevertheless, the sustainable management of these habitats is problematic in general, and often there is not a sufficient scientific basis for management proposals. The natural value of these open forests is concentrated in their herb layer which originates from the grasslands of the neighbourhood, and will be discussed within the grassland category.

These forests play an important role in soil protection, surface and groundwater balance and climate regulation. They serve mostly as protection and safety zones for different installations and, to a smaller extent, as exercise areas. Their secondary functions are timber production, game management and nature conservation. The latter two require natural forest management.

Conditions are favourable because the economic constraints are less than those of other state or private enterprises, particularly in recent decades when the military foresters have not been interested in profit. Large, continuous forest areas were unused, especially in the Transdanubian mountain range and hilly country. Now many parts of them serve as units of the Forest Reserve Network, established in 1993–1994, in cooperation with the Ministry for Agriculture and Ministry for Environment and Regional Policy. The network contains representatives of each native forest type in Hungary, especially old, undisturbed types with high biodiversity. In the core areas of the units all management activities have stopped, and the buffer zones are managed as naturally as possible. This programme involves the following three units of the forest companies of the Defence Ministry (each under protection):

- Burok Valley Forest Reserve in the East Bakony mountains in Middle Transdanubia with beech, hornbeam, rocky and chasmophilous forests. Core area: 95.8ha, buffer zone: 132.4ha.

- Lake Baláta Forest Reserve in Somogy county in Southern Transdanubia with lowland hardwood groves, oak, hornbeam and beech forests, alder bogs and wetlands with relict flora and fauna. Core area: 50.8ha, buffer zone: 185.4ha.
- Gerecse Forest Reserve in the Gerecse mountains in Northern Transdanubia with a complete assortment of calciphilous colline-montane deciduous forests. Core area: 91.1ha, buffer zone: 317.7ha.

Other extensive military areas lying in protected landscape areas are designated for nature conservation in the forest management plans. This will mean the application of management techniques that favour conservation.

### Grasslands

The typical setting for military exercise grounds and firing ranges is grassland, representing very different habitat types. Species richness is lower than in forests, but due to its uniqueness grassland biodiversity can be of equivalent or even greater value. In general grassland vulnerability is high, indicating special conservation importance.

The rarest grassy habitats are the semi-desert communities of the Great Hungarian Plain. These are on poor, sandy and alkaline soils in a semi-arid climate, biogeographically and historically related to the steppe belt of Eastern Europe and Central Asia. These habitat islands are embedded into the mosaic of steppes, wetlands and forests, and only such a complete system can maintain the maximum biodiversity.

The majority of the endemic species of the Carpathian basin are concentrated in the sandy habitat complex of the Kiskunság National Park, including one of the two endemic vertebrates, *Vipera ursinii* ssp. *rákosiensis*, which is critically endangered on a global scale. The last viable population of this snake survives on the large shooting and exercise complex at Örkény and Kunpeszér (no. 5 in Table 1). A considerable part of this area has been transferred to civilian use and put under nature protection. On the remaining military area, the distribution of the adder populations was mapped by the zoologists of the Hungarian Ornithological Society, and conservation measures were built into the local regulations for the exercise ground.

The alkaline grassland complex is also represented in the Kiskunság (no. 11 in Table 1), but occurs mainly in the Hortobágy National Park and its surroundings. Apart from a few endemic and eastern plant and insect species, its main attraction is the extremely rich bird fauna. The correct ratio of the wetlands and grasslands is decisive both for the breeding and winter migrating species. Mention must also be made of the other endemic vertebrate of Hungary, the short-toed lark *Calandrella brachydactyla hungarica* (endangered on a global scale), and the most viable population of the great bustard *Otis tarda*. The Dévaványa Protected Landscape Area was created for the protection of the latter. In 1993, it was extended with the addition of an adjacent military exercise area (no. 18 in Table 1) which had been taken over for civilian use.

The other major site of this type, Hungary's only bombing range (no. 1 in Table 1), protected as part of the Hortobágy National Park, remained under Army management, but its use has been considerably reduced. This unbroken alkaline steppe of 7,050ha is a strange hybrid of a natural and man-made landscape, with virgin grassland damaged by tens of thousands of bomb craters. The craters measure 0.2–10 m in diameter and provide a wide scale of new microhabitats in very homogenous surroundings. Nevertheless, the wildlife is very poor due to the decades of intensive use when the continuous noise and explosions drove out or killed most of the bigger animals. For the present, recolonisation has started, but rather slowly.

Another interesting grassland type is the generally secondary feathergrass steppe of the dolomite and limestone hills and plateaux of the Transdanubian Mountain Range. It was formed after the felling of the original xerophilous oak bush forests, and was colonised from the rocky grasslands and forest steppes of the surrounding steeper slopes. Besides some endemic plants (*Seseli leucospermum*, *Astragalus vesicarius* ssp. *albidus*, *Iris humilis* ssp. *arenaria*), the submediterranean character of these grasslands is striking. The largest continuous exercise and shooting range in Hungary in the south-eastern foothills is in the Bakony mountains (no. 4 in Table 1). It belongs mostly to this grassland type but partly to the next one.

Similar in appearance but quite different in species composition is the acidophilous steppe complex on a granite substrate of the Velence hills (no. 8 in Table 1), which is partly protected.

The remaining grassy habitats are covered by secondary plant communities of characterless floral composition, although occasionally containing rarities (e.g. *Digitalis lanata*, *Taeniatherium asperum* etc.). Their conservation importance, together with the more original types mentioned above, is multiple:

- They serve as refuges in agricultural surroundings.
- They enrich the diversity of afforested landscapes.
- They satisfy the demands of many species which spend their life-cycle in different surroundings (e.g. larvae of many butterflies live in forest, the adults fly in the clearings, and similarly dragonfly larvae develop in wetlands, while the adults hunt for prey in open places).
- They provide feeding places for species breeding in other habitats (especially predatory birds).

The correct sustainable management of grasslands is problematic. Almost all types require some slight or heavier disturbance (grazing, mowing, soil erosion, even burning), but the intensity and frequency is crucial. The consequences of insufficient disturbance (relinquishing of the traditional use) are:

- Spontaneous afforestation with native or adventive trees (*Robinia*, *Ailanthus*, *Elaeagnus*).
- Widespread scrub (*Crataegus monogyna*, *Prunus spinosa*, *Rosa*, *Rubus* spp.).

- The spread of native (*Agropyron repens*, *Calamagrostis epigeios*) or adventive (*Asclepias syriaca*, *Solidago gigantea* etc.) weeds.
- Compacting of the herb layer and soil accumulation in open pioneer communities.

The consequences of overuse (mostly overgrazing) are more predictable, leading to a reduction in species richness, biomass and biodiversity. Further, the intensive use of fertilisers, other chemicals or irrigation leads to eutrophication. Eutrophication is not usual in military areas, but other kinds of pollution, mostly from fuel, sometimes occur.

### **Wetlands**

Since the frontier rivers, especially the Drava, were freed from military control, riverine habitats have become insignificant in this context. Instead ponds, marshes, and flood meadows make up the dominant constituents of the grassland (more rarely forest) habitat complexes. They are not threatened by immediate military impact, but the management of their surroundings should be carefully designed.

### **Ruderal habitats**

In general, devastated surfaces, nitrophilous weed vegetation and fallow fields are not of conservation value, but the best can serve as subjects for habitat restoration. The scrubs and forests of adventive species require occasional assessment from the viewpoint of the vertebrate fauna, especially in lowland, treeless surroundings.

## **2.3. Status of the military areas transferred to civilian use**

As mentioned in the introduction, the transfer of the military areas to civilian use has slowed down, and has concentrated on the logistic areas. Even here, the poor quality and condition of the buildings hinders transfer, since selling the buildings or even simply making use of them is difficult. In addition, within the exercise area, the lack or unreliability of the land registration data is an obstacle to the privatisation process. At certain former Soviet bases, even the exact extent of the military area is unknown.

After the withdrawal of the Soviet troops, oil pollution of the soil and groundwater was revealed. This occurred mostly in the service bases and airfields, often affecting the neighbouring logistic and civilian areas. The site renovation costs were estimated at US\$550 million in 1993 (anon. 1993).

Some of the newly protected areas (e.g. Bócsa in the Kiskunság National Park) are faced with similar problems due to ammunition left on or in the soil, some of it still live. For example, in 1993 an extensive forest fire occurred, but could not be controlled effectively as large areas were made inaccessible by the danger of explosion.

Some former exercise fields of the Soviet troops were transferred not to civilian use but to the Hungarian Army. However, many of these are unused, unguarded and practically



free to enter. As a result, local people have begun to make use of this land, and have in some cases caused problems through illegal waste disposal, accumulation of waste metals, stealing of firewood, poaching etc.

Forest management in the areas transferred to civilian use is generally compatible with nature conservation, except for a few privatised areas where signs of overuse are apparent. The future of the former hayfields is uncertain, especially within the former Iron Curtain zone where many of these habitats have been spontaneously afforested as a consequence of giving up their traditional use during military control. The extinction of the plants *Arnica montana* and *Senecio aurantiacus* is put down to this.

### *2.3.1. Alternatives for civilian use*

The possible civilian uses of the former military areas are determined by their former functions, and limited by the restoration needs and financial resources of the new owners. The logistic areas can be used for community needs (schools, hospitals) or for housing, accommodation, tourism or storage. The airfields could keep their function under civilian management (traffic, transport, agriculture or sport).

The shooting and drill ranges provide more alternatives for civilian use. Traditionally, livestock farming, especially sheep, was a common secondary use of the natural grasslands of the military areas. Even now it is the most widespread farming practice in the old and currently used exercise grounds because of its relative economic security and low investment needs. The risk to conservation is the possible lack of sustainability. These pastures are rented for one to two years by private shepherds who are not interested in a longer-term grazing strategy. Consequently, overgrazing is typical. On the other hand, extensive areas are left out of grazing because of lack of water, degradation of pastures which are overgrown by scrub and weeds, or simply through lack of inclination.

Agriculture is a less attractive proposition for the entrepreneur. In fact the extent of arable lands is decreasing even in the agricultural areas.

In forestry, changes of ownership do not cause immediate change because management plans are effective for ten years. An exception is the afforestation of grasslands, which can be problematic from a conservation viewpoint, especially when a non-native tree species is planted in a natural grass community.

Several adjacent military areas can be considered as regional development areas for the villages involved (see the case study below). These areas were given mostly to local governments which had been struggling with increasingly serious budgeting problems, so there may be pressure to divide up and sell these lands for private plots. However, there is also the potential for public use of the land (e.g. for shooting, riding or motor sports).

Waste disposal is another alternative. During the Ecological Impact Assessment of the dangerous waste disposal of Northern Transdanubia, three possible areas were examined.

Two of them had been military areas. One, a shooting range, was excluded from waste disposal and proposed for protection because of its high natural values, concentrated in the loess steppes of the security zone along the valley sides. Unfortunately, the waste disposal possibilities were very soon recognised by the local residents, who took up this alternative haphazardly and illegally, threatening the natural values and polluting the environmental resources, the soil, surface and groundwaters, and air.

Lastly, nature conservation, occasionally combined with ecotourism, could be an economic and important use of the environment. The areas of international and national significance should have priority for this choice. Furthermore, even the less valuable units could serve as elements of the ECONET and ESA systems.

### 2.3.2. A case study: the Strázsa hill at Dorog

Originally, four sites were considered as possible case study areas. Three of them, Örkény (adjoining to no. 5 in Table 1), Pákozd (no. 8 in Table 1) and Hajmáskér (no. 4 in Table 1) are not yet taken over for civilian use, in contrast to the Strázsa hill at Dorog (no. 3 in Table 1) which is being prepared for incorporation into the Danube Bend National Memorial Park. This involuntary choice may prove to be best because of the complexity of the area, and its management and development problems. The new management plan, made after the area was taken over for civilian use, stresses the area's importance for soil protection and nature conservation.

The study area is situated in the northern part of the Transdanubian Mountain Range, forming the most westerly foothills of the Pilis mountains. It lies 40km north-west of the capital of Hungary, Budapest, 10km away from the state border of Slovakia, and is situated between three towns: Esztergom, Esztergom-Kertváros and Dorog. The maximum height of the double hilltop is 308m above sea level. The relatively small area is composed of different substrates: Triassic (Dachstein) limestone, Jurassic limestone, Eocene bituminous marl, Eocene calcareous sandstone, Pleistocene loess, and Holocene sand-shifts. This geological diversity, with the variety in relief and different historical uses, maintains various habitat types including xerophilous (both calciphilous and acidophilous) oak forests, karstic bush-forests, rocky, sandy and loessic grasslands, some secondary marsh communities, and ruderal places (see Map 2, following page 66).

### Botanical survey

The Pilisvörösvár valley is an important ecological corridor between the Little and Great Hungarian Plains. Its sandy and loessic substrates, with the diverse ecological niches of the surrounding foothills serving as refuges, made possible the postglacial recolonisation of the plains. Along this corridor one can find a unique mixture of mediterranean, eastern and alpine relicts, and even endemic plants such as *Achillea horánszkyi* on the Szamár hill, *Ferula sadlerana* on Mount Pilis, *Linum dolomiticum*, *Carduus glaucinus*, *Knautia*

*kitaibelii*, *Vincetoxicum pannonicum* on the Szénás hills, *Thlaspi montanum* at Solymár and *Digitalis lanata* at Űröm, in a military exercise area.

The vegetation of the study area is a mosaic of original and secondary plant communities of xerophilous character (except for small areas along a temporary creek and two artificial ponds). The ruderal vegetation around the buildings, roads and devastated surfaces is subordinated but could pose a threat in the event of later disturbance of the grasslands. The latter are grazed by sheep and goats. On several parts of the area, overgrazing is noticeable. The forests are in a natural condition and their management is good.

The first botanical description of the study area dates from the last century (Feichtinger 1899). In the 1920s and 1930s, the place was famous among amateur naturalists and photographers for its rich pasque-flower (*Pulsatilla grandis* and *P. nigricans*) populations and other decorative steppe plants. The next report (Seregélyes and Csomós 1993) came from the years after the withdrawal of the Soviet troops. Together with the present survey of 1994, it proves that no significant changes have occurred in the natural value status. The total number of registered higher plant species is 358 (see Appendix, section 2.8 below). The main habitat types are as follows:

#### *Xerophilous oak forests*

This forest type occurs (or rather remains) on the hilltops, ridges and the upper northern slopes. It is a mosaic of three communities, namely the dominant, calciphilous *Orno-Quercetum pubescentis* and *Ceraso-Quercetum pubescentis* of bushy appearance, and the small, subordinate acidophilous *Luzulo-Quercetum*.

The calciphilous oak forest originally covered all of the northern side of the hills as indicated by many characteristic species in the clearings and secondary steppes of the northern slopes (*Brachypodium pinnatum*, *Fragaria vesca*, *Arabis turrata*, *Primula veris*, *Origanum vulgare*, *Lithospermum purpureo-coeruleum*, *Geranium sanguineum*, *Campanula persicifolia*). The forest itself typically represents the maximum biodiversity of this community, with *Quercus pubescens*, *Q. petraea* and *Fraxinus ornus* in the canopy, *Crataegus monogyna*, *Lonicera xylosteum*, *Cornus mas*, *Sorbus torminalis* and *Euonymus verrucosus* in the shrub layer, and with dominance of *Melica uniflora*, *Primula veris*, *Chrysanthemum corymbosum*, *Melittis grandiflora*, *Melampyrum nemorosum*, *Lithospermum purpureo-coeruleum* and *Poa nemoralis* in the herb layer. Locally, some signs of eutrophication are seen, such as the massive populations of *Galium aparine* and *Alliaria petiolata*, due to the high density of big game, deer and boar. The protected plants of this forest community are *Aconitum anthora*, *Iris variegata*, *Dictamnus albus* and *Limodorum abortivum*. The clearings of this forest type contain the original flora and are being naturally regenerated.

The acidophilous oak forest is restricted to the small sandstone surfaces of the north-eastern slopes of the eastern hilltop (Great Strázsa hill). Due to its small area and isolation from the nearest acidophilous forests, the flora is less rich and characteristic. The canopy

is dominated by *Quercus petraea*, and the herb layer is composed of *Luzula multiflora*, *Viscaria vulgaris*, *Hieracium sylvaticum*, *Centaurea stenolepis* and *Digitalis grandiflora*.

The karstic bush forest occurs on the southern slopes of the hills, in a reduced part of its former range. The characteristic trees and shrubs are *Cerasus mahaleb*, *Quercus pubescens*, *Sorbus danubialis* and *Cotoneaster matrensis*. The herb layer is rich in submediterranean species. Protected higher plants are *Sorbus danubialis*, *Cotoneaster matrensis*, *Centaurea sadlerana*, *C. triumphetii*, *Jovibarba hirta*, *Dictamnus albus*, *Inula oculus-christi*, *Iris pumila*, *Jurinea mollis*, *Polygala major* and *Spiraea media*.

### Rocky grassland

The typical calcareous grass communities of the Transdanubian Mountain Range belong to the *Diplachno-Festucetum rupicolae* group. On the Strázsa hill, they are rich in submediterranean floral elements such as *Crupina vulgaris*, *Ononis pusilla*, *Globularia aphyllanthes*, *Trinia glauca*, *Onosma visianii*, *Stipa pulcherrima* and *Dorycnium germanicum*. Except for areas surrounding the quarries, they are undisturbed and spontaneous recovery of the disturbed places is in progress. Protected species are *Jovibarba hirta*, *Onosma visianii*, *Iris pumila* and *Linum tenuifolium*.

### Steppes

The steppes of the northern and southern slopes are of a different character. The more temperate microclimatic conditions of the northern slopes create meadow steppes. These thick tall-grass communities are the richest grasslands of temperate Eurasia. On the Strázsa hill dominants are *Bromus erectus*, *Briza media*, *Carex humilis*, *Campanula rotundifolia*, *Peucedanum cervaria* etc., with hazel *Corylus avellana* scrub. Protected plants are *Adonis vernalis*, *Anemone sylvestris*, *Aster amellus*, *Centaurea sadlerana*, *Centaurea triumphetii*, *Dianthus collinus*, *Dictamnus albus*, *Echium russicum*, *Jurinea mollis*, *Linum flavum*, *Orchis ustulata*, *Polygala major*, *Prunella grandiflora*, *Pulsatilla grandis*, *P. nigricans*, *Scabiosa canescens* and *Stipa joannis*.

The steppes of the southern slopes are generally disturbed. On the western part of the double hill (Little Strázsa hill) there is a mosaic of rocky grasslands and steppes of shallow soils, with *Chrysopogono-Caricetum humilis* communities. Common species are *Chrysopogon gryllus*, *Carex humilis*, *Festuca wagnerii*, *Campanula sibirica*, *Cytisus austriacus*, *Helianthemum ovatum*, *Inula ensifolia*, *Crupina vulgaris*, *Ononis pusilla*, *Scorzonera austriaca* and *Silene otites*. Protected plants are *Helichrysum arenarium*, *Inula oculus-christi*, *Iris arenaria*, *Iris pumila*, *Jurinea mollis*, *Linum tenuifolium*, *Pulsatilla nigricans* and *Scabiosa canescens*. The disturbed areas have a covering of *Crataegus monogyna* scrub, *Rosa caesia*, *Cerasus mahaleb* and *Pyrus pyrastrer*.

The sandy and loess steppes are characterised by many rarities, the former ones even by endemics. These substrates are situated around the bottom of the slopes, and have been damaged by military exercises.

The original sandy steppes are to be found only in small fragments, but their characteristic species have infiltrated into the neighbouring steppes, and include *Achillea ochroleuca*, *Alyssum tortuosum* and the protected *Echinops ruthenicus*, *Helichrysum arenarium*, *Iris arenaria* and *Onosma arenaria*.

Originally, the loessic areas were quite restricted, and are now even more reduced. Their special plants (*Agropyron pectinatum*, *Nepeta pannonica*, *Cerasus fruticosa*) can be found in the surrounding steppes as well, and on loessic soil even the typical grassland community (*Salvio-Festucetum rupicola*) is recognisable, with such characteristic plants as *Salvia nemorosa*, *S. aethiopis*, *Festuca rupicola*, *Taraxacum serotinum*, *Phlomis tuberosa*, *Althaea pallida*, *Euphorbia pannonica* and the protected *Oxytropis pilosa*.

This vegetation belt has suffered the most from the military activities. The starting points for weed spread are the trenches, firing platforms and roads. The most frequent weeds are *Apera spica-venti*, *Artemisia absinthium*, *Agropyron repens*, *Ambrosia elatior*, *Ononis spinosa*, *Gypsophila paniculata*, *Echium vulgare*, *Reseda luteola*, *Onopordum acanthium*, *Sambucus ebulus* and *Carduus acanthoides*. Certain adventive tree species have appeared too, such as *Acer negundo*, *Ailanthus altissima*, *Elaeagnus angustifolia* and *Robinia pseudoacacia*. The area is heavily polluted with different kinds of waste: ammunition, wreckage, demolished buildings, communal waste.

#### *Hygrophilous (marsh) vegetation*

At the bottom of the Little Strázsa hill, along a temporary creek, there are some fragments of willow-marsh and sedge-tall herb communities. Their flora is not distinctive. Common species are *Lythrum salicaria*, *Hypericum tetrapterum*, *Cirsium canum*, *Angelica sylvestris*, *Carex vulpina*, *Salix cinerea* and *S. purpurea*.

Along the shore of the small artificial lakes, reed-groves and poplar-willow groves have established themselves. Characteristic species are *Salix alba*, *S. cinerea*, *Populus nigra*, *Lythrum salicaria*, *Solidago canadensis*, *Carex hirta*, *Eupatorium cannabinum*, *Calystegia sepium* and *Trifolium fragiferum*. The abandoned sand pit at the southern corner of the study area is remarkable for its orchid populations (*Orchis palustris*, *O. militaris*, *Dactylorhiza incarnata*, *Cephalanthera rubra* and *Listera ovata*), all protected species which have naturally regenerated.

#### *Ruderal vegetation*

Areas with devastated and eroded surfaces have lost their original vegetation cover and now contain weeds and plants tolerant of disturbance. These are also found beside roads, structures and buildings. The most frequent species are *Apera spica-venti*, *Ambrosia elatior*, *Agropyron repens*, *Convolvulus arvensis*, *Eryngium campestre*, *Cirsium acanthoides*, *Hypericum perforatum*, *Cichorium intybus*, *Ononis spinosa*, *Salsola kali* and *Artemisia absinthium*. Less weed-like pioneers are *Artemisia campestris*, *Alyssum alyssoides*, *Silene conica* and *Xeranthemum annuum*.

In the abandoned limestone and sandstone quarries, the status of the vegetation depends on the amount of time since abandonment, which varies from three to twenty years. The first plants to recolonise the bare limestone surfaces of the Little Strázsa hill are those of the neighbouring rocky grasslands: *Chrysopogon gryllus*, *Festuca valesiaca*, *Melica ciliata*, *Sedum album*, *S. acre*, *Andropogon ischaemum*, *Dorycnium germanicum*, *Koeleria cristata*, *Seseli osseum*, *Globularia aphyllanthes*, *Stipa capillata*, *Acinos arvensis*, *Dianthus pontederæ* and *Campanula sibirica*. On the walls and slopes even trees and shrubs appear: *Fraxinus ornus*, *Cerasus mahaleb*, *Rosa canina*, *R. corymbifera*, *Cornus sanguinea* and *Ligustrum vulgare*. The older ones are ten to fifteen years old. In other quarries, e.g. at the top of the Great Strázsa hill, or on the south-eastern ridge, the soil and debris had been left and the succession of vegetation is considerably faster. These places are now covered by scrubby, steppe-like communities with *Quercus pubescens*, *Cerasus mahaleb*, *Cornus sanguinea*, *Centaurea sadlerana*, *Potentilla recta*, *Fragaria vesca*, *Teucrium chamaedrys*, *Inula oculus-christi*, *Galium verum*, *Iris pumila*, *Festuca rupicola*, *Inula conyza* etc. The pioneer trees are *Fraxinus ornus* and *Populus tremula*.

The sand and loess quarries are much more sensitive to ruderalisation. Their spontaneous afforestation was started by *Populus nigra*, *Robinia pseudacacia*, *Ailanthus altissima*. Another sand quarry, still in operation, has some conservation importance because of its bee-eater *Merops apiaster* colony.

### *Management recommendations*

Because of the excellent biological diversity of the study area, its primary function should be nature conservation. This seems to be assured by its incorporation into the Danube Bend National Memorial Park. The forest management plan here satisfies conservation needs. More problematic is the use of the grasslands, because there is no legal or financial control of overgrazing, and the present practices threaten the diversity of the grassy habitats. Another urgent task is the clearing of solid wastes from the area and the prevention of further waste disposal.

### **Economic analysis**

#### *Historical background*

The case study area has a very full history. This is an ancient cultural region. Humans first appeared here at the beginning of the Stone Age. Celtic remains have been found in the neighbouring caves (Benczédi 1965), and a number of remains of Roman culture exist. These include an important Pannon fortification system, which follows the right bank of the river Danube, between Esztergom and Budapest. Evidence of the long history of Hungary can also be discovered, for Esztergom has always been one of the most important centres of the Hungarian Christian Church.

However, the present appearance of the case study region has been largely determined during the 40 years following World War II. During that time the main function of this area was the placement of Hungarian and Soviet military installations. The greater part of the territory was used by the conquering and occupying Soviet Army. Soviet Corps stationed here used this territory mainly as a drill ground for a tank division. A large shooting range was built for target practice with light and heavy guns.

#### *Property relations*

In 1991 Soviet troops were withdrawn from Hungary. At that time the predominant part of this territory became the property of the Treasury Asset Management Organisation. A smaller part was previously in use by the Hungarian Army for housing purposes. This area became the property of the local government. The reason for the low proportion of local government ownership of this region is quite complex. It is mainly a result of the large number of local governmental responsibilities. The housing and education programme and restitution of former church properties have been given higher priority, postponing interest in the former military areas.

The present uses of the former military institutions and territories are rather haphazard, and therefore less than efficient. For instance, the former Soviet accommodation complex is almost totally unused. Only the asphalt road surface between the houses is used by the local driving school and an open space of approximately 1ha serves as a drive-in cinema. The preparation and control buildings of the former shooting range are today sheds for a large goat farm.

Areas owned by the Treasury Asset Management Organisation will be sold under competition so the expected future private ownership will vary widely, probably including industrial production and farming as well as service industries, both for tourism and the local population.

The local government does its best to coordinate the economic use of these areas, mainly by organising intensive public relations activities and other promotional techniques aimed at establishing the desired ownership structure.

#### *Industry of the surrounding region*

In the immediate neighbourhood of the study area several small industrial units as well as very large engineering plants (e.g. Suzuki, AMP, Fotex) can be found. Although large scale industry existed here in the past, a great part of it is relatively new in this region. Therefore the factory buildings and the applied technology are quite up-to-date and meet the standards of the last decade of the twentieth century. For example, Dorog boasts coal mining and electricity production based on coal powered plants. These industries are declining in relative importance as are the pharmaceutical and textile industries. There is no significant food industry in this region, except for a small baking industry.

There is however a very strong intention, at state and local government level as well as in the manufacturing companies, to apply environment-friendly technologies. There is a

special regard for environmental aspects in the construction of new industrial plants. It is intended to keep the building level under 30%. By advanced landscaping techniques new planting is improved.

### *Urbanisation*

A large part of the case study area previously used for military purposes is eminently suitable for the expansion of Esztergom-Kertváros. Hungary's former military constructions are nowadays in far better condition, as far as building quality and environmental respects are concerned.

The local government plans to carry out a housing project in this area using buildings previously used for military personnel. Private flats will be developed. The planned objective is to build:

flats	420 units	community centre	300m <sup>2</sup>
school	12 classrooms	commerce and catering	13,700m <sup>2</sup>
play school	75 spaces	sporting area	1.4ha
nursery	25 spaces	public parks	1.1ha
public health	300m <sup>2</sup>		

The area's urban development is a slow process because the local government's only finance for this project comes from selling what were formerly state-owned flats. Because of this the project can only gradually be realised, since each new construction can only be started after the sale of existing flats. In the long term it is planned to extend the housing zone to other parts of the former military areas, including the former shooting range.

### *Agriculture*

Significant farming activity in this area can be expected only after enforcement of the Compensational Law. This was submitted in 1990 and designed to compensate for illegal confiscations after World War II. It has, of course, a special effect on the Hungarian land structure. Nowadays there are many means of additional income which provide part-time work for family farms. These farms include both arable and animal husbandry. The smallholders are selling more and more of their produce direct to the market, but at present home consumption is the most important factor in home production.

The average smallholder of this region can be considered a beginner. Besides a lack of capital his incomplete specialised knowledge hinders progress towards more profitable farming. The fact that there is no professional advisory system with a knowledge of the market and that local government lacks the adequate resources to employ experts and advisers in this field is a great drawback.

Three alternatives have been developed for the future of the agricultural activity in this region by using scenario analysis techniques (Bálint and Czeti 1994).



The first alternative is a well-equipped, specialised, medium-sized farm structure, producing for the market. Considerable local governmental intervention is needed to develop this growing stratum of wealthy farmers, together with all the accompanying social benefits. Significant sacrifices must be made in the present to fuel these future advantages. In addition to the development of a supported, centrally organised, advisory system, extended local investment support needs to be organised. New farmers are in need of financial help to acquire land suitable for agricultural use (e.g. the shooting range and the generally flat and even areas in the vicinity).

The soils in the case study area are suitable for farming. They are mainly Ramann's Brown forest soils and Chernozem Black forest soils. However, in the surrounding area ground cereal and maize production is limited, preference being given to a number of horticultural crops.

The competitive position of agriculture in this region can be described by a SWOT analysis (Thompson and Strickland 1987).

**Strengths:**

- Well-equipped infrastructure.
- Private savings are above state average.
- Adequate soils.
- Good opportunities for irrigation.

**Weaknesses:**

- Lack of experience in agricultural production.
- Lack of good examples.
- No fixed assets.
- High cost of land (as a result of competition).
- Lack of a nearby food industry.
- Less attractive lifestyle.

**Opportunities:**

- Proximity to Budapest, the most important market for fresh agricultural produce.
- Absence of detrimental chemical use. Modern environment-friendly production can be developed.
- In the long term agriculture and landscape protection can complement each other.

**Threats:**

- Reducing competitiveness of Hungarian agriculture as a whole.
- Powerful lobbies in industry appear as competitors for the land.
- Industry and the service sector compete for labour.

In considering this approach the need for a local organisation of private farmers becomes apparent (Neuberger 1977). Such an organisation would have to promote wider application of environment-friendly production methods, such as organic farming and integrated production. Both the environmental aspects (the case study areas are in the buffer zone of a landscape protection area) and market considerations would help the dissemination of these farming

methods. In the first years special market protection is needed for these producers. This type of protection can also be built around environment-friendly farming methods.

The price of agricultural products produced using environment-friendly methods is usually 10%–50% higher than that of products containing permissible chemical additives. This higher price could offset the lower average output that can be achieved here, compared to other parts of the country.

The second alternative for farming in the study region is the so-called 'smallholding'. Production is carried out mainly by part-time family farming, where the determining factor is the family consumption. With this alternative the production structure is wide-ranging and efficient. The most significant activity is small-scale horticulture, especially more extensive cultures with tolerant varieties gaining ground.

The attractiveness of the landscape would be largely destroyed by this scheme. In such a case, smallholdings would be owned by people living 15–50km apart, who would use the land only at weekends for pastime and recreation. Such an owner and cultivation structure inevitably results in 6–8 buildings of 3–6m<sup>2</sup> per hectare. The divided land pattern and the great number of owners raises difficulties in clarification and control. As a result of this the cost of sustaining landscape protection increases greatly.

The third possibility, which can be suggested for the target area, is a form of so-called 'repressed agriculture'. Economic theories describe the competitive advantages (Heyne 1991) which serve as a basis of these development plans. The already existing and developing engineering industry and the immigration of qualified industrial workers can result in positive feedback, which could turn this region into a remarkable industrial centre for the state. Greater urbanisation caused by industrialisation and the prospering tourist industry in the nearby town of Esztergom could transform the case study region into an entertainment and recreation service area.

To achieve this possibility it is essential to set reasonable limits to the industrial activity. The size of the landscape protection area should be increased. Agricultural activity can be restricted by some kind of new local regulation. However maintaining the existing state and local government regulations alone could restrict farming activity considerably.

The tourism industry is expected to develop services that are compatible with considerations of environment protection. An example is the existing riding club, whose horse-shows and riding tours attract a great number of high spending tourists.

In our opinion fulfilment of all three alternatives is possible. There is no order of priority among these variations. Each can be supported by economic arguments. The question of which of them should be realised in the future can be answered only by investigating the various interests of the present owners and of the local population. It is crucial to find a way for these lobbies to reconcile their separate interests.

It is important to realise that these alternatives allow only insignificant overlaps – e.g. a profitable riding tourism could be developed in addition to both smallholder farming and a well-equipped high-tech agriculture. Primarily, however, they preclude each other

because, for example, there is no chance of developing a high level, profitable, professional farming system without considerable local organising effort and central support.

## **2.4. Prospects for nature conservation in the areas remaining in military use**

The environmentally destructive activities of the armies invoked the world-wide cooperation of the conservation and peace movements. Demands have now been made to estimate and repair the environmental damage caused by the armed forces.

The political development of the countries of Central and Eastern Europe also has an effect on the role of their armies, including relations with the civilian community. The Hungarian Defence Ministry accepts and applies the principles declared by the United Nations and NATO, that the primary task of the armed forces is to defend the society which they serve.

Recognising the potential environmental risks inherent in military activities, the Defence Ministry has enforced environment-friendly needs at each phase – planning, operating, closing – of its institutions. These policies were discussed in Norway in 1992 (Conference on Planning Environmentally Friendly Utilisation of Military Establishments and Shooting Ranges), with the following conclusions:

- Planning methodologies can vary country by country, but they should be based on a system of close cooperation between military and civilian experts.
- The national armed forces should enforce the protection of natural and cultural values in their policies and activities. The management of the natural resources involved, in cooperation with governmental and non-governmental institutions, should be sustainable. Management plans are to be worked out for each military base and exercise area.
- It is particularly important to research, evaluate and solve the environmental problems in the case of closing military installations, or when changing their function.
- Improved communications are needed to publicise such efforts.

Hungarian military experts are aware of the threat of military activities to the environment and their effect on nature, and the protection of soil, landscape, biodiversity and living environment. The control of air and water quality, noise, safe waste management, including dangerous waste and live ammunition disposal must be implemented according to the current legislation in each phase of the life of the military installations.

### *Planning*

Ecological Impact Assessments should be carried out before and during the planning of new installations, including the choice of area, in order to analyse and minimise the possible environmental impacts and conflicts of building and working in the area. Principally, new military installations must not be on areas of nature protection, recreation and tourism or on areas that immediately impact on them. As a basic status evaluation, an

inventory of the protected and threatened animals and plants and the mapping of their habitats is necessary. A 'havaria' plan should be made; this assesses possible environmental disasters that could result from military activities (such as fires, chemical contamination), and proposes measures for dealing with such problems if they were to occur.

#### *Operating and maintenance*

Annually, before the start of the military exercise programme, a consultation is necessary with the authorities involved (local governments, directorates for water management, environment protection and nature conservation, local fire departments) to plan for cooperation between these bodies. Continuous control of the environmental and conservation impacts is necessary.

In general, management of sewage and solid waste should be allowed only in closed systems. Where it is impossible to impose conditions, at least cleaning technical instruments and open burning of waste is to be forbidden. Systematic control and maintenance of the environmental and fire protection structures is also required. During exercises, personnel are not allowed to leave the drill grounds. Use of artificial materials is to be minimised. After exercises, any dangerous waste material is to be removed from the drill area.

Training courses are necessary for the troops to learn the principles and active measures of environmental protection and nature conservation. A manual *The Environmental Tasks of Military Field Drilling*, published in 1981, is under revision. Environmental and conservation viewpoints are to be introduced in the evaluation of the military bases and exercises. This methodology was tested in the preparation and evaluation of the joint British-Hungarian army exercise in August 1994.

#### *Closing down and change of use*

An environmental status survey is to be made in such cases, and a restoration plan, including the repair of environmental damage, is to be drawn up. It should cover the restoration or demolition of the installations involved, the restoration of the landscape appearance and water network, and a planting plan, preferably of natural vegetation if it is acceptable to the new use. In practice, as seen in our case study, this planning and its implementation often fails due to insufficient resources.

Incorporation of the area into the regional development concepts is the responsibility of the new owner and user.

## **2.5. Conclusions**

The former and remaining military areas, especially the exercise sites, the forest and game management areas, and the security zones of the shooting ranges, serve as refuges for the

natural flora and fauna, and help nature development activities. In particular, the forests and primary grasslands should become core areas of the National Ecological Network, but most of the remaining habitat types of military use are suitable for nature development areas.

The advantages of civilian management are questionable, especially if there will be an increased number of owners involved. Official protection of the most valuable areas, however, is necessary. The initiatives expressed in the environmental policy of the Army are promising, and augur well for cooperation.

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## 2.8. Appendix: list of the vascular plants of the Strázsa hill study area

<i>Acer campestre</i>	<i>Arum maculatum</i>	<i>Centaurea triumfetti</i>
<i>Acer negundo</i> (adv.)	<i>Asparagus officinalis</i>	<i>Centaureum minus</i>
<i>Acer tataricum</i>	<i>Asperula cynanchica</i>	<i>Cephalanthera rubra</i>
<i>Achillea collina</i>	<i>Aster amellus</i>	<i>Cerasus avium</i>
<i>Achillea nobilis</i>	<i>Aster linosyris</i>	<i>Cerasus fruticosa</i>
<i>Achillea ochroleuca</i>	<i>Astragalus cicer</i>	<i>Cerasus mahaleb</i>
<i>Acinos arvensis</i>	<i>Astragalus onobrychis</i>	<i>Chondrilla juncea</i>
<i>Aconitum anthora</i>	<i>Ballota nigra</i>	<i>Chrysanthemum corymbosum</i>
<i>Adonis vernalis</i>	<i>Berberis vulgaris</i>	<i>Chrysanthemum leucanthemum</i>
<i>Agrimonia eupatoria</i>	<i>Berteroa incana</i>	<i>Chrysanthemum vulgare</i>
<i>Agropyron intermedium</i>	<i>Betonica officinalis</i>	<i>Chrysopogon gryllus</i>
<i>Agropyron pectinatum</i>	<i>Brachypodium pinnatum</i>	<i>Cichorium intybus</i>
<i>Agropyron repens</i>	<i>Brachypodium sylvaticum</i>	<i>Cirsium arvense</i>
<i>Ailanthus altissima</i> (adv.)	<i>Briza media</i>	<i>Cirsium canum</i>
<i>Ajuga genevensis</i>	<i>Bromus erectus</i>	<i>Cirsium eriophorum</i>
<i>Alisma plantago-aquatica</i>	<i>Bromus japonicus</i>	<i>Cirsium vulgare</i>
<i>Alliaria petiolata</i>	<i>Bromus squarrosus</i>	<i>Cleistogenes serotina</i>
<i>Allium flavum</i>	<i>Bromus tectorum</i>	<i>Clematis vitalba</i>
<i>Allium montanum</i>	<i>Bunias orientalis</i>	<i>Colutea arborescens</i>
<i>Allium scorodoprasum</i>	<i>Bupleurum pachnospermum</i>	<i>Convallaria majalis</i>
<i>Allium sphaerocephalon</i>	<i>Calamagrostis epigeios</i>	<i>Convolvulus arvensis</i>
<i>Althaea pallida</i>	<i>Calamintha clinopodium</i>	<i>Cornus mas</i>
<i>Alyssum alyssoides</i>	<i>Caltha palustris</i>	<i>Cornus sanguinea</i>
<i>Alyssum tortuosum</i>	<i>Campanula bononiensis</i>	<i>Coronilla varia</i>
<i>Ambrosia elatior</i>	<i>Campanula glomerata</i>	<i>Corylus avellana</i>
<i>Amygdalus communis</i> (adv.)	<i>Campanula persicifolia</i>	<i>Cotoneaster matrensis</i>
<i>Anchusa officinalis</i>	<i>Campanula rotundifolia</i>	<i>Crupina vulgaris</i>
<i>Andropogon ischaemum</i>	<i>Campanula sibirica</i>	<i>Cydonia oblonga</i> (adv.)
<i>Anemone sylvestris</i>	<i>Cardaminopsis arenosa</i>	<i>Cynanchum vincetoxicum</i>
<i>Angelica sylvestris</i>	<i>Carduus acanthoides</i>	<i>Cynodon dactylon</i>
<i>Anthemis tinctoria</i>	<i>Carduus nutans</i>	<i>Cynoglossum officinale</i>
<i>Anthericum ramosum</i>	<i>Carex hirta</i>	<i>Cytisus austriacus</i>
<i>Anthoxanthum odoratum</i>	<i>Carex humilis</i>	<i>Cytisus hirsutus</i>
<i>Anthriscus cerefolium</i>	<i>Carex liparicarpos</i>	<i>Cytisus nigricans</i>
<i>Anthyllis macrocephala</i>	<i>Carex stenophylla</i>	<i>Dactylis glomerata</i>
<i>Apera spica-venti</i>	<i>Carex vulpina</i>	<i>Dactylis polygama</i>
<i>Arabis turrata</i>	<i>Carpinus betulus</i>	<i>Dactylorrhiza incarnata</i>
<i>Arenaria serpyllifolia</i>	<i>Celtis occidentalis</i> (adv.)	<i>Dianthus collinus</i>
<i>Arrhenatherum elatius</i>	<i>Centaurea jacea</i>	<i>Dianthus pontederae</i>
<i>Artemisia campestris</i>	<i>Centaurea sadleriana</i>	<i>Dictamnus albus</i>
<i>Artemisia absinthium</i>	<i>Centaurea stenolepis</i>	<i>Digitalis grandiflora</i>

## Tanks and thyme

<i>Diplotaxis muralis</i>	<i>Helichrysum arenarium</i>	<i>Malus sylvestris</i>
<i>Dipsacus laciniatus</i>	<i>Heracleum sphondylium</i>	<i>Marrubium peregrinum</i>
<i>Dorycnium germanicum</i>	<i>Hieracium bauhinii</i>	<i>Marrubium vulgare</i>
<i>Echinops ruthenicus</i>	<i>Hieracium pilosella</i>	<i>Medicago lupulina</i>
<i>Echinops sphaerocephalus</i>	<i>Hieracium sabaudum</i>	<i>Medicago minima</i>
<i>Echium italicum</i>	<i>Hypericum perforatum</i>	<i>Melampyrum nemorosum</i>
<i>Echium russicum</i>	<i>Hypericum tetrapterum</i>	<i>Melandryum viscosum</i>
<i>Echium vulgare</i>	<i>Hypochoeris maculata</i>	<i>Melica ciliata</i>
<i>Elaeagnus angustifolia</i> (adv.)	<i>Inula conyza</i>	<i>Melica uniflora</i>
<i>Epilobium hirsutum</i>	<i>Inula ensifolia</i>	<i>Melittis carpatica</i>
<i>Equisetum ramosissimum</i>	<i>Inula germanica</i>	<i>Mentha arvensis</i>
<i>Erigeron canadensis</i>	<i>Inula hirta</i>	<i>Mentha longifolia</i>
<i>Eryngium campestre</i>	<i>Inula oculus-christi</i>	<i>Minuartia fastigiata</i>
<i>Erysimum diffusum</i>	<i>Iris humilis</i>	<i>Muscari comosum</i>
<i>Erysimum odoratum</i>	<i>Iris pumila</i>	<i>Muscari racemosum</i>
<i>Euonymus europaeus</i>	<i>Iris variegata</i>	<i>Mycelis muralis</i>
<i>Euonymus verrucosus</i>	<i>Juncus effusus</i>	<i>Nepeta pannonica</i>
<i>Eupatorium cannabinum</i>	<i>Jurinea mollis</i>	<i>Nigella arvensis</i>
<i>Euphorbia cyparissias</i>	<i>Knautia arvensis</i>	<i>Nonea pulla</i>
<i>Euphorbia pannonica</i>	<i>Kochia laniflora</i>	<i>Onobrychis arenaria</i>
<i>Euphorbia seguieriana</i>	<i>Koeleria cristata</i>	<i>Ononis pusilla</i>
<i>Euphrasia</i> sp.	<i>Lactuca quercina</i>	<i>Ononis spinosa</i>
<i>Falcaria vulgaris</i>	<i>Lappula heteracantha</i>	<i>Onopordum acanthium</i>
<i>Festuca pallens</i>	<i>Lathyrus latifolius</i>	<i>Onosma arenarium</i>
<i>Festuca rupicola</i>	<i>Lathyrus tuberosus</i>	<i>Onosma visianii</i>
<i>Festuca valesiaca</i>	<i>Leontodon hispidus</i>	<i>Orchis militaris</i>
<i>Festuca × wagneri</i>	<i>Ligustrum vulgare</i>	<i>Orchis ustulata</i>
<i>Filipendula vulgaris</i>	<i>Limodorum abortivum</i>	<i>Origanum vulgare</i>
<i>Fragaria vesca</i>	<i>Linaria arvensis</i>	<i>Orlaya grandiflora</i>
<i>Fraxinus ornus</i>	<i>Linaria genistifolia</i>	<i>Oryzopsis virescens</i>
<i>Fumana procumbens</i>	<i>Linum austriacum</i>	<i>Oxytropis pilosa</i>
<i>Galium aparine</i>	<i>Linum flavum</i>	<i>Peucedanum cervaria</i>
<i>Galium schultesii</i>	<i>Linum tenuifolium</i>	<i>Peucedanum oreoselium</i>
<i>Galium sylvaticum</i>	<i>Listera ovata</i>	<i>Phleum pratense</i>
<i>Galium verum</i>	<i>Lithospermum purpureo-coeruleum</i>	<i>Phlomis tuberosa</i>
<i>Genista tinctoria</i>	<i>Lolium perenne</i>	<i>Phragmites communis</i>
<i>Geranium robertianum</i>	<i>Lonicera xylosteum</i>	<i>Pimpinella saxifraga</i>
<i>Geranium sanguineum</i>	<i>Lotus corniculatus</i>	<i>Plantago lanceolata</i>
<i>Geum urbanum</i>	<i>Luzula multiflora</i>	<i>Plantago media</i>
<i>Globularia aphyllanthes</i>	<i>Lysimachia vulgaris</i>	<i>Poa bulbosa</i>
<i>Gypsophila paniculata</i>	<i>Lythrum salicaria</i>	<i>Poa compressa</i>
<i>Hedera helix</i>	<i>Maclura pomifera</i> (adv.)	<i>Poa nemoralis</i>
<i>Helianthemum ovatum</i>		<i>Poa pratensis</i>

## Hungary

<i>Polygala major</i>	<i>Scabiosa canescens</i>	<i>Trifolium repens</i>
<i>Polygonatum odoratum</i>	<i>Scabiosa ochroleuca</i>	<i>Trinia glauca</i>
<i>Polygonum aviculare</i>	<i>Scorzonera austriaca</i>	<i>Tunica prolifera</i>
<i>Populus nigra</i>	<i>Sedum acre</i>	<i>Typha angustifolia</i>
<i>Populus tremula</i>	<i>Sedum album</i>	<i>Ulmus minor</i>
<i>Potentilla anserina</i>	<i>Sedum sexangulare</i>	<i>Urtica dioica</i>
<i>Potentilla arenaria</i>	<i>Sempervivum hirtum</i>	<i>Valeriana officinalis</i>
<i>Potentilla argentea</i>	<i>Sempervivum marmoreum</i>	<i>Verbascum lychnitis</i>
<i>Potentilla recta</i>	<i>Senecio jacobaea</i>	<i>Verbascum phlomoides</i>
<i>Primula veris</i>	<i>Serratula tinctoria</i>	<i>Verbascum phoeniceum</i>
<i>Prunella grandiflora</i>	<i>Seseli osseum</i>	<i>Verbascum speciosum</i>
<i>Prunella laciniata</i>	<i>Sideritis montana</i>	<i>Veronica chamaedrys</i>
<i>Prunella vulgaris</i>	<i>Silene conica</i>	<i>Veronica officinalis</i>
<i>Prunus spinosa</i>	<i>Silene nutans</i>	<i>Veronica spicata</i>
<i>Pulicaria vulgaris</i>	<i>Silene otites</i>	<i>Veronica teucrium</i>
<i>Pulsatilla grandis</i>	<i>Solidago canadensis</i>	<i>Viburnum lantana</i>
<i>Pulsatilla nigricans</i>	<i>Solidago virga-aurea</i>	<i>Viola hirta</i>
<i>Pyrus pyraister</i>	<i>Sorbus danubialis</i>	<i>Viola odorata</i>
<i>Quercus cerris</i>	<i>Sorbus domestica</i>	<i>Viscaria vulgaris</i>
<i>Quercus petraea</i>	<i>Sorbus torminalis</i>	<i>Xeranthemum annuum</i>
<i>Quercus pubescens</i>	<i>Spiraea media</i>	
<i>Ranunculus repens</i>	<i>Stachys germanica</i>	
<i>Reseda lutea</i>	<i>Staphylea pinnata</i>	
<i>Reseda luteola</i>	<i>Stellaria holostea</i>	
<i>Reseda phyteuma</i>	<i>Stipa capillata</i>	
<i>Rhamnus catharticus</i>	<i>Stipa joannis</i>	
<i>Robinia pseudoacacia</i>	<i>Stipa pulcherrima</i>	
<i>Rosa caesia</i>	<i>Symphytum officinale</i>	
<i>Rosa corymbifera</i>	<i>Sysimbrium strictissimum</i>	
<i>Rosa jundzillii</i>	<i>Taraxacum laevigatum</i>	
<i>Rosa rubiginosa</i>	<i>Taraxacum serotinum</i>	
<i>Rubus caesius</i>	<i>Teucrium chamaedrys</i>	
<i>Salix alba</i>	<i>Teucrium montanum</i>	
<i>Salix cinerea</i>	<i>Thalictrum minus</i>	
<i>Salix purpurea</i>	<i>Thesium linophyllon</i>	
<i>Salsola kali</i>	<i>Thymelaea passerina</i>	
<i>Salvia aethiopis</i>	<i>Thymus glabrescens</i>	
<i>Salvia nemorosa</i>	<i>Thymus marschallianus</i>	
<i>Salvia pratensis</i>	<i>Tilia cordata</i>	
<i>Salvia verticillata</i>	<i>Torilis arvensis</i>	
<i>Sambucus ebulus</i>	<i>Tragopogon dubius</i>	
<i>Sambucus nigra</i>	<i>Trifolium arvense</i>	
<i>Sanguisorba minor</i>	<i>Trifolium fragiferum</i>	

### **3. Poland**

#### **3.1. The former Soviet military base at Borne Sulinowo**

##### ***3.1.1. Introduction***

The site of the Soviet Army's former military firing ground near Borne Sulinowo was not available for nature conservation studies for many decades, nor were any flora or fauna studies conducted there before World War II. For this reason it became a matter of the utmost urgency to assess the natural value of the firing ground after it was handed over to the Polish authorities.

Before World War I the area belonged to several large agricultural forestry properties. After 1918 the German State Treasury purchased the forested areas and created the Freierswald States Forestry Inspectorate, with its main headquarters in Marionow (Stankiewicz 1993), which also administered several private forests centred around a few villages. In 1935 the Third Reich resettled the residents of these villages to create a military artillery range which was greatly extended during World War II. The Soviet armed forces took over this area during the final phases of the war and used it as a military firing range until 21 August 1992.

Until 1958, no agricultural or forestry activities were carried out on the firing range. The first division of the range into zones for different activities was carried out in 1960. Until then, the entire Borne Sulinowo area had been used for military purposes, with the small exception of the requirements of the forestry economy. A first assessment of the loss and damage to the forestry economy incurred by the previous users can be found in a plan revised in 1971. It mapped out, from still incompletely assessed leases, the location of the existing forests. Until 1992, the Czaplinek Forestry Inspectorate administered around 18,000ha of forested land within the firing range without the possibility of retaining a permanent base on the area in question.

After the 1992 transfer to the Polish authorities, the forested areas were divided between the inspectorates; the western part was governed by the newly created Borne Sulinowo Forestry Inspectorate, while the eastern part belonged to the Czarnobór Forestry Inspectorate. The residential settlements came under the rural parish administration of Silnowo.

The first studies of the natural resources of the former ranges were carried out with the support of the IUCN Foundation – Fundacja IUCN – in Poland. The aim of these studies was to determine if what remained of the military area would be suitable for incorporation into EECONET, the European Ecological Network. These studies have only been carried out, so far, over less than one growing season. However, a

general picture has been drawn up enabling us to detail several recommendations regarding the future nature conservation management of the area.

### 3.1.2. Description of the area

The Borne Sulinowo installation lies about 14km south-west of Szczecinek. On its western border lies the Piława river, to the south and south-east lies the Czersk–Jeleń road and on the northern side is Lake Pile and the Borne Sulinowo–Jeleń road.

According to the geobotanical division of Poland, this area is located within the Central European lowland-upland province, within the Baltic division, the subdivisions of the littoral belt plains and the Pomeranian Uplands.

The former military site covers over 18,000ha, most of which is now under Forestry Service administration. About 42% of the land is forested, 3.2% is taken up by roads and tracks, 2.3% of the surface area is covered by water and the remaining 52% or so is meadow grass and heather. The central part of the site is open land and is encompassed by a ring of forest.

Water is concentrated along the length of two main river valleys which dissect the site from north to south. The river Piława flows from the Pile lake along the length of the western boundary of the site, creating lake Długie in the upper part of its flow, and further along flows into the picturesque Nadarzyckie freshwater lagoons which cover an area of approximately 350ha. The reservoir north of this area is covered with bulrush *Typha latifolia* communities, which grow not only along the banks but also divide the area of water into several separate pools. There are several small islands here surrounded by wetland plant associations and also two larger islands which are densely overgrown with trees. The lagoons are linked by a network of canals whose banks are overgrown with river valley vegetation. The central and southern reservoirs are overgrown and *T. latifolia* is found only in small inlets.

The Plytnica runs through the eastern part of the site linking several glacial lakes, two of which, the Przełęg and the Kniewo, lie in the vicinity of former military sites. Below lake Kniewo, the Plytnica river flows through a marshy valley heavily overgrown with alluvial vegetation and then cuts a narrow corridor through the forest. As it flows away from the Borne Sulinowo site, the Plytnica leaves extensive wet forest areas to its right, in the south-easterly section of the site.

Tiny reservoirs, small flooded areas and pools of water (*oczka wodne*) form a ring around the central part of the military area; an area of mainly waterless land. The centre of the site is a large, mainly open area, covered in heathers and grasses and on the whole an extensive 'desert' landscape, quite unusual for this part of the Pomerania region. On neighbouring forested land, natural plant succession is occurring – this land is becoming dominated by poplar *Populus tremula*, birch *Betula* spp. and, in places, pine *Pinus* spp. A section of the land is currently being afforested by the Forestry administrative region of Czarnobór and Borne Sulinowo.

### 3.1.3. Botanical evaluation

#### Characteristics of the flora

The report was intended to provide an introductory inventory of the former exercise ground's plant groups, to highlight their botanical value. The inventory focused above all on vascular plants and, from the geobotanical viewpoint, on the basic habitat types there as well as on the main types of plant communities. The data were collected during the 1994 growing season.

Some 376 types of vascular plants were recorded as occurring on the site of the former ranges at Borne Sulinowo. This number comprised seven species of fern, five species of horsetail, two species of club-moss and 362 species of flowering plant. The majority of these are common and of widespread varieties. However, it was also possible to find some that occur rarely in Poland. These included species whose occurrence is restricted to high and transitional peat bogs, such as common andromeda *Andromeda polifolia*, bog arum *Calla palustris*, marsh sedge *Carex limosa*, bog-bean *Menyanthes trifoliata*, the willow *Salix rosmarinifolia*, bog scheuchzeria *Scheuchzeria palustris* and bog bilberry *Vaccinium uliginosum*. The group of rarer water species are represented by fleecy buttercup *Ranunculus lanuginosus* and the simple sparganium *Sparganium emersum*. Among the forest species, the following have been found: winter horsetail *Equisetum hiemale*, mountain pea *Lathyrus montanus*, three-leaved oak-fern *Gymnocarpium dryopteris* and the vetch *Vicia sylvatica*. Finally, the sandy habitats include plants such as common carline *Carline vulgaris*, the bird's-foot *Ornithopus perpusillus* and shepherd's cress *Teesdalia nudicaulis*. The area's value for flora is much increased by species that are protected in Poland.

The following are subject to full protection: round-leaved sundew *Drosera rotundifolia*, juniper club-moss *Lycopodium annotinum* and the peat club-moss *L. inundata*, yellow water-lily *Nuphar luteum* and least water-lily *N. pumilum*; partial protection has been granted to: lily-of-the-valley *Convallaria majallis*, foxglove *Digitalis purpurea*, common alder-buckthorn *Frangula alnus*, the sand helichrysum *Helichrysum arenarium*, marsh tea *Ledum palustre*, thorny rest-harrow *Ononis spinosa*, common polypody *Polypodium vulgare*, common blackcurrant *Ribes nigrum*, cranberry *Viburnum opulus*, and, representing the lichens, *Cetraris islandica*.

#### The importance of the former exercise ground for plant conservation

Although the area is not rich in plant species, the rarer, protected species mentioned above do nevertheless make it a significantly more attractive area in general. Of particular interest is the peat club-moss *Lycopodium inundata* and the least water-lily *Nuphar pumilum* which are both under strict protection. The sites where they occur also require special protection, as do the sites of the other protected plant species.

Priority protection should be given to the habitats of the high peat bog plant communities and the associated xerophobes, on the grounds that these specimens are valuable, endangered and rare, not just here on the former exercise grounds but throughout this part of Pomerania. The wet heaths and parts of the marshy forests in the southern part of the area also deserve to be protected and excluded from normal exploitation by the forestry economy. The lowland and transitional peatlands, those that are scattered over the whole area, as well as those that form part of the valleys of the Plytnica and the Piława, are worthy of protection due to their plant life.

The peat bog plant and animal communities must be protected for their importance to the proper functioning of the many varied ecological chains. However, they are endangered in Poland due to the extensive drainage of the soils and the noticeable fall in the ground water levels.

The extensive psammophilic moorlands, with their uncommonly exuberant lichen populations, have become extinct in most of Poland's regions. It must therefore be advisable to protect parts of these moorlands where the lichens are present. This protection must, however, be active. It would be necessary to preserve the thicket-type formation of these plants on these sites, requiring at least the partial removal of the natural timber undergrowth.

The above considerations make it necessary to propose the following forms of protection for the area's vegetation:

- Protect the highland peat bogs by use of reserves within the Czarnobór Forest Inspectorate and the Borne Sulinowo Forestry Inspectorate.
- Give at least the status of "ecological regions" to all the remaining peat bogs as well as to reservoirs in which stands of protected plants can be found.
- Designate selected parts of psammophilic moorlands in central and north-western parts of the area as ecological regions, as well as the complex of marshy moorlands and woods in the south-western part of the Czarnobór Forestry Inspectorate.
- Classify the Piława and Plytnica river valleys, the Długie Lake with its glacial channel, the Nadarzyckie Lagoons and the valleys of Lake Kniewo and Przełęg as protected landscape areas.

### Summary

1. The initial inventory of the former exercise grounds has shown that the area has an average abundance of flora, which includes, apart from the more common and widespread varieties, many interesting, protected species. Particular attention should be drawn to the peat club-moss *Lycopodium inundata* and the least water-lily *Nuphar pumilum*.
2. Several plant communities have managed to develop and thrive on this extensive and very varied habitat, despite its general devastation. Of particular interest are the peat plant communities and the moorlands which are rich in cryptogamic plants.



3. Timber stands, with very few exceptions, have been destroyed and do not have any value from the viewpoint of plant communities.
4. The most interesting parts of this area's vegetation cover should be protected. Three highland peat bogs merit the protected status of a reserve. All the remaining peat bogs and marshy areas, as well as selected parts of the psammophilic moorlands, should be classified as ecological regions. The Piława and Płytnica river valleys should also be made protected landscape areas.

The former military range has become an interesting topic for scientific research concerning, among other things, plant development, as well as the directions and dynamics of the natural regeneration of devastated plant communities.

#### *3.1.4. Evaluation of the fauna*

### **The significance of the site for selected groups of vertebrates**

#### *Amphibians*

A number of species of amphibian are found in this area particularly in the Nadarzyckie Lagoons which are an important breeding site. Smooth and crested newts *Triturus vulgaris* and *T. cristatus* both occur here as do marsh and moor frogs *Rana esculenta* and *R. arvalis*. The most common species in the area is the common European toad *Bufo bufo*: 300–400 mating individuals can be heard in April in the Nadarzyckie Lagoons alone.

All of these species belong to the moderately endangered category and are therefore subject to some legal protection.

#### *Reptiles*

Five reptile species have been recorded in the area. The viviparous lizard *Lacerta vivipara* and the sand lizard *Lacerta agilis* can both be found, in marshy woods and on the reservoir banks (Juszczuk 1987). The common slow-worm *Anguis fragilis* was not seen in the summer of the survey (no doubt due to the prolonged drought) but is known to occur.

The common grass snake *Natrix natrix* usually inhabits the areas surrounding the reservoirs where there is an abundance of amphibians which constitute its staple diet (Juszczuk 1987). The adder *Vipera berus* occurs in three main areas:

- The swamps in the northern part of the range within the Czarnobór Forestry Inspectorate.
- The belt of mid-forest peat bogs in the southern part of the range within the Czarnobór Forestry Inspectorate.
- The southern part of the range (the mid-forest peat bogs and the surrounds of reservoirs) within the Borne Sulinowo Forestry Inspectorate.

All of these species are subject to some level of protection although none of them are severely endangered.

### Mammals

Some rare mammal species occur in the area. Lagoons and small reservoirs along the Piława river provide breeding grounds for European beaver *Castor fiber* and otter *Lutra lutra*. Otters can also be found the entire length of the river Płynica. Wetlands lying to the west of the southern part of the Płynica provide migrating grounds for elk *Alces alces*.

Also found here are brown hare *Lepus capensis*, red fox *Vulpes vulpes*, raccoon dog *Nyctereutes procyonoides*, wild boar *Sus scrofa*, and roe and red deer *Capreolus capreolus* and *Cervus elaphus*.

### Birds

The area is most valuable for its avifauna. This is made up of 107 breeding bird species (in an area of approximately 180km<sup>2</sup>) and some 59 species of possible breeders per 100km<sup>2</sup>, plus several others which stop over during the breeding season. Compared to other large researched areas in Pomerania, the avifauna of the old ranges is characterised by a high proportion of species per unit of land. By comparison the nearby Drawski Landscape Park (Górski *et al.* 1993) recorded 138 breeding and probably breeding species in an area of about 660km<sup>2</sup> (that is 21 species/100km<sup>2</sup>), while the Bory Tucholskie, which has been designated as a World Biosphere Reserve, has 122 breeding species in an area of 400km<sup>2</sup> (30 species/100km<sup>2</sup> – Przybysz 1983). Within the coastal zones, on the 380km<sup>2</sup> western portion of the Koszalin sea-coast, the presence of 146 breeding and probably breeding species of birds (38 species/100km<sup>2</sup> – Górski 1976) was recorded. In the 180km<sup>2</sup> Słowiński National Park 160 species (90 species/100km<sup>2</sup> – Bednorz 1983) were recorded, with 124 species in the area of the Pobreża (sea-coast) region's rivers (Górski 1982).

In most cases, therefore, the bird species diversity of the relatively small area of the former Borne Sulinowo ranges significantly exceeds that of the larger protected Pomeranian regions (such as national and landscape parks and protected landscape zones).

The Borne Sulinowo area constitutes a breeding refuge for many particularly valuable bird species. Out of the 112 species of birds nesting here and visiting during the breeding season, some 16 species have been found which are particularly endangered within their own range or within the European continent. Twelve of these are birds which nest or probably breed on the Borne Sulinowo area (i.e. golden eagle *Aquila chrysaetos*, bittern *Botaurus stellaris*, black stork *Ciconia nigra*, marsh harrier *Circus aeruginosus*, grey heron *Ardea cinerea*, eagle owl *Bubo bubo*, nightjar *Caprimulgus europaeus*, kingfisher *Alcedo atthis*, black woodpecker *Dryocopus martius*, wood lark *Lullula arborea*, tawny pipit *Anthus campestris* and red-backed shrike *Lanius collurio*), while four more (black kite *Milvus migrans*, Montagu's harrier *Circus pygargus*, lesser-spotted eagle *Aquila pomarina* and osprey *Pandion haliaetus*) visit the area during the breeding season and probably nest in the vicinity

of the old ranges. Numbers of the above do not exceed those for other Pomeranian regions.

However, in the case of the tawny pipit, there appears to be a concentration of breeding pairs, something of an anomaly for this species in Pomerania. This is due to the fact that the biotope in which it usually breeds occurs over an unusually large area in Borne Sulinowo.

The concentration of endangered species in the Borne Sulinowo area puts it on a level with nationally important sites for birds, since the species in question are endangered on a European scale.

In order to award nationwide distinction to a bird refuge, it must be visited by at least five species that are endangered globally or in Europe (Dyrzcz 1989). In Borne Sulinowo this figure is exceeded three times over. Indeed, four of its nesting species (golden eagle, bittern, goldeneye *Bucephala clangula* and eagle owl) and four others that fly in during the breeding season from neighbouring territories (Montagu's harrier, lesser-spotted eagle, osprey and bearded tit *Panurus biarmicus*) were mentioned in the Polish Animal Red Data Book (Głowaciński 1992). Four species on the list of especially endangered birds in Europe (Dyrzcz 1989) were recorded: whinchat *Saxicola rubetra*, Savi's warbler *Locustella luscinioides*, great reed warbler *Acrocephalus arundinaceus* and great grey shrike *Lanius excubitor*. The remainder of the register of endangered species nesting in the area is supplemented either by rare birds or by those in danger of extinction on a regional scale in Pomerania (Górski 1991a). Particularly valuable populations are those of greylag goose *Anser anser* (5–6 pairs), teal *Anas crecca* (which probably nests) and gadwall *Anas strepera*, breeding goldeneye and goosander *Mergus merganser*, as well as sedge warbler *Acrocephalus schoenobaenus*, penduline tit *Remiz pendulinus* and bearded tit. All these occur only locally in Pomerania, with the latter only visiting during the breeding season. Also worth mentioning is the occurrence of the following species which are rare in Pomerania and nest over a widely dispersed area: hoopoe *Upupa epops*, green woodpecker *Picus viridis* and kestrel *Falco tinnunculus* (which is only sporadically encountered beyond ruderal urban areas).

Another reason for the area's ornithological importance on the national level is the significant number of species associated with wetlands, which are among the environments most susceptible to pollution and environmental degradation. Wesółowski and Winiecki (1988) adopted the principle that the occurrence of at least 25 species of aquatic and marsh-based birds in a given area during the breeding season is sufficient to rank it as an important site for the protection of wetland birds in Poland. Borne Sulinowo qualifies for such a distinction in that out of its 107 breeding species and probable breeders, some 29 species occur exclusively on reservoirs and marshy areas while 12 more nest in this biotope as well as in others. A total of 41 species is connected with aquatic-marshy biotopes, which fully justifies the need to include the old ranges on the list of important sites for this group of birds on a national scale.

Habitats which are important for wetland birds are found along the length of the two main rivers, the Piława and Plytnica, which bisect the old ranges. The Nadarzyckie freshwater lagoons, together with neighbouring water pools and floodwaters, are also particularly important here. Nesting birds include heron (2–3 pairs), marsh harrier (2 pairs), bittern, greylag goose (5–6 pairs), goldeneye, goosander *Mergus merganser*, kingfisher (4 pairs), Savi's warbler, great reed warbler, sedge warbler, penduline tit and, on the edges of this area, probably the eagle owl. The lagoons form part of the territory of other birds which nest in the vicinity: golden eagle, osprey and black kite. They are also periodically visited by the black stork, marsh harrier and the lesser-spotted eagle. According to data supplied by the forestry services, up to 200 mute and whooper swans *Cygnus olor* and *C. cygnus* overwinter on the lagoons, while greylag geese also spend the winter here.

Another important breeding area for birds associated with wetland biotopes are the Przełęg and Kniewo lakes which lie along the course of the Plytnica, as well as the peat bog areas to the west of this river in the south-eastern part of the research area. The following birds nest on the lakes and marshy areas connected with the Plytnica as well as along the length of the Plytnica's river-bed: bittern, goldeneye, marsh harrier, heron, golden eagle, black stork, kingfisher, Savi's warbler and great reed warbler. During the breeding season, the bearded tit was also recorded there.

Another habitat with a specific avifauna is an extensive open area covered with heather, where the tawny pipit is most characteristic and whose borders are nesting sites for wood lark, nightjar, great grey shrike and hoopoe.

## Summary

1. During a 12-month period of research, five species of reptiles, five amphibians, and 107 breeding and probably breeding bird species (as well as five more bird species that fly in from surrounding areas during the breeding season) were recorded as occurring on the old ranges. A group of mammals was also recorded, of which the European beaver, otter and elk are particularly notable.
2. The old ranges constitute a particularly valuable bird breeding refuge which is of great importance on a national scale. Thanks to its biotope and microhabitat diversity, this area is characterised by a large number of species per unit of land (59 breeding species per 100km<sup>2</sup>) compared with the large-scale protected areas in Pomerania (i.e. national parks, landscape parks and protected landscape zones). The area fully satisfies the criteria for inclusion into the group of refugia which are important in Poland for the protection they give to endangered species. There are 16 species here which are endangered globally and on the European level, eight species which are recorded in the Polish Mammal Red Data book (Głowaciński 1992), with six additional species which are endangered on the global or continental level, along with several species that are rare in Poland or in Pomerania. This area also constitutes an important

breeding site at a national level for wetland birds as it has 41 species whose nesting depends on the presence of reservoirs and marsh areas.

3. Areas that are important to birds comprise two types of habitat: water reservoirs and marshy areas, and open areas covered with heather. The former biotope is concentrated along the course of the Piława and Płynica rivers in the western and eastern parts of the ranges, while the latter moorlands are located in the central part of Borne Sulinowo. The bird refuges on marshy ground constitute breeding or hunting sites for the following valued species in Europe: golden eagle, black stork, marsh harrier, black kite, Montagu's harrier, lesser-spotted eagle, eagle owl, heron, kingfisher, bearded tit, greylag goose, teal, goldeneye, Savi's warbler and penduline tit. The moorlands are breeding grounds for relatively numerous local populations of tawny pipit, nightjar and woodlark.
4. Data on amphibians, reptiles and mammals augment the arguments for the protection of the reservoirs and marshy areas bordering the Piława and Płynica rivers. The area above the Nadarzyckie Lagoons, along the course of the Piława, boasts an important mating ground for common toad, smooth newt and crested newt as well as marsh frog. Five species of reptiles also occur here: sand lizard, viviparous lizard, slow-worm, grass snake and adder. The reservoirs around the Nadarzyckie Lagoons provide a refuge for two or three beaver families. While the Piława and Długie Lake are the otter's refuge, it also occurs above Lake Przełęg along the course of the Płynica.
5. To retain the status of the reservoir and marshy areas along the banks of the Piława and Płynica rivers as a habitat for reptiles, amphibians, birds and mammals that are dependent on a wetland environment, it is necessary to maintain water levels and restrict human entry into some areas. The preservation of the moorlands that still survive constitutes the primary requirement for maintaining their resident populations of tawny pipit, nightjar and woodlark. However, a further problem for this habitat is in arresting natural plant succession and in restraining afforestation.

### *3.1.5. Recommendations for future management*

Both the natural aspects and the landscape features of the Borne Sulinowo developed as a result of the military's use of the area for artillery and tanks. The previously described natural features of Borne Sulinowo are unique to this area and distinct from the normal Pomeranian landscape.

The principal change brought about by the new Polish administration was to make the State Forests the area's main consumer and manager. The forestry management plan (developed in accordance with the law on forests) provides basic guidelines for the relevant state forest units (Borne Sulinowo and Czarnobór Forestry Inspectorates) for managing the forestry economy. These units are currently preparing plans for work to be

undertaken. Field surveys are being carried out to divide the land area and an access road network to the forest complexes is in preparation. The current road network mainly encompassed the borders of the military ranges which makes the management of the forested and open areas more difficult. Several kilometres of hard surface roads are therefore expected to be built while at the same time some of the former exercise grounds' roads will be eliminated, which will restrict any unauthorised access to the area. These road construction plans are linked with plans aimed at establishing zones to provide biological immunity and fire control provisions.

With regard to the exploitation of the forest clearings, plans have been laid down to first eliminate the unproductive stands and secondly to remove the sparse and poor quality timber stands.

Very radical changes have been envisaged on the open areas which make up some 60% of the old ranges. These were previously predominantly arable or forested lands which no longer retain their former character after many years of military use. They now form part of a unique landscape, particularly given its large area but concentrated character. The land areas administered by the Borne Sulinowo and Czarnobór Forest Inspectorates are going to be gradually forested. Restoration and afforestation will be introduced over a period as laid down in the clearings plan. These measures will lead to calculable advantages for the forestry economy. The qualitative composition of the forested, cultivatable land will be similar to that which is recommended for the formerly arable lands, while at the same time, measures will be taken to achieve the natural restoration of pine and beech. As several hundred hectares are planned to be afforested per annum, it is expected that the old ranges will be under full forest management by the year 2010. Recultivation and planting work has progressed in both inspectorates, from the western (Borne Sulinowo) and the eastern (Czarnobór) edges to the centre of the tank trial grounds. Categories of protected forests, which include forests which protect their wetland features, were at the same time mapped out and presented to the Ministry for Environmental Protection, Natural Resources and Forestry, for ratification. In 1993, plans were laid to create a 5,000ha hunting district (no. 112) on the utilisable land in the Czarnobór Forestry Inspectorate in 1993. This plan would exclude all bogs, meadows and pastures as well as patches of marshy moorlands from the forested areas and earmark them for game refuges.

The effect of a management plan laid down for foresters, the custodians of the areas, by conservationists is such that, in general, it does favour the preservation and protection of flora and fauna species which are part of the wetland environment. However, it also radically restricts and sometimes even helps eliminate the habitats of species that occur in the larger expanse of open moorland and grassland.

The foresters' plans agree to a great extent with those of biologists concerning the necessity for protecting the areas along the banks of the Piława and Płynica rivers. These plans anticipate the creation of two protected landscape zones, running southward in the

eastern and western parts of the old ranges. The concentration of protected land along river banks represents an approach which prioritises that land most susceptible to degradation caused by human activity, i.e. carbonated peat bogs, wetlands and small reservoirs. Zonation of the river system ensures the unhampered propagation of flora and fauna that depend on wetland habitats.

The proposed Piława Valley protected area is expected to include the entire stretch of this river in the western part of the former military grounds, along with Lake Długie and the Nadarzyckie Lagoons, while in the southern part, the proposed protected landscape zone would include forested areas to the east of the lagoons and simultaneously encompass a whole series of small lakes, reservoirs and marshy areas, which are home to a variety of protected species of plants, reptiles, amphibians, birds and mammals. The protection of these species should distinguish between nature reserves and ecological regions, according to their needs.

The highland peat bog in department 338 of the Borne Sulimow Forestry Inspectorate has been proposed as a flora reserve as it is the site of the rare least water lily, while the northern reservoir of the Nadarzyckie Lagoons qualifies as an avifauna reserve for its numerous concentrations of important wetland birds.

**The northern reservoir of the Nadarzyckie Lagoons – the most important waterfowl refuge in the former military area**



The peat bogs of the area should, above all, be nominated as protected ecological regions due to their hydrological, landscape and ecological significance. Small reservoirs should also be included in this category as a refuge for certain important fauna, such as the European beaver and certain reptile, amphibian and bird species.

The Piława Valley proposed landscape area is such that it does not, in accordance with the status of protected landscape areas, restrict economic activities taking place in that area and does not violate the comparative ecological stability of the presiding natural systems. Its legal infrastructure also ensures the area is protected against industrial and transport threats while, at the same time, making the moderate exploitation of the area for tourism a real possibility. Similarly, the management of the forests here does not endanger the area's natural assets but rather puts certain curbs on recreational and tourist activities resulting from the expanding urban centre of Borne Sulinowo. The southern and central basin of the Nadarzyckie Lagoons could serve a limited recreational and tourist purpose by filtering human access and indeed stopping access to sites belonging to the network of reserves and ecological regions. The success of these aims would require the managing body of the area – the Borne Sulinowo Forestry Inspectorate – to participate fully in the implementation of this concept.

The second proposed site for a protected landscape area – the Plytnica Valley – lies on a line along the banks of the Plytnica, dissecting the eastern part of the ranges within the Czarnobór Forestry Inspectorate area (see Map 1, following page 92). This zone should be expanded northward as far as Lake Rymierzewo, or further, to include lakes Dzicze and Kopiel. The forestry services agreed with the biologists' proposals to protect the entire course of the Plytnica in this area. The protected area would include highly diversified terrains. It would have the Przełęg and Kniewo lakes in the north and a forest buffer zone (also including patches of beech woods on the shores of Lake Przełęg) and riverine alders in the central part of the Plytnica's course through the ranges. Finally there are extensive moorlands between the forests on peat soil to the west of the river but in the southern part of the ranges. The latter is a valuable breeding site for golden eagle, which nests there and is a globally endangered species, as well as black stork, heron and marsh harrier (species endangered on the European scale). The areas of marshy peat bogs surrounded by forests in the south-eastern part of the ranges require more research on their flora with a view to creating a flora and ornithological reserve, with certain restrictions regarding its forestry management which would anticipate the creation of a game refuge. The highland peat bog in department no. 180 of the Czarnobór Forestry Inspectorate which botanically qualifies as a flora reserve should also be included in the Plytnica Valley protected landscape area.

There are also certain particularly valuable areas, from the natural and landscape point of view, whose protection can be ensured once they have been excluded from afforestation plans. They can be assigned for protection or used to implement the aims of the hunting economy.



The extensive areas of open moorland in the central part of the old ranges are the most difficult to protect as the forestry management plans gradually to afforest this region. This would totally invalidate its landscape and natural values. This area is currently unique for its picturesque and extensive grasslands and moorland tracts. Botanically, the area's uncommonly abundant lichen growth on the psammophilic moorlands must be emphasised as an important natural asset, as must the characteristic group of birds it attracts. Especially significant are the concentrations of tawny pipit, which is endangered in Europe. The greatest threat to the open moorlands, apart from the afforestation plans for this region, is posed by the natural plant succession, especially the development of brushwood cover with birch, aspen and pine. This is most evident in the areas adjoining the forest surrounding the former tank trial grounds. To maintain the state of affairs that an almost 60 year period of military usage has created, it would be necessary to preserve the current stage of succession. It would not suffice to demarcate a protected area here (even in the form of a reserve), but an appropriate form of management would also be essential, involving the annual clearance of tree and brushwood scrub. This process would require financial resources, a willing workforce and suitable supervision. In the event of finding a sponsor (such as Ecofund) it would be practical to apply to the State Forests for permission to designate part of the current moorlands as having protected status (i.e. reserve, ecological region or natural landscape unit). The moorland, covering a surface area in excess of 1,000ha, could become a great tourist attraction for the Borne Sulinowo district and a network of footpaths could be marked out, later followed by cycle paths and horse tracks leading into the area of the old ranges. Apart from the areas on which the early stages of plant succession are preserved, certain regions should be left for comparison where the natural succession process has not been checked, which would assist the investigation of this process.

The proposed system of protected areas, which encompasses the Piława valley with the Nadarzyckie Lagoons, the Plytnica valley with its adjoining peat-based moorland complexes, and the part of the former ranges which is occupied by extensive psammophilic moorlands, would allow for the effective protection of the former Borne Sulinowo's nature and landscape assets.

## **3.2. The former Soviet Air Force training area near Przemków**

### ***3.2.1. Introduction***

The former Soviet Air Force training area near Przemków in Silesia (south-west Poland) has not been a subject of broad natural investigations since the end of the war. According to limited data from the first half of the 1980s, referring to the margins of the area, it was known as an important breeding area for some waterfowl species.

Since the second half of the 1980s, because of drainage works in the outskirts of the area and the cessation of any forms of management (such as mowing and grazing), its attractiveness for waterfowl has declined significantly. In summer 1992 the Soviet Army left the area and passed it to the Polish government. Since then, more comprehensive studies of the nature of the whole area have become possible. On this basis we have gained a better knowledge of its real importance and are able to formulate indications for its future management.

The future designation of the area remains uncertain. Its eastern part (in Legnica province) was transferred to National Forests' stewardship while the western part (Zielona Góra province) remains in the hands of the local administration. In 1992 the Polish Society of Wildlife Friends "Pro Natura" proposed the management of the area as a nature reserve with some extensive forms of agricultural use. The idea was initially accepted by the local authorities and communities. In 1993 the eastern part (Legnica province) came under protection as "a place of ecological use". The main obstacle which impeded the implementation of further stages of the concept was the lack of detailed information about the actual state of its natural value.

The current study, made with the support of the IUCN Foundation in Poland and with the aim of evaluating nature quality in relation to the European Ecological Network (EECONET), is an important step in closing this gap.

Despite their rather general character (from only one season of studies, in 1994) the results give an overview of the current natural value and importance of the former military area. They constitute an important argument supporting the proposal of protected status for the area and make possible the more detailed determination of recommendations for the future management of the whole area.

### *3.2.2. Description of the area*

The former Soviet Air Force training area "Przemków North" is situated in south-west Poland, 45km north-west of Legnica and 5km north of Przemków. Its area belongs to two provinces and three communities (province Legnica: communities Przemków and Gaworzyce; province Zielona Góra: community Niegostawice). It covers 3,100ha, 1,600ha in province Legnica and 1,500ha in province Zielona Góra.

The area is situated on former swamps in the valley of the Szprotawa river, between two hilly areas, Dalkowskie Hills (to the north) and Chocianowskie Hills (to the south). It is a flat area, less than 130m above sea level, gradually sloping down to the west. The difference between its highest and lowest point is about 3.5m.

Until World War II the area consisted of cultivated meadows and pastures on the drained marshlands. After the war it was occupied by the Soviet Army and used as an air force training ground (air-raids and bombardments). As no stores were located in the area, there is no serious chemical pollution there, in contrast to the majority of former Soviet

Air Force areas in Poland. Instead, there is the still unrecognised danger of unexploded shells or bombs lying in the ground.

After the area had been taken over by the Soviet Army only some marginal parts could be extensively cultivated. The majority of uncultivated (i.e. no mowing, fertilisation or grazing) meadows became 'wild'. They were gradually colonised by willow bushes, changed their plant species composition and turned into a marsh. Today the area is covered by a mixture of various meadow and marsh plant communities, overgrown by willow shrubs and bushes to various degrees. The expansion of the willow is mostly along the former drainage ditches and their surroundings. Trees occur in the area mostly in the form of poplar rows along some channels or roads. Additionally, in some larger conglomerations of willow bushes, small groups of trees have already developed, mainly willows and poplars.

The most extensive scrub developed in the central part of the area, which was the main site for bombardment training and has not been cultivated since the war. Most of the more open meadows exist on the margins of the military area, where the local inhabitants occasionally mowed grass or pastured cattle or sheep (until the mid-1980s). In some lower parts of the area wet marshes and reedbeds occur. Occasional summer fires of dried grass layers (sod) originate from many shallow, irregular basins among meadows or marshes, which are usually filled with water in spring.

The main flowing water is the Northern Channel which divides the area east-west. Along the southern border of the area flows the Southern Channel and to the south of it, outside the military area, the Szprotawa river. Both channels draw water from many smaller old drainage ditches within the area and flow into the Szprotawa river. In the northern part of the area flows the small river Szprotawka, which often dries up in summer.

The surroundings of the military area constitute: to the south, cultivated meadow and pastures; to the east, meadows and arable fields; to the north, wet deciduous forests and meadows; to the north-west, meadows, forests and arable fields; to the south-west, a large fishpond complex, which is protected as the ornithological reserve "Przemków Ponds".

### *3.2.3. Botanical evaluation*

In 1994, 338 species of vascular plants from 68 families were recorded in the former military area near Przemków. Of these, 35% were species associated with water, marsh and meadow habitats while the majority (65%) constituted species occurring along the roads, on the banks or in other synanthropic habitats. The majority of recorded species belong to common and widely distributed plants, with few rarities. Nine of the species are protected in Poland: *Orchis latifolia*, *O. maculata*, *Primula officinalis*, *Convallaria majalis*, *Nymphaea alba*, *Nuphar luteum*, *Ribes nigrum*, *Frangula alnus* and *Viburnum opulus*.

With respect to plant communities, no other valuable associations occur here. Most of the communities occurring on the former military area are transitory associations, developing after abandonment of traditional forms of cultivation. Because of the transitory

and unstable character of most plant communities in the area it is rather difficult to distinguish specific associations. However, particular physiosociological associations and stages of succession can be identified, and the following communities (following Matuszkiewicz 1984) have been identified:

1. *Meadow communities* (Class: *Molinio-Arrhenatheretea*)

These dominate, above all, in the eastern and north-western parts of the area, and include:

- a) wet meadows (Order: *Molinietalia*), associations of the alliance *Calthion*. They are the commonest type of meadow in the area. The elements characteristic for the alliance *Molinion* are lacking.
- b) fresh meadows (Order: *Arrhenatheretalia*), associations of the alliance *Arrhenatherion*. They occur locally on some higher, non-marshy places. In the majority of the meadow communities in the former military area a significant participation of *Calamagrostis* spp. occurs with *Phragmites communis* as the accompanying species.

2. *Sedge and reed associations* (Class: *Phragmitetea*, Order: *Phragmitetalia*)

These are the dominant type of vegetation in the lowest, south-western parts of the area, especially in the territories bordering on the ponds, and include:

- a) reeds – communities with associations of the alliance *Phragmition*. Among others there are communities of *Phragmites communis*, *Glyceria aquatica*, *Typha latifolia*, *Equisetum limosum*, *Eleocharis palustris*, *Oenanthe aquatica*. They occupy the wettest, most permanently waterlogged locations.
- b) sedge meadows – communities referring to the associations of the alliance *Magnocaricion*. Among others there are communities of *Carex gracilis*, *C. acutiformis*, *C. riparia*, *C. paniculata*, *Phalaris arundinacea*. They occur in intermediate locations between reeds and wet meadows.

3. *Willow bushes* (Class: *Alnetea glutinosae*, Order: *Alnetalia glutinosae*, Alliance: *Alnion glutinosae*)

The bushes of latifolious willows tend towards the association *Salicetum pentandrocinereae*. The development of such communities starts in the wettest places, such as ditches or local depressions. Subsequently particular clumps grow in size and join greater conglomerations. The greatest occurrence of compact willow bushes is in the central field of air-raids and bombardments – the triangular segment in the central part of the former military area.

In basins which originated as a result of summer sod fires, but which are not fully filled with water, communities of mosses develop, mostly *Ceratodon purpureus*, *Pohlia* sp., *Bryum* sp. and *Marchantia* sp. These are pioneer species which start the process of succession on the altered ground. In basins filled with water and other water bodies communities of the class *Potamogetonetea* with *Hottonia palustris* or *Lemna* sp. sometimes develop.

In well-trodden places, along the roads or on the banks the synanthropic communities from the classes *Plantaginetea majoris*, *Chenopodietea* and *Arthemisietea* occur, as well as some elements from the class *Festuco-Brometea*.

Summing up, because of the infrequent occurrence of rare plant species, the former military area near Przemków does not represent great value as a refuge for endangered elements of the flora. Similarly, because of the transitory and unstable character of the majority of plant communities recorded here, it has little importance for the protection of interesting or endangered plant associations. As the most valuable elements of vegetation in this area one could mention some sedge associations with some rarer species (i.e. *Eriophorum angustifolium*, *Carex hartmannii*) or the orchids growing individually on some meadows.

However, in comparison to the surrounding cultivated areas, the former military area distinguishes itself significantly by generally more frequent occurrence of marshes and wet meadows, which have become increasingly rare as a result of intensification and mechanisation in agriculture. Accordingly, it is quite possible that the area could potentially gain even greater value as a site of wetland vegetation. This kind of vegetation is generally endangered resulting from drainage and lowering of the ground-water level in Poland. Managing the site as a wetland would demand changing the water balance in the area, slowing down the outflow, increasing the water retention in the ground and raising the level of ground-water. Action to stop the expansion of willow bushes would be also desirable. From the perspective of protection of particularly rare plant species, the most valuable method of future management would be maintaining and increasing the area of wet meadows (order *Molinietalia*). These associations hold a wealth of interesting plants and at the same time they are seriously endangered.

#### *3.2.4. Ornithological evaluation*

The marshes and meadows in the neighbourhood of Przemków have been known as one of the most important breeding places for waterfowl in Silesia since before World War II (Pax 1925). In the first half of the 1980s preliminary observations made on the margins of the Soviet Army training area revealed its continuing importance for waterfowl. At that time it was one of the few places in Silesia where a significant number of species and pairs of birds from this group occurred in the breeding season. Among others about 15 pairs of snipe *Gallinago gallinago*, ten pairs of common redshank *Tringa totanus*, 20 pairs of black-tailed godwit *Limosa limosa* and four pairs of curlew *Numenius arquata* have been recorded as breeding there (Cieślak *et al.* 1991). The populations of godwit, redshank and snipe were at that time among the most numerous in south-west Poland and for the Curlew it was one of the three last breeding places for this species in Silesia. Most interesting was the presence and breeding of crane *Grus grus*, shoveler *Anas clypeata*, garganey *Anas querquedula*, corncrake *Crex crex* and others. The attractiveness of the former military area for the waterfowl resulted from waterlogging in the spring as well as from very short vegetation from mowing or grazing on the margins in the spring.

Unfortunately, since the end of the 1980s and the beginning of the 1990s, many unfavourable changes in the avifauna have come about as a consequence of the deterioration of water conditions and of the abandonment of any agricultural management in the area. Redshank, snipe, shoveler and garganey abandoned the area, and godwit became much less numerous.

On the whole, during 1945–1993 at least 60 species of birds were recorded in the area, including 32 species associated with water or wet habitats. The current studies, made in the spring of 1994, revealed the occurrence of 102 species of birds: 81 species as breeding or probably breeding species and 21 species as nonbreeding. Of them, 40 were species of waterfowl. The study confirmed the especial importance of the area for the preservation of rare bird species.<sup>7</sup>

Seven of the species recorded here are included in the Polish Red Data Book for Animals (Głowaciński 1992): bittern *Botaurus stellaris*, little crane *Porzana parva*, curlew, short-eared owl *Asio flammeus*, Montagu's harrier *Circus pygargus*, white-tailed eagle *Haliaeetus albicilla* and red kite *Milvus milvus*.

Fourteen species belonged to the group threatened on an European scale (Grimmet and Jones 1989): bittern, black stork *Ciconia nigra*, white stork *C. ciconia*, honey buzzard *Pernis apivorus*, black kite *Milvus migrans*, marsh harrier *Circus aeruginosus*, Montagu's harrier, black grouse *Lyrulus tetrix*, little crane, crane, black-tailed godwit, short-eared owl, barred warbler *Sylvia nisoria* and red-backed shrike *Lanius collurio*. Three species were regarded as globally threatened (Collar and Andrew 1988): corncrake, white-tailed eagle and red kite. In the case of the corncrake, Poland, as a country with one of the largest populations of the species in the world, has particular importance (Grimmet and Jones 1989).

In this regard, the former military area at Przemków fulfils one of the criteria that would qualify an area as ornithologically important on a national scale (the occurrence of at least five species endangered on a global or European scale; Dyrzcz 1989). Moreover, because of the presence of 40 species of birds associated with water or wetland habitats (among them 27 breeding species), the area also fulfils criteria for qualifying as an area of national importance for waterfowl (among others: at least 25 species of breeding waterfowl; Wesołowski and Winiecki 1988).

On a regional scale, the former military area at Przemków distinguishes itself by the occurrence of many species which are rare or endangered in Silesia (Dyrzcz *et al.* 1991). To this group belong 27 (25%) of the species recorded here. Particularly important are the high numbers of four species, for which the area is the prime breeding place in the whole region. These species are: crane (10–11 pairs in the area/130 pairs in whole Silesia; Dyrzcz *et al.* 1991), corncrake (20–25 males/about 100 males in Silesia), snipe (30 pairs/about 400 pairs in Silesia) and grasshopper warbler *Locustella naevia* (350 males/about 1,000 males in Silesia). Scarlet grosbeak *Carpodacus erythrinus*, meadow pipit *Anthus pratensis*, water rail *Rallus aquaticus* and Savi's warbler *Locustella luscinioides* also reach high

concentrations of breeding pairs, important on a regional scale. In the case of black grouse the area is one of only seven breeding places of the species in the lowland part of Silesia. For the short-eared owl it is the only place with regular records in the breeding season in Silesia (Dyrz *et al.* 1991). The rich composition of raptors is notable – 11 species in total. Four species breed in the area, the rest used it as a hunting area (most of them probably bred in the vicinity).

Because of sparse occurrence of most of the rare species, it is difficult to specify which parts of the area are most important for the protection of birds. The greatest numbers of interesting species were found in the open waterlogged part of the area, by the eastern border of the fish ponds (including among others greylag goose *Anser anser*, gadwall *Anas strepera*, water rail, little crane and crane). But the majority of species, and among them infrequent occurrences of many rare species, range over the whole area under study. In this situation one can only indicate the categories of the habitat which hold the greatest number of rare or endangered species. Undoubtedly, the most important are three kinds of habitats:

*a) open meadows (especially wet open meadows)*

the breeding habitat of the corncrake (20–25 males), grasshopper warbler (at least 350 males), meadow pipit (more than 150 males), snipe (at least 30 pairs), curlew (1 pair probably breeding), gadwall (at least 2 nests), shoveler (at least 1 pair), garganey (at least 2 pairs) and Montagu's harrier (1 pair).

*b) waterlogged reedbeds and sedge meadows (with small basins of open water in local depressions)*

the breeding habitat of the crane (10–11 pairs), water rail (at least 24 pairs), greylag goose (at least 2–3 pairs), little crane (1 pair), Savi's warbler (at least 16 pairs) and marsh harrier (at least 6 pairs).

*c) moderately shrubby meadows and reedbeds*

breeding habitat of the scarlet grosbeak (about 50 males), penduline tit *Remiz pendulinus* (at least 25 pairs) and red-backed shrike (about 100 pairs).

The least valuable from the perspective of the protection of birds are those parts of the area which are most overgrown by bushes. Although high numbers of birds breed there, they are mainly common and widely distributed species.

Summing up, one has to stress the great value of the former Soviet Army military area at Przemków for the protection of rare bird species. This value is associated with the presence of considerable areas of wetlands (wet meadows, sedge, reedbeds). At the same time the whole area is being subjected to gradual changes in its habitat, which markedly damage the living conditions for breeding birds. To prevent the changes one would have to plan and implement such future management that will ensure the maintenance or even the raising of the current groundwater level, the flooding of the area in spring and at least periodically mowing or grazing some parts of it. Next, one should consider the possibility of removing some willow bushes, in order to create larger areas of open meadows or

reeds, as habitats which hold the greatest number of most valuable and endangered species.

### *3.2.5. Suggestions for future management and protection*

The present status of the former Soviet Army training area near Przemków allows consideration of almost every possible variant of its future management. The larger part of the area (in the province of Legnica) is under the stewardship of National Forestry, but they do not plan to use it in the near future and are agreeable to any plans that would not negatively influence the neighbouring forest areas. The rest (province Zielona Góra) is still in the hands of the local administration. Their decision depends on the situation in the Legnica province, as they have decided to treat the former military area as a whole, regardless of administration divisions.

Under these circumstances it is possible to develop future management plans which will ensure the preservation – if not improvement – of its natural value. In making decisions one has to consider the following circumstances:

- In the past the area was managed in the form of extensively cultivated meadows on the drained marshes.
- In that state, despite management, the area had considerable natural value as a breeding place for many waterfowl species.
- The abandonment of traditional use as a result of its takeover by the Soviet Army caused a significant deterioration of its value.
- On the other hand, the military use prevented implementation of more intensive forms of agricultural or forestry management, which would have led to much greater degradation of the avifauna; as a result today we are able to consider a much broader range of possible forms of its future management than would otherwise have been possible.
- At present the area has numerous natural values, which make it nationally important.
- The present natural value of the former military area is the result of the presence of wetland habitats, among others reeds and wet meadows. These habitats are seriously endangered here in consequence of the continuous decline in the groundwater level.

The results of the above evaluations, both botanical and ornithological, indicate that, in order to preserve the natural values, the best solution would be management of suitable parts of the area as extensively cultivated grasslands. Simultaneously, one should change the water conditions, in order to reduce the speed of the outflow and raise the level of groundwater. Both evaluations indicate the possibility of significant improvement of the current natural value of the area as a result of such a management regime. This concept seems to be the most appropriate for the reconciliation of nature protection requirements and economic expectations. Leaving the area in the present state ('passive protection') would lead to the gradual loss of the existing values without any economic gains. On the



other hand, implementation of intensive forms of management, apart from the great costs of adaptation of the area and the future influence on the ecosystem, would inevitably lead to the disappearance of all the valuable natural elements.

The results of the current evaluation confirm the correctness of the existing concept for the future management of the former military area, created and developed by "Pro Natura" in cooperation with local administrations in Legnica and Zielona Góra. According to this concept the area will be protected (as "a place of ecological use" or reserve), with the recommendation of the introduction of certain activities for the preservation or improvement of its natural values. The main goal of management would be the creation of a large refuge for endangered waterfowl species, with the maintenance of economic functions of the area, at least on the suitable parts of it. To achieve the above goal it is planned to carry out:

- The regulation of water conditions through restoration or building of new sluice gates damming the water and raising its ground level as well as slowing the outflow.
- The restoration of extensive grassland management on the largest possible part of the former military area. Such management would have to be subject to some restrictions resulting from the requirements of nature protection (level of fertilisation, timing of mowing, size of the herds, and so on).
- The removal of some overgrown willow bushes and the extension of open meadows and marshes.
- The protection of waterlogged reeds and sedge meadows by preventing the colonisation of willow bushes.
- Restoration of flowing water to the area.

This concept has been created on the basis of very limited amounts of information about the natural value and the state of the environment in the area. The results of the current inventory are a strong argument for its further promotion. One has to stress how much the conclusions of the investigations agree with and support the theoretical background of the concept.

The acceptance and realisation of this proposal for the use of the former military area should yield the following economic advantages:

- The use of suitable parts of the area by the local community and the development of their economy based on grasslands.
- The recovery of a large area for water retention. There would exist the possibility of using the area as a flood polder intercepting surplus water from the Szprotawa river.
- The prevention of long summer fires of the dried sod, particularly onerous for the inhabitants of the surrounding villages.
- The possibility of hunting (the existing reedbeds and bushes are the habitat for game species, such as wild boar and deer).
- The possibility of developing the tourist infrastructure in the surrounding villages, along with the development of various forms of tourism and ecological education, and the promotion of the natural and cultural values of the neighbourhood.

The expected result should be the establishment of one of the largest wetland reserves in Lower Silesia. Waterfowl especially, as an ecological group with particularly high demands in terms of habitat, could find a safe refuge here, large enough to ensure the maintenance of large populations.

The experiences gained in the course of the realisation of the plan could be useful in other similar trials of restoration of wetlands in Poland. In this sense it would be a model project, concordant with basic principles of the strategy of sustainable use – consideration of the requirements of and connections between the natural environment and economic activity.

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## **4. Slovakia**

The original aims of the IUCN European Programme project to study the former military areas in Slovakia were defined as follows:

- Basic evaluation and classification of the areas used by the former Soviet Army in Slovakia in regions with high potential of biodiversity.
- Production of a management plan for one or two selected regions with recommendations for other areas. The plan proposal should meet requirements for clearing up pollution and enable integration of military training or other forms of land use with nature conservation.
- According to the capabilities and capacities to recommend the selected regions for their integration in the European ecological network.

### **4.1. Survey of the areas used by the former Soviet army**

The survey focused on areas of greatest significance for nature conservation, and excluded areas of low importance, e.g. barracks, warehouses, etc. In addition, a target location in the Slovenský kras karst Biosphere Reserve was selected where an independent team of experts carried out a survey, with follow-up work in some other locations.

The former Soviet Army occupied 81 sites within 15 broad areas. The sites were usually spatially isolated with the exception of the 17 sites found within the Lešť area. The number of sites within individual military areas ranges from 1 to 17. Their distribution, number and the other characteristics are displayed on Map 1 (following page 138).

Individual sites, meeting at least one of the criteria discussed later, were classified into four groups for nature conservation purposes.

#### **I. Sites of major significance (three sites and individual sites in the Lešť area)**

- parts of protected areas or proposed protected areas.
- sites with original natural communities present.
- meeting criteria for inclusion in the European Ecological Network (EECONET).

#### **II. Significant sites (11 sites)**

- original but damaged natural units.
- altered but relatively undisturbed areas.

#### **III. Sites of minor significance (22 sites)**

- partially undisturbed areas or areas altered by succession after disturbance.
- areas with presence of ecostabilising elements.
- areas with valuable cultural elements.

#### **IV. Non-significant sites (45 sites)**

- built-up and developed areas.
- devastated and degraded sites.
- areas without presence of original elements (e.g. artificial orchards).

##### ***4.1.1. Selection of the main demonstration site: Silická planina plateau***

One of the sites where the former Soviet army established their bases during 1968–1991 was Rožňava, situated in a basin bordered by the Volovské vrchy Mountains to the north and by the plateau of Slovenský kras karst to the south. Army use of the karst area is a unique case. This fact led to selection of this area as the main demonstration site of the project. IGHP s.p. Žilina (Geological Survey state enterprise) carried out a geological survey of all the military areas administered by the former Soviet army. Those with headquarters in Rožňava were inspected with total expenses of 1,028,000 Sk paid from the Federal budget. The total estimate of remedial costs for restoration of these areas reached 4,633,000 Sk at 1991 prices. Restoration was suspended on 1 January 1992. In the demonstration area only basic restoration has been carried out on the basis of recommendations by the Soviet Army before their withdrawal.

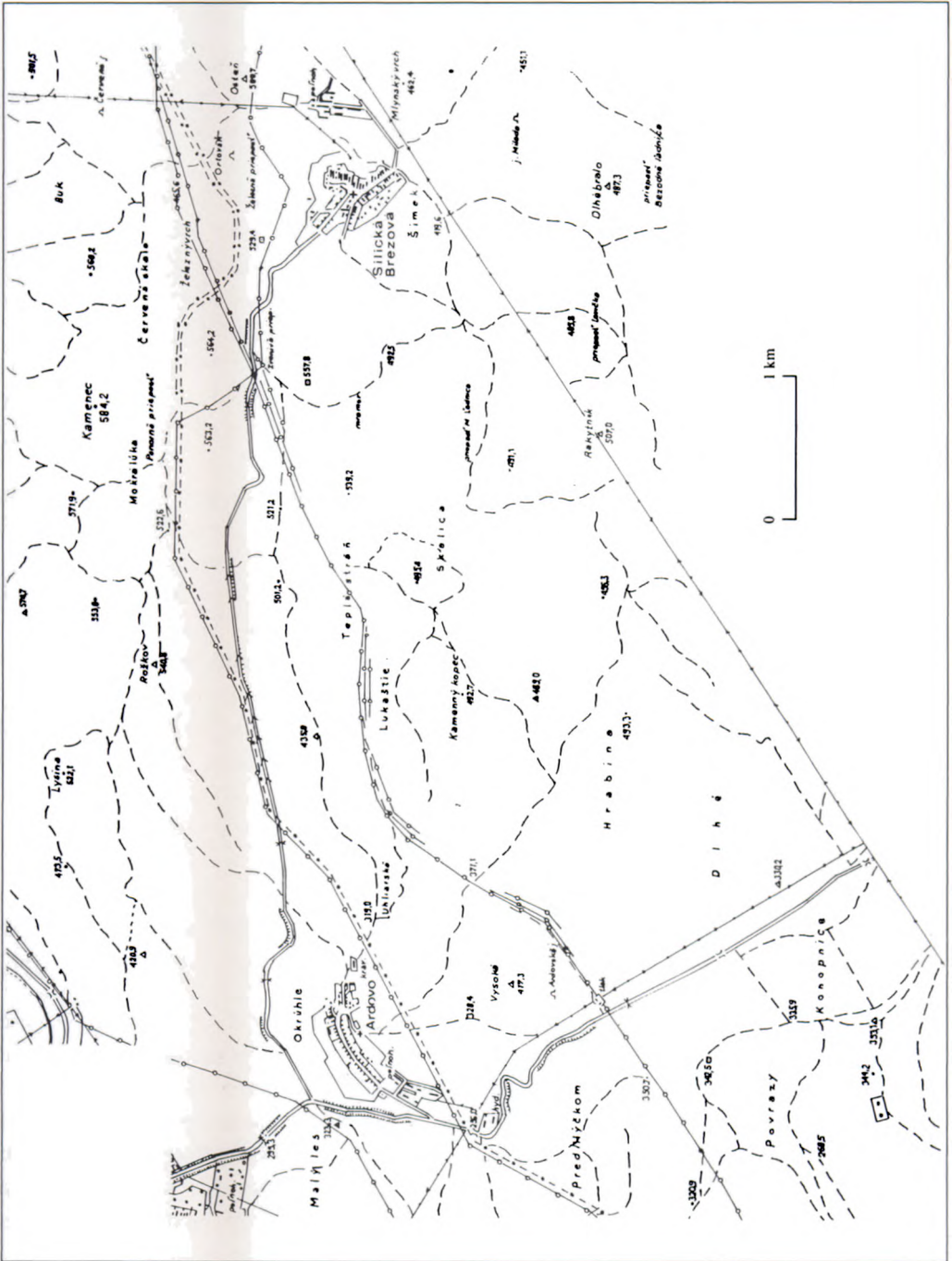
Since the management plan for the area of Slovak Karst is focused mainly on restoration issues, locations of the second order were selected for less detailed proposals, particularly in the Lešť area, where nature protection interests conflict with the interests of the Slovak Army. Thus, these sites can be used as examples of conflict resolution for other sites. In addition, some third order sites are recommended for detailed analysis. These are: Nemšová, Skalka, Voderady, Kamenný Most, Komárno-old fort and Modrany.

#### **4.2. Abiotic components of the Silická planina plateau**

##### ***4.2.1. Geography***

The region chosen as the main demonstration site is situated south-east of the village of Plešivec in Rožňava district and covers 32km<sup>2</sup>. The main part of the region has a well-developed karst relief. It belongs to Silická planina plateau which is one of the sub-elements of Slovenský kras karst. This region consists of a plateau bordered by gentle hills in the south-west which slope down and transform into the smooth relief of Gemerská pahorkatina hill-country. There are two villages: Ardovo in the west (in a marginal part of the karst) and Silická Brezová, situated in a dip within of Silická planina plateau (see Map 2).

Map 2. The location of Silická planina





#### *4.2.2. Geomorphology*

##### **Orographic and morphographic characteristics**

The study area belongs to two different geomorphological areas. The north-eastern part of the study area which belongs to Silická planina plateau has a midmontane character. The smaller south-western part of the study area extends predominantly across the smooth erosion-accumulative relief of the intramountain basin. The part of the study area belonging to Silická planina has an upland character. The altitude of its summit point, Kamenec, is 558m above sea level. Its lower parts are between 401 and 500m above sea level. Upper territories with developed karst ridges range between 501 and 600m above sea level.

The north-western part of the upland, which represents a contact with a canyon-shaped valley of the Slaná stream, is bordered by steep limestone hillsides. Part of the study area belonging to Gemerská pahorkatina hill country reaches 400m above sea level. The lowest part of the territory lies 220m above sea level.

##### **Basic forms of relief**

Because of the lithology and structure of the bedrock, the area is morphologically diverse. Its relief is strongly affected by diverse geology, evident mainly at the point of contact of karst with other rocks. There were two different types of relief created on these contacts: karst relief of Silická planina plateau and non-karst relief of Gemerská pahorkatina hill-country.

The diverse geology of Silická planina plateau as well as the relatively complicated tectonic pattern of the territory has produced three different karst features: karst forms, fluvio-karst forms and marginal karst forms. In this respect Silická planina plateau can be divided into three or four different parts: karst plain, semi-karst plain, spurs of the plain and steep lime hillsides of the plain.

#### *4.2.3. Climate*

The area is in a moderately warm and moderately humid climatic zone with cold winters. The annual temperature average is 7°C and the hottest month is July, with an average temperature of 17°C. The lowest average monthly temperature is -4.5°C in January. Temperatures can range from -24°C in winter to 35°C in summer.

The highest humidity typically occurs in December, with a minimum in April and May. Average annual humidity is 79%. During spells of stable weather the average relative humidity is about 5%–10% lower on plains than in valleys.

The highest monthly precipitation rate is in the summer months, with the maximum in June. Between 1931 and 1960 the monthly average precipitation was 101mm and the annual average precipitation 725mm. The minimum precipitation, 37mm, falls in January. First snowfalls come in mid-November. Snow stays until the third week of March.

Northerly winds dominate the area while north-westerly winds are the most frequent across Silická planina.

#### 4.2.4. Hydrology

##### Surface waters

From the hydrological point of view the area is a special natural complex. Its main part is formed by a plateau with a well-developed karst relief. The surface river network is absent here; part of the precipitation in the area of karst plateau evaporates and part infiltrates creating a well-developed underground river network. There are many karst springs, known as *vyvieračka*.

There are two water sources used for water supply. First is the spring Klincova studňa situated close to Silická Brezová. The second is directly in the village of Ardo vo.

##### Ground waters

Slovenský kras karst is unique with respect to its sources of groundwater. According to the system of ground water zoning (Repka, in Mazúr *et al.* 1971) the waters occurring here belong to the group of karst plain groundwaters and/or the covered karst underground waters. The sites affected by activities of the former Soviet Army are situated within the area of extreme importance.

### 4.3. Biotic components of the Silická planina plateau

#### 4.3.1. Potential vegetation

According to the map of reconstructed vegetation of climax communities (Michalko *et al.* 1986), developed on principles of potential vegetation, the Carpathian oak-hornbeam woods of alliance *Carici pilosae – Carpinenion betuli* prevail in the study area of Slovenský kras karst. The Sub-Mediterranean xerothermophilous oakwoods of the alliance *Quercion pubescentis-petraea*, which in the south-west transform into quite scarce oak-hornbeam woods of the alliance *Quercion confertae-cerris*, are more rare here. The calciphilous beech woods of suballiance *Cephalanthero-Fagenion* are dominant in the submontane zone. The submontane floodplain woods of the alliance *Alnion glutinoso-incanae* are less frequent here.

#### Botanic and synecological characteristics of the geobotanical map units

##### 1. Floodplain woods: *Alnion glutinoso-incanae*

Riparian alder and ash-alder floodplain woods and all their successional stages grow on the alluvial deposits along the river Slaná (215m above sea level). Ecologically they are

tioned to silt sediments of rivers and streams which are waterlogged by flowing water or frequent floods. The loamy soils with a high content of gravel, pebbles, and mineral nutrients are not fully developed (raw or protoalluvial soils).

*2. Carpathian oak-hornbeam woods: Carici pilosea-Carpinenion betuli*

The mesophilous mixed deciduous forests are the most widespread forest formation within the defined region. They are communities of alkali brown earths and rendzina soils of the medium depth predominantly developed on limestone bedrock. They are relatively rich in species.

*3. Oak woods with Quercus cerris: Quercion confortae-cerris*

These represent sub-xerothermophilous woods of the Central Europe. Within the Pannonian botanical region they disappear gradually at the foot of the Západné Karpaty mountains. They are confined to pseudogley brown earths on loess nappes. These soils dry out in summer, while in spring they retain moisture from precipitation. As a result of the high amount of clay they are heavy and slightly acid.

*4. Xerothermophilous oak woods: Quercion pubescentis-petraeae*

This unit belongs to the group of Sub-Mediterranean mixed deciduous broadleaf oak woods, the northern boundary of which crosses Slovakia. Together with thermophilous shrubs and the forest-grassland communities they comprise the clearly distinguished xerothermophilous complex with many Sub-Mediterranean, Balkan and Pontic species (extremely important for the protection of endangered species). The xerothermophilous oak woods are confined to warm, south, south-eastern, south-western and west slopes and exposed relief forms such as mountain ridges and steep slopes on limestones and dolomites. The soils are diverse, base-rich and well-supplied with humus.

*5. Calciphilous beech woods: Cephalanthero-Fagenion*

This unit includes the oak-beech and the beech mixed woods of the submontane and the montane vegetation zone, distributed on steep limestone slopes, on skeletonised grey rendzina soils and occasionally on brown rendzina soils or terra rosa.

*4.3.2. The flora of the Protected Landscape Area and Biosphere Reserve Slovenský kras karst and the floristic-phytocoenologic characteristics of the Silická planina study area*

The flora of the Slovenský kras karst is remarkable, with dominance of the xerothermophilous Pannonian species occurring from plains to hilly zones, and overlapping with the montane Carpathian flora.

According to the latest scientific investigations, there are 1,460 taxa of vascular plants (70 of them protected, which is more than half of all the protected higher plant species in Slovakia).

On the basis of floristic-phytocoenologic criteria the following types of primary and secondary plant communities in the area of interest were identified.

Pasqueflower *Pulsatilla grandis* (photo by Mikuláš Rozložník)



### **Pod Vysokou**

Characteristic stands of oak-hornbeam woods of *Poa nemoralis-Quercetum dalechampii* association of class *Querco-Fagetea*. In the tree layer the prevailing species is *Quercus dalechampii* together with *Carpinus betulus*, occasional *Tilia cordata* and *Ulmus glabra* ssp. *scabra*. There is high abundance of *Poa nemoralis*, *Dactylis polygama*, *Carex digitata*, *Pulmonaria obscura*, *Geum urbanum*, *Asarum europaeum* and *Fallopia convolvulus* with *Luzula luzuloides* on the acidified foothills. On the altered slopes of this forest complex occur ruderal communities of the class *Artemisietea vulgaris*. In the deeper trench above the bunker a community with dominant *Tussilago farfara* was found.

### **Lapoš**

Stands of oak woods with *Quercus cerris* and *Poa nemoralis-Quercetum dalechampii* association of class *Querco-Fagetea* with well-developed shrub undergrowth with prevailing *Ligustrum vulgare* and thinned groves consisting of oak trees *Quercus petraea* and *Q. cerris*. In the herbaceous layer with dominant *Poa nemoralis* some thermophilous species such as *Lathyrus niger*, *Carex michelii*, *Poa compressa* and *Clinopodium vulgare* occur. In deep trenches with temporary pools class *Plantagineae majoris* occurred, represented by the association *Rorippo sylvestris-Agrostietum stoloniferae* supplemented by *Agrostis stolonifera*. Flora species from the adjacent oak wood include *Dactylis polygama*, *Viola reichenbachiana*, *Carex pilosa*, *Echinochloa crus-galli* and *Xanthoxalis fontana*. The banks of the forest road are covered with dominant blackberry *Rubus fruticosus* agg. of class *Epilobietea angustifolii* with shrubs and herbs such as *Acer campestre*, *Carpinus betulus*, *Swida hungarica*, *Poa nemoralis*, *Geum urbanum* and *Waldsteinia geoides*.

### **Pisik völgy**

The bottoms of valleys in the Silická planina plateau are covered by mesophilous meadows of *Molinio-Arrhenatheretea* class. As a consequence of permanent trampling, secondary growth of the class *Plantagineae majoris* represented by *Lolio-Plantagineum* association substitute for the potential communities of *Festucetum pratensis* association. In the trampled sites more resistant species occur, particularly *Lolium perenne*, *Polygonum aviculare*, *Poa annua*, *Potentilla reptans*, *Plantago major* and *P. lanceolata*. Denudation of the original surface caused degradation of communities with dominant *Polygonum aviculare*.

At the enclosure of the valley on the base of Lysina hill (522m) stands of Oak-hornbeam woods of *Melico uniflorae, Quercetum dalechampii* association, class *Querco-Fagetea* occur. In the tree layer there are *Quercus dalechampii* and *Carpinus betulus*, less commonly with *Fagus sylvatica* and *Tilia cordata*. The shrub and herbaceous layer is very well-developed with a high species diversity. Rare and endangered plant species include *Epipactis atrorubens* and *Clematis recta*.

Slopes of this karst valley were damaged by excavations and relief modifications for heavy vehicles of the former Soviet Army. The original vegetation, mainly shrubs of *Rhamno-Prunetea* class was damaged in some places. Copses of *Prunus spinosa* ssp. *dasyphylla* and *Ligustrum vulgare* regenerate fast and grow quickly. They are characterised by monodominant prevalence of a species and occurrence of some rare xerothermic species, e.g. *Acer tataricum*, *Pseudolysimachion orchideum*, *Sedum krajinae*, *Achillea nobilis* and *Colymbada scabiosa*. Secondary ecotopes such as landslides are densely covered by blackberries *Rubus fruticosus* agg., and nitrophilous species of association *Sambucetum ebuli* of *Artemisietea vulgaris* class. These associations may potentially be a source for spreading ruderal species such as *Cirsium arvense*, *Chaiturus marrubiastrum*, *Urtica dioica* and *Cucubulus baccifer*.

### Pod Rožkovom

Xerothermophilous oak woods of the alliance *Quercion pubescentis-petraeae* on the southern slopes of Rožkov hill (540m) represent a climax type of vegetation in the area. Their natural substitute communities are thermophilous shrubs of the alliance *Prunion fruticosae* and *Prunion spinosae* and grass-herbaceous formations of the alliance *Festucion valesiaca* of *Festico-Brometea* class. They create a mosaic-like complex of xerothermophilous communities significantly altered by excavation of terraces for heavy vehicles.

In the west and east some larger patches of grass-herbaceous formations of *Festuco-Brometea* with dominance of *Festuca valesiaca* were preserved. Their characteristic feature is an abundance of protected species such as *Adonis vernalis*, as well as some other rare and endangered species: *Linum hirsutum*, *Teucrium montanum* ssp. *pannonicum*, *Rosa gallica*, *Hippocrepis comosa*, *Linum tenuifolium*, *Achillea pannonica*. A community with *Dichanthium ischaemum* colonises excavations of slope loams (with apparent soil erosion) on the upper terrace. Rare species *Cyanus triumfettii*, *Colymbada scabiosa*, *Quercus virgiliana* and *Dorycnium germanicum* can be found.

The xerothermic complex of plant communities is accompanied by growth of *Brachypodium Cephalanthero-Fagenion pinnatum* of association *Brachypodietum pinnati* in the central area. The endemic species of the Slovenský kras karst *Jurinea mollis* ssp. *macrocalathia* occurs, as well as *Adonis vernalis* and endangered plants of the Slovakian flora e.g. *Acer tataricum*, *Allium flavum*, *Pyrethrum corymbosum*, *Thymus kosteleckyianus*, *Potentilla arenaria* ssp. *tommasiniana* and *Galium album* ssp. *pycnotrichum*. The association *Teucrio chamaedryos-Calamagrostietum epigei* with dominant *Calamagrostis epigei* occurs exceptionally. Rare species *Trifolium flexuosum* and *Plantago media* ssp. *stepposa* were recorded.

On the bottom of the lower terrace copses of blackthorn from the *Ligustro-Prunetum dasyphyllae* association can be found. Ruderal vegetation of *Artemisietea vulgaris* class appears in the fragments of association *Sambucetum ebuli* in the east.

### Falu kút

Oak-hornbeam woods of association *Melico uniflorae-Quercetum dalechampii* of class *Querco-Fageta* cover the northern area. In the tree layer *Carpinus betulus* prevails. In the herbaceous undergrowth *Galium odoratum* prevails accompanied by *Glechoma hirsuta*. Higher content of soil nitrogen is indicated by species such as *Chelidonium majus*, *Geranium robertianum*, *Parietaria officinalis*. Orchids are represented by rare *Epipactis atrorubens* and *E. helleborine*. As an original type of vegetation of the sloped grazing pastures the association *Anthoxantho-Agrostietum tenuis* class *Molinio-Arrhenatheretea* was identified. Besides dominating *Agrostis tenuis* also *Festuca rupicola* and *Achillea collina* can be found. From the botanical point of view they are exceptional due to the occurrence of endemic species of the Pannonian flora region: *Taraxacum slovacum* and a hybrid population of *Dianthus armeria* with *D. deltoides*: *D. × helwigii*. Secondary and ruderal vegetation occurs at sites altered by man, such as excavations and ramparts.

Communities poor in species, of class *Plantaginetea majoris*, occur on the verges of the road in the upper part of the site. They are represented by the association *Lolio-Plantagineteum majoris*. Trampling allows only well-adapted species to grow, such as *Lolium perenne*, *Poa annua*, *Leotodon autumnalis*, *Achillea collina* and some others. Flora composition includes an important endemic, *Taraxacum slovacum*. On the sites of several wet ecotopes such as the bottoms of the karst depressions the association *Rorripo sylvestris-Agrostietum stoloniferae* was found. Besides dominant *Agrostis stolonifera* the other common species are *Potentilla reptans*, *Lysimachia nummularia* and *Juncus conglomeratus*.

On the drier rocky sites on the margins of trenches grow *Rubus fruticosus* agg. from the class *Epilobietea angustifolii* with the species from adjacent pastures and shrubberies, e.g. *Prunus spinosa* ssp. *dasyphylla* or *Rosa glauca*. Similar rocky ecotopes are colonised by copses of the association *Potentillo argentae-Artemisietum absinthii* of *Artemisietea vulgaris* class. Species of *Festuco-Brometea* class can be found such as *Festuca rupicola*, *Potentilla argentea*, *Achillea pannonica*. The occurrence of this association was recorded for the first time in the Slovenský kras karst. Wet sites rich in nitrogen have communities with *Urtica dioica*. Copses of the association of *Sambucetum ebuli* can be found with prevailing characteristic species *Sambucus ebulus*. Other nitrophilous species occur such as *Cirsium arvense*, *Chelidonium majus*, *Glechoma hederacea*, *Chaerophyllum hirsutum*.

### Vekaš

The original grass herbaceous communities of this area belong to the classes *Molinio-Arrhenatheretea* and *Festuco-Brometea*. Mesophytic copses of the association *Festucetum pratensis* occur in fragmented succession on the bottom of karst depressions. Besides dominant *Festuca pratensis*, high abundance is achieved by *Festuca rubra*, *Arrhenatherum elatius*, *Trifolium pratense*, *Achillea millefolium* and some others. On the slopes they are replaced by the association *Arrhenatheretum elatoris*, the most common type of non-forest

vegetation in the Silická Brezová area. Subxerophilous growth of *Bromus erectus* (*Brometum erecitii* association, class *Festuco-Brometea*) occur in the parts with the highest elevation.

This site is significant for pannonian endemics – *Dianthus potederae*, *Taraxacum slovacum*, protected *Adonis vernalis*, rare and endangered *Pilosella macrantha*, *Pseudolysimachion orchideum*, *Trifolium flexosum* and others. Shrub communities of the class *Rhamno-Prunetea* are created by *Prunus spinosa* ssp. *dasyphylla* of the association *Ligustro-Prunetum dasyphyllae* and are secondarily penetrated by nitrophilous species such as *Sambucus ebulus*, *Urtica dioica*, *Cirsium arvense* and other ruderal species.

On the sites with damaged soil cover communities of class *Epilobietea angustifolii* with prevailing *Rubus fruticosus* take over. Species from the adjacent oak-hornbeam woods such as *Galium schultesii*, *Stellaria holostea* or grass-herbaceous formations of *Poa angustifolia*, *Festuca valesiaca*, or *Plantago media* ssp. *stepposa* reach lower levels of abundance. Ruderal vegetation of the class *Artemisietea vulgaris* is overgrown with *Elytrigia repens* settling the clay excavated from trenches. *Fragaria moschata*, *Teucrium chamaedrys*, *Salvia pratensis*, and *Festuca pseudovina* are even more abundant. The association *Potentillo argenteae-Artemisium absinthii* occurs on similar skeletonised sites with subdominant occurrence of *Artemisia absinthium* and *Hypericum perforatum* ssp. *angustifolium*. *Anchusa officinalis*, *Elytrigia intermedia* and *Ajuga genevensis* are also significant as is the rare *Potentilla alba* in the marginal parts of the Slovak karst.

### Majkov závrť

The original grass-herbaceous copses of the class *Festuco-Brometea* have been preserved on the east-facing slopes of Majkov závrť. They are represented by botanically rich growths of the association *Festucetum valesiacae* with *Festuca valesiaca* accompanied by *F. rupicola*, *Briza media*, *Carex michelii*. Some rare species have been recorded, such as *Thalictrum simplex* ssp. *galioides*, *T. foetidum*, *Gentiana cruciata*, *Clematis recta* and *Rosa gallica*.

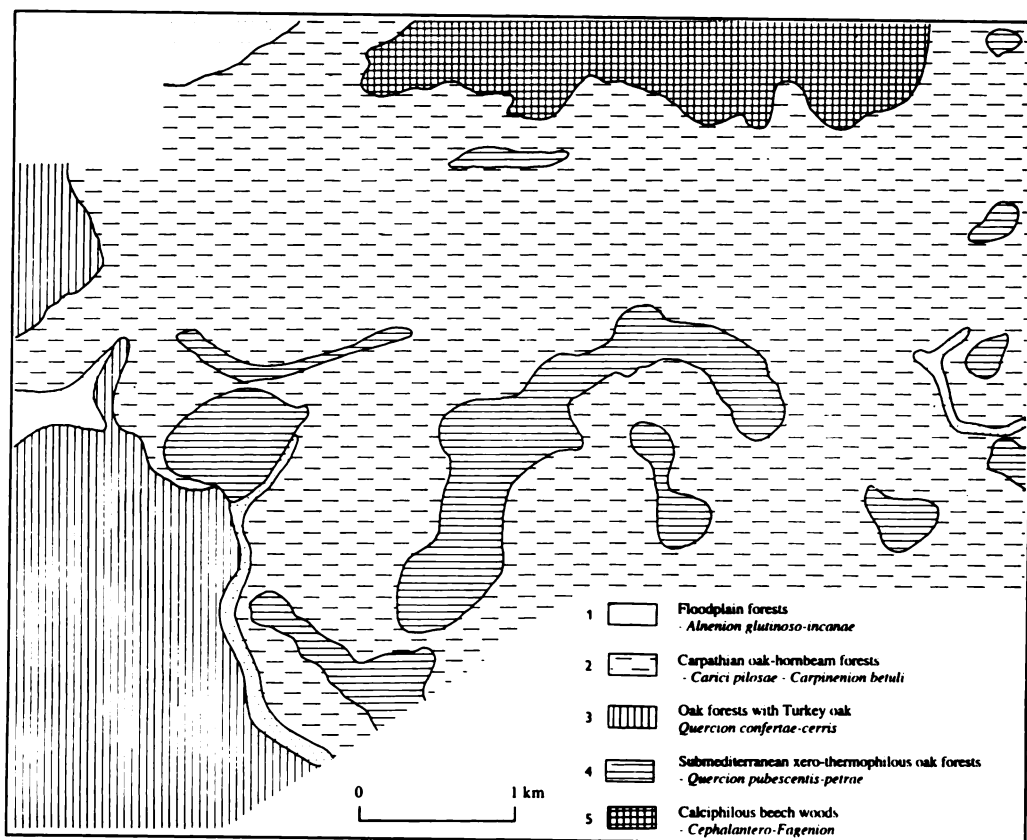
Mesophilous meadows of the class *Molinio-Arrhenatheretea* (association *Festucetum pratensis*), at the bottom of the karst hole, declined as a result of the change in ecological conditions (e.g. extensive excavations). The secondary ecotopes are now occupied by ruderal communities of the class *Artemisia vulgaris*. The prevailing vegetation type in this site is the nettle association (*Urtica dioica*) substituted by the association *Urtico-Artenietum vulgaris*. Other common species are *Cirsium arvense*, *Aegopodium podagraria*, *Glechoma hederacea*, *Elytrigia repens*.

A community of *Rubus idaeus* class *Epilobietea angustifolii* spreads in the marginal part of the forest. There is extensive penetration of species from the adjacent oak-hornbeam woods, e.g. *Asarum europeum*, *Pulmonaria obscura*, *Stellaria holostea* and *Aegopodium podagraria*; timber species are represented mainly by *Acer tatarica*.

For each individual site tables of phytocoenological record have been compiled together with a review of syntaxonomical units. These can be found in the Slovak version of this publication (IUCN 1995).



**Map 3. Potential vegetation of the Silická planina plateau**



#### 4.3.3. Evaluation of the flora and vegetation of the Silická planina study area

The flora of the Slovak karst represents the richest region in Slovakia, characterised by a high ratio of endemic, subendemic, rare and endangered species. Of 1,460 vascular plant species, rare and endangered species account for 39% (Háberová and Karasová 1993), 5.4% of which are endemics and sub-endemics of the Pannónio–Prae-Carpathian region and West-Carpathian region. Activities of the former Soviet Army in the Silická planina have negatively affected the vegetation cover at particular sites. Botanic-phytocoenological analysis indicates alteration of the forest complexes of the alliances *Carpinion betuli* and *Quercion confertae-cerris*, where the penetration of ruderal vegetation is by the class *Artemisietea vulgaris*.

Shrubby vegetation of the alliance *Prunion spinosae* was either partially or completely destroyed. However, it has been regenerating quickly during the

process of secondary succession. The most significant changes have been observed in the non-forest grass-herbaceous vegetation of the alliances *Arrhenatherion elatoris*, *Cynosurion cristati*, *Carduo-Brachypodium pinnati*, *Mesobromion* and *Festucion valesiacae*, having been replaced by some ruderal and nitrophilous communities of the alliances *Polygonion avicularis*, *Saginion procumbentis*, *Onopordion acanthii*, *Convolvulo-Agropyrion repentis*, *Arction lappae* and *Galio-Alliario*.

In total, 11 associations of the original vegetation of the class *Querceto-Fagetea*, *Rhamno-Prunetea*, *Festuco-Brometea* and *Molinio-Arrhenatheretea* have been recorded as well as 11 associations of ruderal and substitute vegetation of the classes *Epilobietea angustifolii*, *Plantaginetea majoris* and *Artemisietea vulgaris*.

A decrease in the number of some protected, rare and endangered species has been observed. The following species were recorded as declining:

1. Protected species: *Adonis vernalis*, *Cornus mas*, *Lilium martagon*, *Pulsatilla grandis*.
2. Endemics: *Dianthus pontederiae*, *Taraxacum slovacum*, *Trifolium sarosiense*.
3. Rare and endangered species: *Acer tatarica*, *Achillea pannonica*, *Aconitum variegatum*, *Allium flavum*, *Campanula sibirica* ssp. *divergentiformis*, *Cerasus mahaleb*, *Clematis recta*, *Cyanus triumfetti* ssp. *dominii*, *Epipactis atrorubens*, *Gentiana cruciata*, *Inula salicina* ssp. *aspera*, *Linum hirsutum*, *Linum tenuifolium*, *Platanthera bifolia* ssp. *laxiflora*, *Pneumonanthe asclepiadea*, *Rosa gallica*, *R. pendulina*, *Seseli annuum*, *Thalictrum simplex* ssp. *galioides*.

The following is a complete list of endemic, protected, rare and endangered taxa of higher plants to be found on the Silická planina plateau.

### Protected species

- |  |   |
|--|---|
| 1. <i>Aconitum anthora</i>                         | 8. <i>Lilium martagon</i>                           |
| 2. <i>Adonis vernalis</i>                          | 9. <i>Platanthera bifolia</i> ssp. <i>laxiflora</i> |
| 3. <i>Cerasus mahaleb</i>                          | 10. <i>Pneumonanthe asclepiadea</i>                 |
| 4. <i>Cornus mas</i>                               | 11. <i>Pulsatilla grandis</i> ssp. <i>grandis</i>   |
| 5. <i>Dictamnus albus</i>                          | 12. <i>Stipa dasyphylla</i>                         |
| 6. <i>Iris pumila</i>                              | 13. <i>Stipa pulcherrima</i>                        |
| 7. <i>Jurinea mollis</i> ssp. <i>macrocalathia</i> |   |

### Endemic species

- |  |   |
|--|---|
| 1. <i>Campanula sibirica</i><br>ssp. <i>divergentiformis</i> | 5. <i>Melittis melissophyllum</i> ssp. <i>carpatica</i> |
| 2. <i>Cyanus triumfetti</i> ssp. <i>dominii</i>              | 6. <i>Taraxacum slovacum</i>                            |
| 3. <i>Dianthus pontederiae</i>                               | 7. <i>Thlaspi caerulescens</i> ssp. <i>tatrense</i>     |
| 4. <i>Jovibarba hirta</i> ssp. <i>glabrescens</i>            | 8. <i>Trifolium sarosiense</i>                          |

### Rare and endangered species

- |  |   |
|--|---|
| 1. <i>Acer tatarica</i>                                | 20. <i>Linum tenuifolium</i>                        |
| 2. <i>Achillea pannonica</i>                           | 21. <i>Nigella arvensis</i>                         |
| 3. <i>Adonis aestivalis</i>                            | 22. <i>Orchis purpurea</i>                          |
| 4. <i>Allium flavum</i>                                | 23. <i>Ornithogalum pyramidales</i>                 |
| 5. <i>Alyssum tortuosum</i> ssp. <i>heterophyllum</i>  | 24. <i>Orobanche teucrii</i>                        |
| 6. <i>Aster amelloides</i>                             | 25. <i>Otites sillingeri</i>                        |
| 7. <i>Cephalanthera damasonium</i>                     | 26. <i>Pilosella macrantha</i>                      |
| 8. <i>Cephalanthera rubra</i>                          | 27. <i>Potentilla rupestris</i>                     |
| 9. <i>Cerasus fruticosa</i>                            | 28. <i>Rosa gallica</i>                             |
| 10. <i>Chamaeptytis chia</i>                           | 29. <i>Rosa pendulina</i>                           |
| 11. <i>Clematis recta</i>                              | 30. <i>Scorzonera purpurea</i>                      |
| 12. <i>Epipactis atrorubens</i> ssp. <i>atrorubens</i> | 31. <i>Sempervivum marmoreum</i>                    |
| 13. <i>Eremogone graminifolia</i>                      | 32. <i>Seseli annuum</i>                            |
| 14. <i>Gentiana cruciata</i>                           | 33. <i>Silene viridiflora</i>                       |
| 15. <i>Hippocrepis comosa</i>                          | 34. <i>Thalictrum simplex</i> ssp. <i>galioides</i> |
| 16. <i>Inula salicina</i>                              | 35. <i>Valerinella coronata</i>                     |
| 17. <i>Lactuca perennis</i>                            | 36. <i>Viola kitaibeliana</i>                       |
| 18. <i>Lathyrus nissolia</i> ssp. <i>pubescens</i>     | 37. <i>Waldsteinia geoides</i>                      |
| 19. <i>Linum hirsutum</i> ssp. <i>hirsutum</i>         |   |

#### 4.3.4. Forests of the Silická planina study area

Human activity has had a significant influence on the forests of the Slovenský kras karst. Over three thousand years, old growth forests have been replaced by immature forests and scrub, and gradually they evolved into karst steppes. As a consequence of long-term deforestation the xerothermic communities have had sufficient time to develop, hence the high species diversity. Forest stands have not been suppressed everywhere since they could find numerous refuges in karst depressions and holes. Past and present trends show certain signs of reforestation. The current situation is characterised by the spreading of forest formations naturally or artificially by planting on abandoned pastures.

Of the forested area, 56% is used for timber production. Forests with protection functions represent 36% of the forested area and mainly function as anti-erosion belts. Forests that have specific, restricted functions account only for 5% of the forested area and mainly function in water management. Forests of other types cover 3% of the study area.

The current age composition of the forests in the area reflects timber felling practices in the past and is:

older than 100 years	6%	81–100 years old	2%
61–80 years old	19%	41–60 years old	56%
21–40 years old	10%	younger than 20 years	7%

#### 4.3.5. Fauna of the Slovenský kras and of the study area

The Slovenský kras karst is one of the most significant sites in Slovakia for fauna, with a high ratio of endemic, relic or zoologically interesting species. The best studied animal groups in the area are molluscs (Mollusca, 133 species, 57% of Slovakian fauna), spiders (Aranaea, 293 species, 36%), grasshoppers and crickets (Orthoptera, 71 species, 64%), beetles (Coleoptera, more than 1,500 species), butterflies (Lepidoptera, 1,022 species), flies (Diptera, 1,273 species, 27%), and vertebrates (Vertebrata, 330 species) (Rozložník and Karasová 1994).

The most significant species are endemics of the Slovenský kras, respectively the endemics and relics of the Carpathian region. The following should be mentioned: *Sadleriana pannonica*, *Chondrina tatrica*, *Alopi clathrata*, *Hylebinosoma tatranum*, *Lulus curvicornis*, *Izophya beybienkoi*, *Phyllodromica harzi*, *Duvalius hungaricus* ssp. *sziliczensis*, *Athous silicensis*, *Otiorynchus roubali*, *Brachyosomus slovacicus* and *Barypeithes interpositum* ssp. *silicensis*. Some of the species reach the boundary of their distribution area, e.g. *Lacerta viridis*, *Ablepharus kitaibelii*, *Strix uralensis*, *Emberiza cia* and *Rhinolophus euryale*.

There is high bird species diversity, with a total of 196 species. The Slovenský kras karst is included in the network of Important Bird Areas within the framework of the BirdLife International Project.

#### Characteristics of the fauna of the Silická planina plateau study area

##### *Invertebrates*

Significant are: Carpathian endemics *Heteroporetia vihorlaticum*, *Chromatoiulus silvaticus* (Diplopoda) and *Paranemastoma kochi* (Opilionea). Most significant is the occurrence of genuine triglobiontic *Mesoniscus graniger* (Oniscoidea), recorded in the caves Matilda, Milada and Ardovská.

The cave Milada has the highest degree of conservation significance due to the presence of a periglacial relic species *Gyraulus acronicus* (Šteffek 1992). Surrounding this site a rich community of beetles (Coleoptera) was recorded (Majzlan and Rychlík 1994). The authors of the study warn of the dangers of waste dumping and eutrophication of the water resources in this site. The activities of the former Soviet Army troops could have potentially endangered terrestrial zoocoenoses chiefly by destruction of vegetation and soil cover, and also by waste production. Species numbers recorded are: Mollusca – 45 species (Ložek 1990), Diplopoda – 16, Chilopoda – 10, Isopoda-Oniscoidea – 15, Opilionea – 13 (Gulička 1985), Coleoptera – 67 (Majzlan and Rychlík 1994), Acari-Mesostigmata – 7 (Ambros 1994), Diptera – 113 (Čepelák 1990), Lepidoptera – 295 (Laštuvka 1990).

The study area is valuable for the number of different mollusc habitats, with the occurrence of some endangered species. The following species occur in the area: *Bythinella*

*austriaca*, *Acicula polita*, *Lymnaea peregra*, *Galba truncatula*, *Anisus leucostomus*, *Cochlicopa lubricella*, *Truncatellina cylindrica*, *Orcula dolium*, *Chondrina clienta*, *Acanthinula aculeata*, *Argna bielzi*, *Vallonia costata*, *V. pulchella*, *Chondrula tridens*, *Punctum pygmaeum*, *Eucobresia nivalis*, *Aegopinella pura*, *A. minor*, *Oxychilus inopinatus*, *Vitrea contracta*, *V. diaphana*, *V. subrimata*, *Euconulus fulvus*, *Balea biplicata*, *Clausilia dubia*, *Cochlodina cerata*, *C. orthostoma*, *C. laminata*, *Laciniaria plicata*, *Macrogastra plicatula*, *Ruthenica filograna*, *Bradybaena fruticum*, *Cepaea vindobonensis*, *Euomphalia strigella*, *Helicodonta obvoluta*, *Isognomostoma isognomostoma*, *Perforatella incarnata*, *Trichia unidentata*, *Sphyradium doliolum*, *Oxyloma elegans*, *Zonitoides nitidus*, *Chilostoma faustinum*, *Granaria frumentum* and *Chondrula tridens*.

### Vertebrates

Vertebrates found in the investigated area are described in detail in the Slovak version of this report (IUCN 1995). During the survey three species of amphibians (*Salamandra salamandra*, *Bombina variegata* and *Bufo viridis*) and two species of reptiles (*Lacerta agilis* and *Anguis fragilis*) were found. In the area of Falu kút and Lapoš terrain, *Bombina variegata* have been found in depressions filled with water, and in Pisik völgy pools individual specimens of *Bufo viridis*. Temporary pools suitable for the reproduction of amphibians can often be found in the trenches, which can affect their reproduction positively. The low numbers of amphibian and reptile species found may be explained by the timing of the survey. In the area of Silická ľadnica the presence of viper *Vipera berus* was recorded which is considered to be a relic species (Stolman and Uhrin 1992).

More than 90 bird species have been recorded in the study area. The following were observed directly at sites used by the former Soviet Army: *Pernis apivorus*, *Buteo buteo*, *Falco tinnunculus*, *F. cherrug*, *Coturnix coturnix*, *Streptopelia turtur*, *Cuculus canorus*, *Apus apus*, *Upupa epops*, *Dendrocopus major*, *Ficedula albicollis*, *Sylvia atricapilla*, *S. communis*, *Phylloscopus collybita*, *Anthus trivialis*, *Phylloscopus trochilus*, *P. sibilatrix*, *Regulus regulus*, *Turdus philomelos*, *T. merula*, *Erithacus rubecula*, *Saxicola torquata*, *Luscinia megarhynchos*, *Lanius collurio*, *Parus major*, *P. caeruleus*, *P. ater*, *Aegithalos caudatus*, *Hirundo rustica*, *Delichon urbica*, *Sitta europaea*, *Coccothraustes coccothraustes*, *Fringilla coelebs*, *Loxia curvirostra*, *Emberiza citrinella*, *Alauda arvensis*, *Oriolus oriolus*, *Garrulus glandarius*.

In the study area species typical of forest habitats, such as *Strix aluco*, *Phylloscopus sibilatrix* and *Ficedula albicollis*, can be found together with the species of shrub formations. The most significant nesting species in the site are *Lanius collurio*, *Sylvia nisoria* and *Saxicola torquata*. In May 1994 the presence of *Upupa epops* was recorded, a species rare in Slovakia but with relatively high population density in the Silická planina plateau (Hubálek 1984). In the marginal parts of the areas Lapoš and Majkov závrť typical species of farmland, such as *Coturnix coturnix*, have been found.

The following mammals have been recorded in the area: *Erinaceus concolor*, *Talpa europea*, *Vulpes vulpes*, *Citellus citellus*, *Pitymys subterraneus*, *Microtus arvalis*, *Apodemus agrarius*, *Apodemus flavicollis*, *Sus scrofa*, *Cervus elaphus* and *Capreolus capreolus*.

An important mammal is the European suslik, *Citellus citellus*, with a medium size population found along the road between Ardovská jaskyňa cave and the village of Dlhá Ves. Currently this is an endangered species with a declining population. Moreover, considering that this species is a major component of the diet of some critically endangered species of falcons (e.g. *Falco cherrug*), more attention should be paid to its protection. In the study area's karst holes (deep, wet depressions in the terrain) *Microtus agrestis* may occur, a species potentially endangered in the Slovak territory. Other sites of this type, with occurrence of *Vipera berus* for example, usually have a relic character (Ambros 1983, Uhrín *et al.* 1994). The caves in the study area have a significant importance as habitat for bats (Chiroptera). So far 11 species have been recorded in three different sites (Gaisler and Hanák 1972, Vachold 1990, Uhrín 1993). Of great significance is the occurrence of the Mediterranean horseshoe bat *Rhinolopus euryale*, reaching the northernmost border of its distribution. The Ardovská jaskyňa cave was a breeding site for this species with a medium size summer colony found in 1956. The importance of this site as a hibernation site is also supported by long-term monitoring 1954–1994, which indicated no significant changes in total abundance of winter bat communities. This knowledge is also applicable to the Milada cave which was monitored for a shorter period.

#### 4.4. Land use and human impact on the study area

##### 4.4.1. Basic characteristics and main economic interests

The two small villages in the area, Silická Brezová and Ardovo, have together about 500 inhabitants. The influence of these two settlements on the local environment is related to exploitation of the local water sources and neglected problems with waste and waste water treatment. Quarrying of decorative stone also has adverse effects.

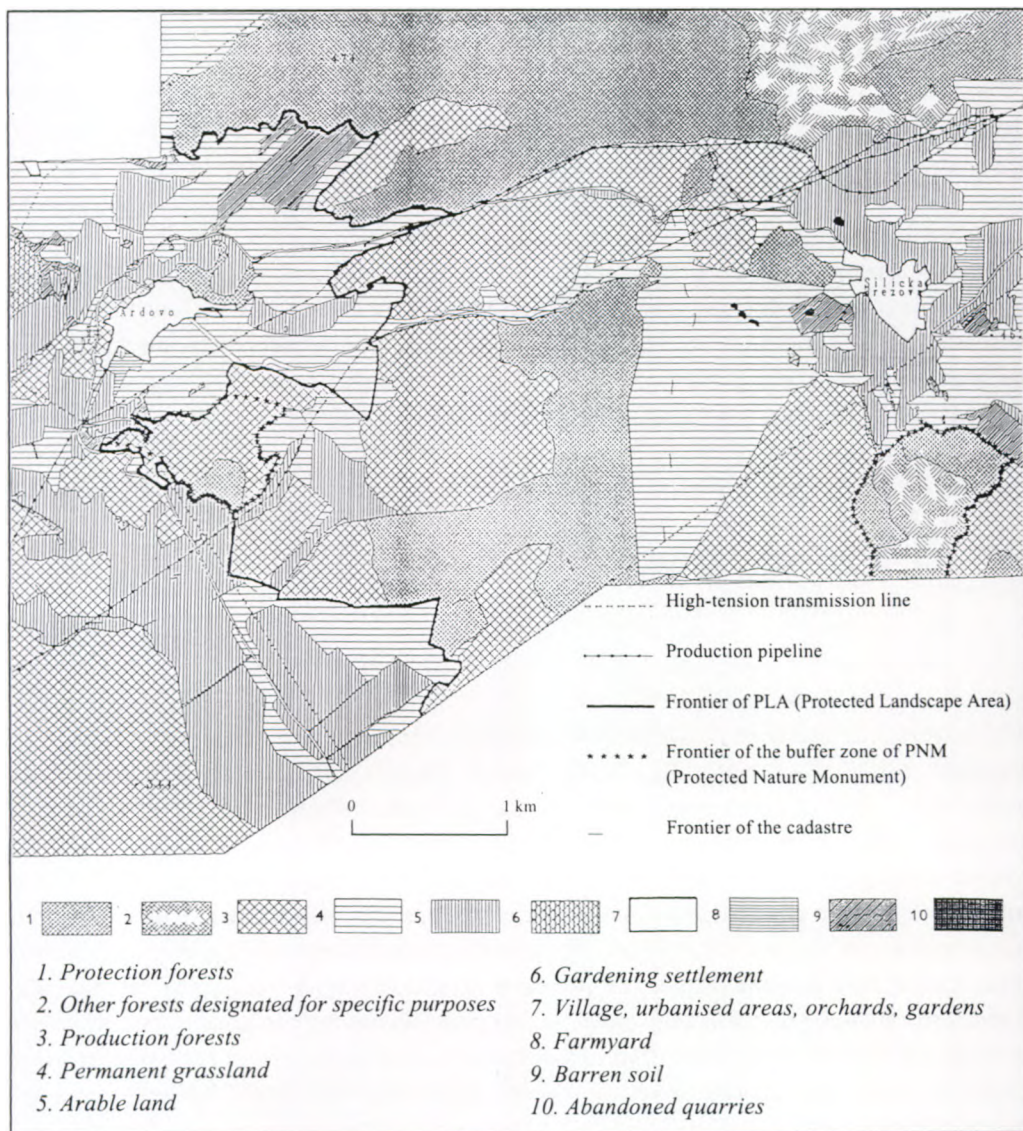
In the forest stands, felling of trees, building of forest roads and mechanisation of timber production do not meet the requirements of landscape protection. Therefore, timber production in the area can also be considered as an adverse element.

Agricultural production plays an important role. The major part of the agricultural land is used as grazing pastures and meadows, and to a smaller extent as arable land. Cattle and sheep grazing is extensive, without using moveable enclosures. Grazing itself is not based on regular land utilisation. As a result, a number of the grazing pastures are neglected. Meadow and pasture plant communities have been damaged by penetration of ruderal species and synanthropisation as a result of unsuitable

management practices. Agricultural intensification and increased input of fertilisers caused arable soil deterioration and a negative impact on groundwater. Recent economic stagnation in agriculture caused by the state of the economy and changes in land ownership also have a bearing.

Mining in the area dates back to 1760. The oldest activity is lead and zinc ore mining, both opencast and underground, surrounding Ardovo. The mine was abandoned

**Map 4. Land use on the Silická planina plateau**



before World War I. Deposits of Brezová marble close to Silická Brezová were exploited in small hillside quarries. Later, a larger commercial enterprise opened another quarry nearby. Both quarry sites have been assigned for exploitation but, for different reasons both of them were closed down. Another abandoned small stone quarry was used to satisfy local demand.

Other major impacts in the area were caused by the Družba oil pipeline and the parallel gas pipelines. A clear-cut land strip follows one 400kV powerline and four other smaller 22kV ones.

#### *4.4.2. Legal status of nature conservation in the area*

A substantial part of the area used by the former Soviet Army lies in the Protected Landscape Area (PLA)/Biosphere Reserve (BR) Slovenský kras karst, and the rest of it lies in the PLA buffer and transition zones (Ministry of Culture regulation No. 110/1973 Zb. from 31 August 1973, establishing the PLA). In the south-eastern portion of the area there is a protected natural monument, the Ardovská jaskyňa cave (declared by the amendment of the Ministry of Culture SSR No. 9284/1972-OP from December 1972, with an area of 73.47ha including its buffer zone). The north-eastern portion of the area belongs to the core zone of the Biosphere Reserve, a major part to the buffer zone and a smaller part to the transition zone.

The south-eastern portion of the area also overlays the water supply resource Kečovo-Dlhá Ves with a zone of hygienic protection (declared by the district authority – former Regional National Committee – department for agriculture, forest and water management in Rožňava by means of decision No. Vod.hosp. 1024/1988/90–2, 14 November 1990).

#### *4.4.3. Analysis of the activities of the former Soviet Army*

The activities of the former Soviet Army were concentrated in the following sites: Pod Vysokou, Lapoš, Pisik völgy, Pod Rožkovom, Falu kút, Majkov závrť and Vekaš. On 26 and 27 July 1990, a field inspection of these areas was carried out under the supervision of the state water management inspection deputy. The inspection was focused on storage practices and on potential dangers to the water supply. In the inspected areas no waterflows or water resources and reservoirs were identified, nor any warehouses or landfills with dangerous materials, nor any latrines with potential to pollute water resources. However, these could have existed during the presence of the former Soviet Army in the area. Therefore, an analysis of harmful materials in the soil was recommended, to be carried out in randomly selected sites. Since two of these sites were situated within the water resource protection zone boundaries, analysis of the water samples from the reservoir was recommended.



**Table 1. Costs in Slovak crowns for mitigation of damage caused by former Soviet troops**

site	work required*						total
	1	2	3	4	5	6	
Pod Vysokou	40,635	28,700	1,250	–	–	–	70,585
Lapoš	49,990	–	1,250	–	–	–	51,240
Pisik völgy	154,480	5,800	–	–	–	–	160,280
Pod Rožkovom	96,105	–	–	25,900	–	–	122,005
Falu kút	223,280	73,640	–	–	20,000	–	316,920
Majkov závrť	14,510	16,569	–	–	–	1,935	33,014
Vekaš	11,352	7,417	–	–	–	–	64,177
<b>total</b>							<b>818,221</b>

\* key to work required: 1 – trench filling; 2 – demolition of bunker and building constructions; 3 – transport of demolished materials to waste landfills; 4 – social value of protected plant species; 5 – clean-up and reconstruction of well; 6 – clean-up of cave entrance.

*Basic damage estimation – price for restoration of biotic components of the evaluated area. Calculation of the amounts necessary for physical damage mitigation was carried out according to price list No. 800–1 with 1994 approximate prices and on the basis of Ministry of Environment regulation No.192/1993 z.z. regarding social value of selected nature elements.*

The consequences of activities of the former Soviet troops include:

- direct devastation of the karst microforms on the plateau surface.
- devastation and total destruction of the soil cover.
- soil surface pollution caused mainly by materials of oil origin.
- extermination of rare, protected and endangered species of fauna and flora.
- creation of opportunities for penetration of ruderal species into natural communities of meadows and pastures.
- destruction of habitats of original fauna and groups of invertebrates.
- deforestation.
- surface and groundwater pollution.
- relief and landscape alteration in the area.
- destruction of karst phenomena in the caves, filling in of cave entrances, destruction of karst holes and swallow hole pollution.
- overall increased human impact in the area.

In addition, intensive clear-cutting has resulted in undergrowth destruction, the disappearance of protected and endangered plant species from the disturbed sites, destruction

of nesting habitats and habitats of invertebrates, and an undesirable migration of vertebrates. Development of waste landfills in the area has led to penetration of ruderal plant communities, pollution and deterioration of the area, and an accumulation of undesirable animal species. The creation of a dense road network (for heavy machinery) has resulted in the development of heavy erosion and pollution of soil, water and air, mainly by oil products and fumes.

On the basis of information from the Federal Committee for the Environment No. 3898/10/90 submitted to the Government of ČSFR on 29 November 1990 with identification of possible ecological damage caused, we conclude that the Soviet Government only recognises the damage mentioned in that document. The total cost calculated for mitigation of damage caused by physical interference of the former Soviet troops in the area is 818,221 Sk (see Table 1).

Impacts of the former Soviet Army activities on the environment specified above basically concern all natural elements in the area. The submitted damage mitigation expenses calculation only includes expenses for the most necessary restoration provisions. It does not include all aspects of the impact due to non-existing methodology (e.g. impact on karst relief microforms) as well as damage caused by removals. For a more complete assessment a detailed survey must be carried out.

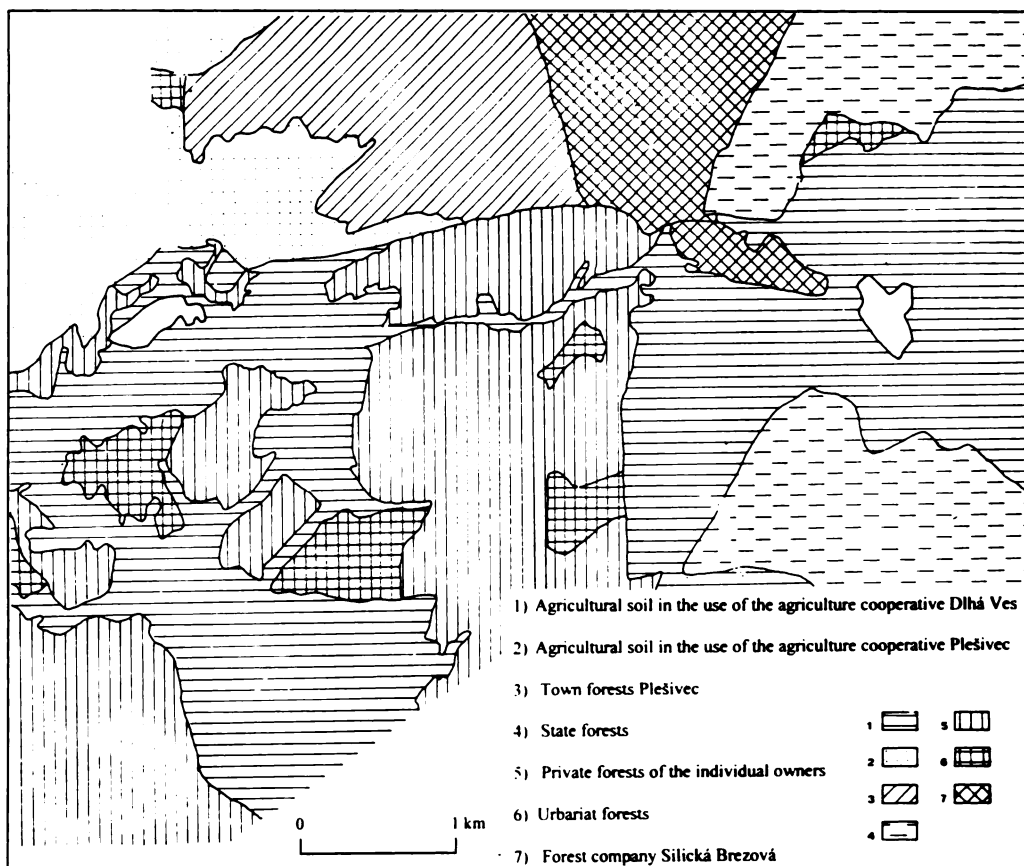
#### *4.4.4. Current ownership and user relations*

The area of interest stretches into cadastres of Silická Brezová, Ardovo, Dlhá Ves, Bohúňovo and Plešivec. Ownership and user relations in the last few years reflect the economic and political situation in the country, when significant changes in ownership took place and many legal issues have still to be resolved. Therefore, detailed analysis of this kind of issue is meaningless at present and the section below gives only a brief review of the current status (see also Map 5).

The major users of the forested land in the area are East-Slovakian Forests in Košice – district Rožňava and Central-Slovakian Forests in Banská Bystrica – district Rimavská Sobota. The forested land these two enterprises administer is in each case being returned to the hands of the former private owners on the basis of mutual agreements resulting from the current legislation. Such forest owners in the area are City Forests Plešivec, Forest Society Silická Brezová, the Slovak Republic, Urbariát Silická Brezová, Silická Brezová, Urbariát Ardovo, Pasture Society Silická Brezová and some other private owners. (Urbariát is a specific type of forest society, common in Slovakia).

Agricultural land in the area had two users. Most of the land was utilised by the cooperative farm Dlhá Ves, the smaller portion was in the use of the cooperative farm Plešivec. So far, only a small number of former owners have claimed their land. Also, the cooperative farm Dlhá Ves is being closed down and the situation regarding ownership in the near future is unpredictable.

**Map 5. Land owners and users on the Silická planina plateau**



## 4.5. Proposed management action plan for the Silická planina study area

### 4.5.1. Analysis of the relations and conflicts in the area

In order to achieve coordination of multi-functional use, respecting the requirements for natural wealth and beauty protection, the area joined the international network of Biosphere Reserves in 1977, through the framework of the MAB programme.

The establishment of the training area of the former Soviet Army in this area has magnified the negative impacts of its previous uses, not only on individual landscape elements but also the area as a whole. Necessarily, the training area itself led to further development, for example excavations, access road construction and construction of installations probably used as shelters for headquarters. The extent of excavation and trench construction reflects the Soviet Army's requirements for heavy machinery use.

Soil cover in karst landscape is usually thin and thus, in most cases, was destroyed down to the depth of the rock layer. This resulted in extermination of plant communities, potential soil and water pollution, creation of pathways for ruderal species penetration, waste dumping etc. Moreover, the activities took place in the water supply protection zone for Kečovo-Dlhá Ves, with a number of karst swallow holes which function as a direct connection between surface and aquifers.

#### *4.5.2. Proposal for the sustainable management of the area*

Nature conservation provisions in these areas must reflect the degree of human influence in accordance with ecological conditions and goals and interests of nature conservation. Proposals for optimal use of these areas must be treated individually according to their ecological potential, level of human influence, landscape values, the requirements of biodiversity conservation and the interests of owners and users.

The methodologies currently used for impact assessments do not allow evaluation of impacts in a broad context. Besides, acquisition of detailed initial data requires accurate measurements and mapping of all the sites used by the former Soviet Army. This is directly related to the issue of compensation for damages caused to land owners, who are difficult to identify during the ownership transition process.

To improve this situation the following actions are recommended:

- collection and analysis of soil and water samples.
- implementation of proposed basic reconstruction works at the individual sites, removal of debris, restoration of terrain, with levelling of excavations and possible grass sowing, removal of weeds and seedlings, cleaning and opening of the Matilda cave entrance and reviewing the function of the well.

Total costs before taking possible soil or water pollution into account are 1,181,236 Sk.

In order to create preconditions for sustainable management of the area, the following works are needed:

- realisation of the geodetic survey and development of geodetic plans as a basis for definition of ownership relations to the damaged sites.
- identification of the plots and definition of final ownership relations to the sites.
- identification of ownership rights to claim land within the restitution process, current status identification and profit (income) estimation.
- optimal land use plan design.
- utilisation of the area by the owner in accordance with its function in the landscape.

Forestry plays an important role in the sustainable development of the area by means of reforestation, timber production, landscape protection and creation of new landscape elements. Its main goal is to increase primary productivity of forest ecosystems and speed up the nutrient cycle and energy transformation in the ecosphere. Forestry contributes to

nature conservation by means of rare community protection, gene pool preservation and protection of landscape. Favourable forest properties should also be used in landscape planning and sustainable management design.

We recommend that for forestry management to achieve and maintain sustainability it should:

1. Prioritise strongly selective and small-scale cutting practices with application of natural regeneration procedures.
2. Carry out thinning of the stands, regularly and more frequently.
3. Avoid use of unsuitable and introduced material, fence new plantations, check and repair damaged fencing and remove it after use.
4. Rely on natural regeneration more often, especially in forests with a protection function on steep slopes or shallow soils and glint.
5. Construct forest track systems with consideration and design them wisely and thoughtfully, without landscape devastation.
6. Respect forest hygiene, avoid damaging standing trees and their root system during timber harvesting and regularly check for possible parasites and diseases.
7. Solve the ownership relations in the forest land and define the land-use in the area in accordance with the current delimitation of the agriculture and forest land.
8. Reconsider the significance of those low-yield forests that play a role in the conservation of rare and endangered plant and animal species or their communities.
9. Differentiate forest management practices in respect to the functions of particular zones in the Protected Landscape Area.
10. Safeguard the balance of all the forest functions during forestry management.
11. Assign a category of special purpose forests and differentiate the forms of management of those forests in the Protected Landscape Area, which are used mainly for timber production.
12. Maintain current status and conditions in the forest with respect to the conservation of xerothermophilous communities.
13. Restrict the use of chemicals in forest management to a minimum.
14. Assign high priority to the harvesting of storm-damaged timber and include the amount of this kind of timber in the annual timber harvesting plan.

Similarly, agricultural production has a very complex effect on the natural environment, characterised by a variety of relations and influences, mainly defined by land use structure and farming and cooperative agriculture practices. To create positive relations between agriculture and landscape protection, it is necessary to implement environmentally friendly and thoughtful utilisation of agricultural land. The protection of natural elements should be prioritised and agricultural practices must respect the necessities of the balanced natural system.

We recommend that for agricultural management to achieve and maintain sustainability it should:

1. Differentiate agricultural land use according to the most suitable practices for a given site determined by natural conditions, securing at the same time effective protection of the core zone.
2. Subordinate agricultural practices in the core zone of the given area to requirements of nature conservation.
3. Exclude the use of chemicals for meadow and pasture treatment and eliminate the use of fertilisers, silage effluent, manure and other liquid waste.
4. Maintain existing meadows and pastures on the plateau.
5. Reduce the impact of human disturbance, creating a barrier against penetration of ruderal species and restoring altered plant communities.
6. Establish a suitable management regime for permanent grasslands to prevent possible reforestation of this land cover type.
7. Regulate the length of the grazing season, numbers of livestock and grazing practices so that the carrying capacity of the pastures is not exceeded.
8. Prohibit any kind of land reclamation or accelerated regeneration of grasslands in the core zone and the buffer zone.
9. Restructure (through application of economic tools) the current production practices in order to eliminate discrepancies between agricultural and nature conservation interests.
10. Avoid building any waste landfills, farmsteads and dangerous material storages within the limits of the Protected Landscape Area.
11. Maintain scattered verdure on agricultural land and create conditions for its regeneration alongside roads and farmsteads.
12. Use only light machinery on permanent grassland in order to prevent damage of vegetation cover.
13. Utilise progressive forms of nutrient input using mainly those of organic origin; on the basis of up-to-date analyses, decrease use of fertilisers, eliminate contamination of environment and improve soil properties.
14. Promote alternative forms of agriculture not only to meet requirements of nature protection but also to bring economic results (e.g. organically grown products).
15. Improve standards of existing agricultural facilities, to restrict further construction to existing farmyards.
16. Change the technology of livestock raising so that this activity does not have a negative impact on the environment (particularly on water quality).
17. Build field manure depositions outside the core zone; shelter belts and other kind of verdure should be composed of original plant and tree species.
18. Pay attention to water protection in agriculture.
19. Evaluate the network of field tracks in agricultural land, establish hedges and trees along them, maintain a hard surface, and keep tracks to a minimum in the plateau area.

Other activities in the area, such as settlements, industry, power production, manufacturing and services, also contribute to the loss of natural landscape and to

qualitative changes. These activities can affect the landscape both positively and negatively.

We recommend that for other activities to achieve and maintain sustainability they should:

1. Evaluate current status of mineral mining in respect to utilisation of water resources as well as restoration after closing mining operations.
2. Find a solution to the water management situation in the area, to find sources for water supply as well as waste water treatment, especially in the settlements situated in the karst area.
3. Respect local conditions and nature conservation requirements when considering further development and promote implementation of harmless technologies in the long term.
4. Relocate the oil pipeline into a less sensitive area; in the meantime, maintain the existing pipeline in good repair.
5. Regulate economic activities in the zone of water source protection.
6. Subordinate the economic interests of hunting to the interests of protection and maintenance of natural values in the protected area.
7. Define possibilities and perspectives of the villages of Ardovo and Silická Brezová in regional planning to take account of nature conservation.
8. Find a solution to the disposal of municipal waste in this area.
9. Evaluate the current status of recreation and elaborate a concept of tourism development in the area.

### **Estimation of the cost of sustainable management of the area**

It is clear that minimal financial resources are a basic prerequisite of the sustainable management of the evaluated Silická planina plateau study area, therefore this section provides an estimate of the total cost of sustainable management of the area. The cost of reconstruction works has been estimated above at 1,181,316 Sk. Besides these reconstruction costs the sustainable management of the area also requires the following estimated expense:

<b>activity</b>	<b>estimated cost</b>
geodetic measurement of the areas, geodetic plans and map development, including identification of plots:	90,000 Sk
ownership identification and compensation for loss of income:	980,000 Sk
development of regime for optimal land-use and provisions for landowners:	100,000 Sk
<b>total cost of sustainable management:</b>	<b>1,170,000 Sk</b>
<b>total cost of reconstruction and of the realisation of sustainable management of the study area:</b>	<b>2,351,316 Sk</b>

## 4.6. Evaluation and management proposals for sites at Lešť and Gavurky

### 4.6.1. Basic characteristics

The Lešť area is situated in the Krupinská planina plateau (Slovenské stredohorie mountains) and is characterised especially by abandoned training grounds on meadow biotopes, with scattered verdure accompanied by rocky formations and old orchards (Šamilova skala, Viničky, Mavercová). There is a well-preserved beech wood in Lažtek and nearby Sokolovo bralo cliff. Of the wetlands Močiar, below Brezové vršky hills, a fish-pond below Šamilova skala rock (1ha) and several creeks with bank vegetation deserve special attention. Lešť provides good conditions for a number of protected and rare thermophilous animal species.

The major part of the Gavúrky site is situated in the cadastre of the village of Dobrá Niva, at an elevation of 460–475m above sea level. It consists of a pasture covered by a thin copse of oaks 150 to 200 years old, with a total area of 100ha.

### 4.6.2. Botany

#### Lešť

The main area of interest belongs to the region of West Carpathian flora (Praecarpaticum) and the district of Slovenské stredohorie. Surrounding forest stands, according to the geobotanical map of ČSSR (Michalko *et al.* 1986), predominantly represent Carpathian oak-hornbeam woods (*Carici pilosae-Carpinenion betuli*) and only at higher altitudes beech forb-rich submontane woods (*Eu-Fagenion*). From the flora perspective the most valuable site in the Lešť area is Močiar.

During a short term survey of the Močiar site the following formations were recorded:

- Swamp vegetation (*Phragmition*).
- Long-stem *Carex* vegetation (*Magnocaricion elatae*).
- Vegetation of salt marshes (*Calthion*, *Caricion fuchsae*, *Molinion*).
- Shrubby vegetation (*Salicion cinereae*).

The flora composition of particular phytocoenoses is also enriched by many botanically important species (Maglocký 1983) from the category of very rare species of Slovakian flora:

C.II. *Achillea ptarmica*, *Carex dioica*, *Gentiana pneumonanthe*, *Iris sibirica*, *Menyanthes trifoliata*.

C.III. *Carex paniculata*.

C.IV. *Carex curta*, *C. distans*, *C. flava*, *Dactylorhiza majalis*, *Epilobium palustre*, *Eriophorum latifolium*, *Succisa pratensis*.

For listed species the site deserves a detailed botanical survey. Uniqueness and good condition of the biotope, high level of plant communities diversity as well as occurrence of protected, rare and endangered species is a principle reason for its conservation.



### Gavúrky

Judging by the bedrock, oak woods of the acid forest type series probably grew in this area: oak woods of a normal height on exposed rocks with a thin loess loam blanket and gentle slope gradient. The soils are mostly high yellow in different stages of podsolisation, with medium depth and a slight content of loess loams in the upper layers. They are usually dry and have fine gravelly sand loamy granularity. Of herbs the most common include *Avenella flexuosa*, *Genista pilosa*, *G. tinctoria*, *Hieracium lachenalii* and *Luzula luzuloides*. Herbaceous undergrowth is primarily grassy and has been significantly changed due to grazing.

From the perspective of nature conservation, the 150–200-year-old thinned oak stand (*Carpineto-Quercetum*) of Slavonian type is important. The old, majestic oaks have a different genotype, most likely from *Quercus robur*, with a few individuals of *Quercus cerris*. The current appearance, with the trunk branching about 1.5m above the ground, indicates a human influence on the growth from the very beginning. Branching is extremely dense, stretching far away from the trunk. Leaves are dense and healthy in appearance with a leathery surface – an effect of sunshine. The trunks of some trees are damaged by axe cuts and pruning. Some of the trees are starting to dry out in the canopy. A few individuals are completely dry, drying or overturned.

#### 4.6.3. Selected groups of invertebrates

### Orthoptera in the Lešť and Gavúrky areas

A survey of Orthoptera has been carried out during one-day field-trips from July to November 1993. In the area Lešť (Krupinská planina plateau), altogether three study sites were surveyed: Mavercová (100ha), Turie Pole (100ha) and the surroundings of Šamilova skala rock (100ha), which represent unmown xerothermic and mesophilous meadows with scattered verdure in elevations from 600 to 740 m above sea level. In the Pliešovská kotlina basin another site, Gavúrky, was surveyed with intensively grazed meadows and pastures.

During the survey 22 Orthoptera species belonging to 3 families, 7 subfamilies and 14 genera were found. The following species were recorded: *Meconema thalassinum* (Gavúrky – G), *Tettigonia cantans*, (Lešť – L), *Decticus verrucivorus* (L), *Platycleis grisea* (G), *Metrioptera bicolor* (L), *M. brachyptera* (L), *Pholidoptera aptera* (L), *P. grisoaptera* (L,G), *Ephippiger ephippiger* (L), *Gryllus campestris* (L,G), *Oegipoda caerulescens* (G), *Chryzochraon brachyptera* (L,G), *C. dispar* (L,G), *Omocestus haemorrhoidalis* (L), *O. ventralis* (G), *O. viridulus* (L,G), *Stenobothrus lineatus*, (L,G), *Gomphocerus rufus* (L,G), *Chorthippus albomarginatus* (G), *C. biguttulus* (L,G), *C. mollis* (L,G), *C. parallelus* (L).

This should be taken as a minimal number of species as the field trips were carried out mostly in October. An occurrence of *Ephippiger ephippiger* with high density of males is remarkable. Other rare species are *Platycleis grisea* and *Pholidoptera aptera*.

#### Butterflies of selected sites in the Lešť area

During 30 June and 1 July a field survey of butterflies (Lepidoptera: superfamilies Hesperioidea and Papilionoidea) was carried out in four sites of the Lešť area: Lažtek, Sokolovo bralo, Močiar, and the Pod bralom meadow complexes.

Altogether 46 butterfly species were recorded belonging to the families Hesperidae, Papilionidae, Pieridae, Lycaenidae, Satyridae and Nymphalidae, including the following vulnerable and endangered species: *Parnassius mnemosyne* (vulnerable – V), *Lycaena dispar* (endangered – E), *Nordmannia acaciae* (E), *N. pruni* (E), *Brenthys hecate* (E), and *Melitaea aurelia* (V).

The number of observed butterfly species reflects the duration of the survey and the season, so is not complete. However, species composition as well as remarkably high density of butterflies suggest that the visited sites, especially vast meadow biotopes, represent areas without intensive human disturbances.

#### 4.6.4. Birds

Altogether 94 bird surveys and individual observation records from the period between June 1992 and June 1994 have been recorded during 27 days (Gavúrky 12, Lešť 15). Quantitative observations in the selected transects were carried out particularly during the nesting period (74 records), then during the rest of year (20 records). A strip method was used, with the strip 50m and 200m wide in the forest and open country respectively. Research was supplemented by catching birds in Japanese barrier nets.

#### Characteristics of avifauna of the evaluated areas in the Lešť site:

- 1. Lažtek:** Altogether 57 species of birds have been found: 30 breeding species, 26 non-breeding species and one permigrant. Seven species are in the red list as endangered. The most valuable discoveries recorded were nesting *Columba oenas*, *Caprimulgus europaeus* and *Ficedula parva*. The number of natural cavities in trees create good conditions for nesting by *Glaucidium passerinum*, *Aegolius funereus* and *Dryocopus martius*. Rich undergrowth is a suitable shelter for *Bonasia bonasia*. The presence of *Sylvia communis* and *Phoenicurus ochruros* in the marginal clearings is also interesting.
- 2. Sokolovo bralo:** Altogether 44 bird species have been found with 29 breeding species and 15 non-breeding species. Six species are in the red list as endangered. The old wide canopy oaks of a pasture type support nesting *Columba oenas* and *Caprimulgus europaeus*, and on the rock cliff nesting *Corvus corax* and *Muscicapa striata* have been observed.
- 3. Šamilova skala rock and surroundings:** A rocky formation serves as a viewpoint for hawks, owls and other bird species. In the 70ha area, altogether 101 bird species have been found, with 59 breeding species, 35 non-breeding species, two permigrants and five wintering species. This is the highest number of bird species found in one site in the area Lešť. Twenty-five species are in the red list as endangered species in Slovakia. For such a

high elevation (700m above sea level) there is an unusually large *Miliaria calandra* population (16 territories per 100ha), and also *Crex crex*, *Coturnix coturnix*, *Lullula arborea*, *Lanius collurio* and *Upupa epops*. Along the creek *Locustella fluviatilis* and *Oriolus oriolus* occur and on the nearby Rybník fishpond *Ardea cinerea* and *Gallinula chloropus* have been recorded.

**4. Mavercová forest-steppe:** Altogether 81 species of birds have been found – 40 breeding species, 37 non-breeding species, one permigrant and three wintering species. Seventeen species are in the red list marked as endangered. Rare species such as *Miliaria calandra*, *Crex crex*, *Coturnix coturnix*, *Lanius collurio* have a high population density and *Upupa epops*, *Saxicola rubetra* and *S. torquata* are nesting here.

**5. Močiar wetland (below the summit of Brezové vŕšky):** 78 species of birds have been recorded, out of which 49 species were breeding species, 27 non-breeding species, one permigrant and one wintering species. Altogether 17 species are listed in the red list as endangered, indicating the extremely high value of the area. This rare submontane wetland type community further includes species such as *Crex crex*, *Coturnix coturnix*, *Saxicola rubetra*, *Oriolus oriolus*, *Emberiza schoeniculus*, *Locustella naevia* and *L. fluviatilis*. Occurrence of the last two together in one place at 603m above sea level is interesting. This is the third known nesting site of *Locustella naevia* in the territory of central Slovakia and the tenth known in the whole of Slovakia.

**6. Stará rieka (Lešiansky potok):** A total of 98 species of bird has been found, of which 76 were breeding species, 19 non-breeding species, one permigrant and two wintering species. Altogether 22 species are listed as endangered in the red list. The occurrence of nesting *Ciconia nigra*, abundant populations of *Crex crex*, *Coturnix coturnix* and *Miliaria calandra* in the meadows, *Caprimulgus europaeus* at the forest edges, and *Alcedo atthis*, *Cinclus cinclus* and *Locustella fluviatilis* at Stará rieka stream should be mentioned.

**7. Bralo:** Altogether 53 bird species have been found, of which 24 were breeding species and 29 non-breeding species. Eight species are listed as endangered in the red list, including nesting *Columba oenas*, *Dryocopus martius* and *Picus viridis* in the cavities of beeches, *Oriolus oriolus* at the forest edge and *Ciconia nigra*.

Within the whole Lešt area a large population of *Lanius collurio* deserves a special mention with its high density in the pasture biotopes, then the species *Miliaria calandra*, *Coturnix coturnix*, *Crex crex* and *Lullula arborea*. On the suitable southern oriented biotopes, there are large numbers of *Caprimulgus caprimulgus*. A discovery of the third nesting site of *Locustella naevia* in central Slovakia, and a regular and numerous occurrence of *Corvus corax*, which, in the 1940s, was considered by Ferianc (1949) a very unusual record for Zvolen district, is noteworthy. Similarly, *Turdus pilaris*, previously also rare, is nowadays a regular nesting species in the region. On the other hand, Ferianc (1949) mentions *Ficedula ficedula* as a nesting species in Javorie mountains. During our research it was recorded only during migration.

### Characteristics of avifauna in the site Gavúrky

During the years mentioned above altogether 96 species of birds have been found in the site, out of which 63 species were breeding species with one assumed to be a breeding species, 23 non-breeding species, four permigrants and five wintering species. Of these, 23 species are listed in the red list as endangered, which shows the site to be extremely important from the perspective of avifauna conservation. The most valuable nesting species are *Falco subbuteo*, *Columba oenas*, *Dendrocopus medius*, *Caprimulgus europaeus*, *Upupa epops*, *Lullula arborea* and *Miliaria calandra*. The first four species are dependent on the old oak stand for nest sites, the last two mentioned depend on pastures. The complete records of observations can be found in the Slovak version of this report.

### 4.6.5. Amphibians, reptiles and mammals

This review is based on 11 one-day field trips carried out in the summers of 1992, 1993 and 1994 and in the autumn of 1993, as well as on the basis of the data and information received from the colleagues living near the area and from the employees of Vojenské lesy a majetky Pliešovce. Direct observation (catch and release) was used combined with larvae collection. However, no data was collected during the important spring period. In the case of mammals we focused on visual observations of larger and mid-size mammals and/or on observation of tracks and other signs indicating their presence.

### Important fauna of studied groups of vertebrates in the Lešť area

**1. Lažtek:** Diverse mid-size fauna and large mammals are valuable with the occurrence of *Ursus arctos* and *Lynx lynx* and at some times *Canis lupus*.

**2. Sokolovo bralo:** Its block debris accumulations are also interesting for the regular occurrence of some mid-size and large mammals (*Ursus arctos*, *Meles meles*, *Felis sylvestris* etc.), which visit the site mainly for food collection but they find a shelter too. Some of the carnivorous species (*Martes* spp.) use it as a temporary shelter. Bats or traces of their presence have not been observed.

**3. Šamilova skala rock:** In spite of its small size, its foot and the immediate surroundings create a suitable biotope for several mammal species, large carnivores included. Directly under the rock a badger (*Meles meles*) was recorded.

**4. Mavercová forest-steppe:** This is a valuable site especially from the perspective of herpetofauna, where an occurrence of three reptile species has been recorded: *Lacerta agilis*, *Lacerta muralis* and *Coronella austriaca*.

**5. Močiar wetland:** It is situated in the depression of the drying left tributary of Stará rieka stream at the elevation of 590 to 615m above sea level. Numerous pools, many of which are temporary and dry out in summer, provide sites suitable for reproduction of

amphibians, particularly *Bombina variegata*, *Rana temporaria* and even *Bufo bufo*. The area is also a suitable biotope for several mid-size and large mammals.

**6. Dlhý diel – Urbanová:** The site presents a valuable biotope of several mammal species, including large carnivores.

**7. Rybník:** A small artificial reservoir on the Slatinka stream, 560–565m above sea level. The reservoir functions as a suitable reproduction site not only for several amphibian species (*Bombina variegata*, *Bufo bufo*, *Rana temporaria* and *Rana dalmatina*) but also for reptiles including *Natrix natrix*.

**8. Dolina Plachtinského potoka valley:** The area represents a part of the Plachtinský stream valley. Besides shore vegetation composed of species *Alnus glutinosa*, *Salix* sp., *Acer campestre*, *Prunus spinosa* and some others, in some places well-preserved, there are also wood copses of the association *Carpineto-Quercetum* on the hillsides leading down to the valley.

### **Important fauna of studied groups of vertebrates in Gavúrky**

In this site only a few amphibian and reptile species have been found. There are some interesting mammal species, in particular several colonies of *Citellus citellus*. Protected and endangered species that should be mentioned are:

- Amphibians: *Bufo bufo*, *Hyla arborea* (both very rare – VV).
- Reptiles: *Lacerta agilis* (abundant – H), *Lacerta muralis* (VV), *Coronella austriaca* (rare – V).
- Mammals: *Erinaceus concolor* (VV), *Citellus citellus* (H), *Myotis myotis*.

### **4.6.6. Land use and sustainable management proposals**

#### **Consequences of the former Soviet Army activities**

##### ***Damage caused by the former Soviet Army at the Lešť site***

The major part of the Lešť site consists of vast meadows with scattered shrub and tree verdure and remnants of orchard. Also, there are forest complexes in the control of Vojenské lesy a majetky Pliešovce. After 25 years of neglect, fruit trees have mostly died, and fields, gardens and vineyards have turned into meadows. These were used as training or shooting grounds or tracks for heavy vehicles. Establishment of the former Soviet Army reserve training areas required a number of earthworks, excavations, construction of new roads, building constructions, barracks and blocks of flats for the Soviet soldiers and their families. Construction of fuel containers, warehouses and garages for heavy machinery presents a risk of soil and groundwater pollution which has not been sufficiently investigated so far. A lot of machinery and munitions have been buried and overgrown by vegetation.

Damage caused by the former Soviet Army cannot be estimated exactly at present but will probably reach millions of Slovak crowns. The demolition of buildings must be undertaken together with the removal of the remnants of munitions and machinery. Also,

the purity of surface groundwater must be monitored regularly. Some of this is being carried out by the users of the Lešť area but much more needs to be done.

*Damage caused by the former Soviet Army at the Gavúrky site*

Although some damage to the trees could be very old, in some places (the most valuable part of the area) there are apparent signs of the former Soviet Army activities, especially: excavations for fords for heavy machinery (20 × 15m), neighbouring subterranean concrete and brick bunkers (25 × 8m), remnants of 13 concrete blocks scattered as far as 40m from bunkers, trenches for heavy machinery (5), and other trenches approximately 250m long and 1m deep.

According to the reports of the Centre for State Nature Conservation in Banská Bystrica, the total cost of the damage was estimated at 225,270 Sk. Also, physical and chemical analysis of the soils should be done before the final estimate of costs.

**Relations and conflicts**

*Current interests in the Lešť site*

Currently, only the forests administered by Vojenské lesy Pliešovce are used for economic purposes. Meadows and old orchards are not used any more. Maintenance of the area was taken over by the headquarters of the Slovak Army. At this moment none of the mentioned areas, valuable from the nature conservation point of view, is significantly endangered by training activities. Earthworks (excavations of trenches and ramparts) are being carried out only to a small extent in the Mavercová forest-steppe. These works as well as heavy machinery tracks construction and some other intensive activities in the landscape will have to be discussed with the local and regional state environmental authorities.

*Economic use of the Gavúrky site*

Nowadays, the whole area is used for cattle grazing (by the cooperative farm in Dobrá Niva), especially in the north-east part where there are several colonies of critically endangered *Citellus citellus*. The smaller part belongs to the cadastre of the village Sása. The total area of both cadastres is 682,955ha. Besides municipal ownership of land there are smaller owners. Part of the oak timber is being harvested illegally. Identification of the original forest utilisation will require a survey carried out among the elderly citizens of Dobrá Niva and Sása or investigation of town records. Also the owners of individual plots will have to be found and included in management plans.

**Management plan proposals**

*Sustainable management proposals for important sites at Lešť*

**1. Lažtek:** The area is not utilised intensively. We suggest elimination of the timber harvesting and spruce planting, as well as forest track construction. We propose that the

site be declared a National Nature Reserve as an oak wood biocentre of regional significance. One reason is to secure suitable refuges for small and mid-size mammals.

**2. Sokolovo bralo:** The area is not intensively utilised now. Again, we suggest excluding timber harvesting and reforestation with spruce here. We propose that the site be declared a small protected area. The area is significant especially for its abiotic components as well as for part of its forest stands.

**3. Šamilova skala rock and surroundings:** Used as target grounds. In the period between training sessions we recommend the area be grazed extensively by sheep and goats to prevent it from becoming overgrown and losing its meadow communities. Further, no waste should be discharged into the Koprovnica creek and the fishpond must be cleaned up. Šamilova skala rock should not be used as a target. We propose the area be declared a protected area within the framework of the National Ecological Network.

**Rybník:** Current forms of utilisation should be maintained, and the site need not be protected legally, but we recommend it to be classified as a regional gene pool site for amphibians and reptiles.

**4. Mavercová forest-steppe:** Used as target grounds and field training grounds. In the site we recommend only temporary activities (targets, tactical training). In the periods when it is not used, the site can be grazed by sheep and goats, supplemented by cutting tree and shrub seedlings to prevent the area from becoming too overgrown. The site should also be declared a protected area since it is a biocentre of regional significance.

**5. Močiar wetland:** This highly valuable site should be completely excluded from training and economic use. No water management drainage should be permitted in the watershed area above the site. The site is not used for intensive training. We propose this area to be declared a National Nature Reserve, a potential Ramsar site and an important biocentre (core area) of the European or National Ecological Network. Also, we recommend it be classified as a significant regional gene pool site for amphibians and reptiles. We recommend a regular removal of seedlings, possibly supplemented with mowing. In autumn the depressions and holes used by amphibians should be regularly deepened and broadened.

**6. Stará rieka (Leštiansky potok creek):** Timber harvesting should be kept under control and artificial plantations of non-native species excluded. The site should be classified as a tranquil zone. (It was never heavily disturbed and there are no plans for its utilisation in future.) We propose the area be declared a National Nature Reserve and a significant biocentre in the framework of the National Ecological Network.

**7. Bralo:** Timber harvesting should be limited here and artificial plantations of non-native species should be excluded. We propose the site be declared a protected area from the landscape preservation perspective. The site has never been and will not be intensively used.

**8. Priečne:** We suggest a similar approach to that suggested for Bralo.

**9. Dlhý diel – Urbanová:** Timber harvesting and reforestation by non-native species should be excluded. We recommend the area be declared a small protected area significant for its abiotic elements including a part of the surrounding forest stands.

**Summary:** The most valuable of all the surveyed sites is Močiar. We recommend protecting it by means of a National Nature Reserve declaration and also outlining the areas proposed for legal protection by means of small protected areas and stipulating sustainable management practices for users in written agreements with the headquarters of the area Lešť.

*Sustainable management proposals for the Gavúrky site*

To assess the oak wood conditions and to propose optimal provisions detailed botanical, dendrological and zoological surveys should be carried out over several years. The dendrological survey should be focused on evaluation of the appearance of the trees, their marking, biometrics and assessment of their general condition, damage etc. In the meantime we propose the area to be declared a National Nature Reserve (70ha). Intensive use of the area for training purposes was stopped after the withdrawal of the former Soviet Army and there are no threats of this kind in future.

*Proposal for cleaning up the area and necessary provisions*

1. Removal of concrete foundations and deep bunkers, or their reconstruction as educational centres for nature conservation.
2. Removal of the concrete blocks and waste products from heavy machinery of the former Soviet army and cleaning of the site.
3. Filling the excavations, trenches, ramparts for the heavy machinery, cable furrows and erosion holes.
4. Prior to each earthwork a detection for unexploded munitions and metal pieces must be carried out and any terrain alteration must be discussed with soil scientists.

*Proposal for the further sustainable management of the area*

We recommend acceptance of the proposal of the former Centre of State Nature Conservation in Banská Bystrica in 1991 to declare Gavúrky a protected area. The provisions should involve both land owners and users as well as the supervision bodies. The proposal for designation of the area is currently at a standstill as a result of unresolved ownership issues. The best solution is to purchase the land and declare it a small protected area.

Plans for utilisation of the area should be developed, with the following aims:

1. Acquisition of the original oak timber and securing its growth in a selected area of the Gavúrky site.
2. Solution of the problems relating to water management at the site.
3. Elimination of dense livestock grazing and its replacement with extensive sheep and goat grazing in selected sites at certain periods, with exclusion of grazing in the south-west part of the site.



4. Elimination of illegal collecting of beetles: populations are being increasingly depleted by commercial entomologists.
5. Elimination of the illegal burning of hollow trees.

#### **4.7. Evaluation and sustainable management proposals for the Ivachnovský luh site**

##### **4.7.1. Abiotic and biotic components**

The Liptov region is famous for its mountain ecosystems. Their counterparts in the valley of the Liptov basin include the longest Slovak river, Váh. The most valuable part of this area includes the Ivachnovský luh floodplain, created by the forest copses on both parts of the river at altitudes of 494–500m above sea level. Ivachnovský luh was declared a National Nature Reserve in 1992, with an area of 10.54ha to provide protection for the relic floodplain forest, which is the northernmost one in Slovakia and the last fragment of this type in the Liptov region.

##### **Evaluation of the abiotic conditions**

**Relief:** The surface of the river plain is irregularly furrowed by erosion, which sometimes creates depressions. On the south-west fringe of the Lazy settlement is an old branch of the Váh river which is now drying out, and has adjacent silted meanders. The river bottoms are sand-gravel with large stones. The bank sand-gravel terrace is created by the fluvial material with the sand and sand loams.

**Hydrology:** In the middle of this century works were carried out on the river banks to regulate water flow, and this has altered the natural regime of floods. The water deficit was addressed by the construction of an extraordinarily large water dam, Liptovská Mara, several kilometres nearby. The river was deepened and ramparts were built on the banks. The Váh river flow has the characteristics of a submontane river, with gravelly and stony bottom, 25m wide and with clear water.

**Climate:** The site has a basin climate with large temperature inversions, fairly dry to moist, with annual precipitation of 600–850mm, and mildly cold. The site has less than 50 days with temperature above 25°C. The average temperature in July is 16–18°C, in January 4–5°C. Temperatures are below 0°C for 91 days/year. The period without frosts is 140–160 days.

##### **Evaluation of the flora and vegetation**

Copses of the floodplain forest in the reserve belong to the group of forest types *Saliceto-Alnetum*. In the Zurich-Montpellier school classification, the most valuable copses belong to the union *Salicion albae*, association *Salici-Populetum*. In the tree layer occur *Populus nigra*, *P. tremula*, *Salix fragilis*, *S. alba*, *S. incana*, *S. purpurea* and *Padus avium*. A very

rich shrub layer, forming dense copses, is created mainly by *Salix triandra*, *S. caprea*, *Sambucus nigra*, *Lonicera xylosteum*, *Euonymus europaeus*, *Swida sanguinea*, and *Ribes nigrum*. In the herb layer, nitrophilous species and those typical of wet and shaded sites prevail. During the inventory, 162 species of higher plants were recorded.

Vegetation cover has greatly suffered from the change in water regime connected with the construction of Liptovská Mara dam. The forest growths are mostly 80–90 years old. From the original black poplar of Ivachnová in the Gabčíkovo Research Station the variety *Populus nigra* “Ivachnová 1” was selected, with plantings resistant to rusts, poplar dotchitize and the leaf disease caused by the fungus *Marsonina brunnea*.

### Evaluation of the fauna

**Invertebrates:** Terrestrial macrofauna from the phyla Annelida, Mollusca, and Arthropoda has been documented up to now, including 27 orders. A more detailed review has been undertaken for Insecta, especially the order Coleoptera with 29 families (family Carabidae counting 44 species). Remarkably high biodiversity indicates a high biological value of the area and a vital role of the forest copses in the country economy. Ten species of Molluscs have been determined. The mollusc community is typical of the floodplain forest, with a distinctive representation of species typical of wet sites. Most significant is the occurrence of the Carpathian endemic *Trichia villosula*.

**Ichthyofauna:** The submontane characteristic of the area creates habitat for 18 species of fish. The most valuable are protected tadpole-fish, trout, grayling, stucco, gudgeon, and others.

**Avifauna:** The regular observation of birds dates from the 1960s. Of the 90 bird species recorded, there are 57 nesting species, ten assumed nesting species and 23 temporary migrants. Most of these are protected, 11 of them are endangered, 52 are rare species. Examples include *Phalacrocorax carbo*, *Ardea purpurea*, *Upupa epops*, *Oriolus oriolus*, *Alcedo atthis*, *Ciconia nigra* and *Aquila pomarina*.

**Amphibians:** *Bombina variegata* and *Rana temporaria* have been observed.

**Mammals:** Thirty species recorded to date include three rare species and 12 uncommon species, such as *Sorex alpinus*, *S. araneus*, *S. minutus*, *Crocidura suaveolens*, *Neomys anomalus* and *Lutra lutra* (all of them protected).

#### 4.7.2. Damage caused by the former Soviet army

The damaged part of the NNR is situated on the left bank of the Váh river and covers an area of 3.96ha. The reserve training area was situated here. The damage was done by excavations for heavy vehicles, by the development of a 3m wide road along the whole length of the territory, by felling a large number of trees, by destroying the vegetation and

through accumulation of waste, including metal waste and large tyres, by laying mines and through contamination of water and soil by oil products. The natural regeneration of the area will require at least ten years. The cost of the damage was estimated in 1990 to be 371,512 Sk.

#### *4.7.3. Ownership issues*

The ownership issues are complex as most of the area belongs to small private owners. The river Váh divides the National Nature Reserve into two parts. Its forests are administered by the Stredoslovenské štátne lesy Žilina (Central Slovakian State Forests in the town Žilina), belonging to the Lesný hospodársky celok (LHC – Forest Economic Whole) Biely Potok and Liptovská Teplá. At this time, there is no tree felling.

#### *4.7.4. Proposals for reconstruction and sustainable management*

##### **Proposed reconstruction measures**

According to the results of inventory, a specific protection regime for the NNR Ivachnovský luh was set out in 1990. This proposes a number of measures, the aim of which is to revive the floodplain forest regime and renew the biological potential of the whole complex. The basic provisions – preconditions to the cleaning and management plan – are:

- To remove waste landfills and to stop development of new ones.
- To remove the excavations for tanks and fill the trenches.
- To eliminate tree felling and vegetation damage.
- To eliminate negative influences from agriculture activities.
- To enable flooding of the area again.

An estimate for the cost of restoration was prepared but to date this money has not been paid. Part of the proposed cleaning and reconstruction provisions were carried out by the former Regional Centre for Nature and Monuments Conservation in Banská Bystrica. Similarly, the state nature conservation authorities in Liptovský Mikuláš organised removal of waste, filling four tank trenches, nurturing damaged trees, closing of a functional mine and studying the water regime.

##### **Proposed cleaning provisions**

- To provide security of the area by means of munitions research.
- To realise the proposed improvement of the water regime.
- To reinstate periodical flooding of the area.
- To eliminate the contamination of underground waters from the waste tip.
- To provide specific care for the most precious parts of the NNR.

Without these cleaning measures no sustainable management will be realised. The proper sustainable management measures are described below.

### Proposed sustainable management provisions

- To complete filling in the trenches, to remove the waste from the river branches, to eliminate the contamination of groundwater from the waste tip.
- To renew periodic floods from the Váh river and to provide a connection between the Turický stream and the system of river branches.
- To provide complex care and improvement for the floodplain habitat in the section between Ivachnová and the bridge at Lisková.

### 4.8. Conclusions

The project "Biodiversity and nature conservation in the areas used by the former Soviet Army in Slovakia" is producing many proposals to solve the damage to natural ecosystems resulting from almost 25 years of activity of the former Soviet troops. As the results show, some of the damaged ecosystems are still especially valuable areas, providing refuge for many rare, endangered and protected species.

We are facing substantial questions now as to how to cope with the proposed provisions, with cleaning up and sustainable management plans and how to provide sufficient resources to start the action. We believe that there is room for further international nature conservation work in the field, and for activities of the government nature conservation institutions in Slovakia, e.g. Ministry for the Environment of the Slovak Republic, Slovak Environmental Agency and also the participation of conservation-oriented non-governmental organisations in Europe. The identified valuable sites represent a common European heritage. On another level, our consideration is to widen the scope of the original idea to embrace other valuable sites used by the armies of the Central European countries. The areas rich in biodiversity that we have found so far suggest that further extraordinarily valuable areas of this type await our attention.

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## IUCN – The World Conservation Union

Founded in 1948, The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organisations in a unique world partnership: over 900 members in all, spread across some 125 countries.

As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. A central secretariat coordinates the IUCN Programme and serves the Union membership, representing their views on the world stage and providing them with the strategies, services, scientific knowledge and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 6,000 expert volunteers in project teams and action groups, focusing in particular on species and biodiversity conservation and the management of habitats and natural resources. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge through the field projects it supervises. Operations are increasingly decentralised and are carried forward by an expanding network of regional and country offices, located principally in developing countries.

The World Conservation Union builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

### European Programme

Established in 1987, the aims of the Programme are to promote environmentally sound planning in accordance with the aims of the World Conservation Strategy and the Report of the World Commission on Environment and Development, to participate in international conservation affairs and to promote and support the application of restoration ecology. The Programme has built up an unparalleled store of information on conservation issues in eastern, central and south-eastern Europe. Dissemination of this information is being carried forward through the EP Report and Research Series.

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