Conflicts between human activities and the conservation of biodiversity in agricultural landscapes, grasslands, forests, wetlands and uplands in the Acceding and Candidate Countries (ACC)

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CONTENTS:

7. Uplands

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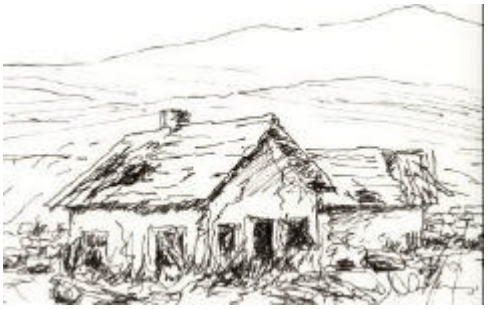

7.1. Introduction

Uplands are considered to include, usually, land above an altitude of 200m. An important trait of uplands is the great diversity of habitats and human activities that determine their complexity and significance in terms of biodiversity and livelihood. The agricultural potential of uplands of some of the Acceding and Candidate Countries is shown in Table 7.1.

Table 7.1. The distribution of Utilized Agricultural Area in selected Uplands (in thousands of hectares)

Countries	Uplands	Utilized agriculture area		Permanent grassland	
Mount. Reg.	Area	Area	% of studied area.	Area	% of agricultural land
Bulgaria	2,598.6	477.6	18.6	98.6	20.6
Czech Republic	6,360.0	3,282.7	51.6	968.3	27.5
Polish-Slovakian Carpathians:	5,063.8	2,060.7	40.7	895.7	43.4
Slovakia	3,103.8	1,061.1	34.2	648.7	61.1
Poland	1,960.0	999.6	51.0	247.0	24.7
Romania	7,362.5	2,945.0	43.5	1,470.8	10.2
Total upland area	21,384.9	8,766.0	41.0	3,433.4	16.1

Sources: Krajcovic et al., 2001; Main Statistical Office of Poland, 2002; Romanian National Institute of Statistics, 2003.

Uplands in central and south-eastern Europe are represented by the extensive Carpathian range, Caucasus and the mountains of the Balkan Peninsula. The Carpathian range covers border areas of the Czech Republic, Hungary, Poland and Ukraine, together with a significant part of Romania and the Slovak Republic The contribution of uplands in terms of biodiversity and cultural heritage is high compared to lowland regions. This is mainly due to climate, topography, geology and land use in these areas that result in major changes in plant growth conditions and in a diversity of habitats. The conservation value of the uplands is determined by the great number of rare, threatened and endemic species of plants and animals, glacial and tertiary relicts and high diversity of habitats occurring, which are protected by establishment of several National Parks and natural reserves. Uplands in central and south-eastern Europe represent various types of habitats: grasslands, scrubs – *Pinus mugo,*

Juniperus sibirica, J. oxycedrus (only in the South), peat bogs, woodlands (coniferous, deciduous and mixed), caves, screes, lakes, carst, riparian communities, springs. The role of mountains in the Balkan Peninsula is also recognized in terms of their importance for speciation and the maintenance of a rich gene pool after the post-glacial re-colonisation of Central and Northern Europe. It should be underlined that alpine and sub-alpine zones represent vulnerable, fragile ecosystems with slow recovery after disturbances due to both natural causes and human activities.

7.2. Identifying sources of conflicts

The different activities and pressures in uplands that may lead to conflicts with biodiversity can be categorised as follows:
- Land use change (due to agriculture, forestry or game management)
- Direct use of resources (like wind farms, hydroelectric power or extraction of minerals)
- Access and recreation (tourism and infrastructure)
- Indirect pressures (like atmospheric deposition or climate change)

7.2.1 Agriculture

In many parts of Eastern European upland areas, agriculture has developed through the fragmentation of land in smaller plots. This applied to meadows and pastures as well as forests. Although the process of degradation in uplands is not new, the problem was exacerbated after World War II when economical considerations particularly in agriculture and forestry were more important than environmental or ecological considerations. It was therefore assumed that for both internal consumption and export, a large volume of plant and animal production represented the guarantee of a stable national economy.

Excessive emphasis on plough land exploitation led to the creation, and consolidation of inappropriate spatial structures. Structural problems included badly planned agriculture land, scattered settlements, and a linear infrastructure. Added problems included a large concentration of overpopulated farms, low technical level of many farmhouses and buildings, and a low standard of equipment for collecting the organic matter originating from domestic sewage and from animal production. Added to this, ineffective supply of water in rural areas, badly managed sewage plants, and very high unemployment rates have all indirectly contributed to the deterioration of the natural environment (Twardy *et al.*, 1994; 2001).

The agricultural economy in the Carpathians is mostly based on private ownership of land. In Poland for example, 93% of the land is owned privately (Main Statistical Office of Poland, 2002). In the Communist era, Polish agriculture was not collectivised like its neighbours but remained a country of small farms. There is a strong bond to the land, with many farmers regarding it as a legacy, leading to the partitioning of farms and increase in small plots of land with very different management practices (see table 7.2).

Table 7.2. The area of agricultural land in the Carpathian farms (PL-Poland and RO-Romania)

Specification		The area of agricultural land in the holdings in ha					Total
		< 2	2-5	5-7	7-10	> 10	
Number of farms	PL	186,132	242,989	4,246	4,734	1,253	439,354
	RO	988,012	247,981	33,934	28,713	6,252	1,305,168
Total area of farms	PL	260,585	704,668	25,900	39,766	26,940	1,057,859
	RO	1,142,660	1,110,265	315,115	265,050	97,185	2,930,275
Percentage of farm areas	PL	24.6	66.7	2.4	3.8	2.5	100.0
	RO	75.7	19.0	2.6	2.2	0.5	100

Sources: Twardy et al. 2001 and the Romanian National Institute of Statistics, 2001.

The small plot holdings also explain the high population density in Carpathian agricultural areas. For example in Romania there are nearly a thousand farms below 2 hectares, which cover an area of about 1,1 million hectares. The great number of permanent inhabitants results from numerous and large families living in these areas, and the industrial restructuring resulting in an immigration of unemployed people from the cities back to family villages where living costs are lower. In Poland for example, a total of 54 people make a living from agriculture on only 100 ha of land- nearly twice as many as on agricultural land in lowland areas. Upland farmers are forced to develop low-input systems of plant and animal production for their own consumption and the local market. However, the general nature of upland environments limits the potential for communities and individuals to introduce alternative economic forms of exploitation.

However, while abandonment of land is becoming an increasingly common occurrence in Central Europe, intensive livestock production and overgrazing is still a serious environmental issue and can result in a direct loss of habitats. Intensity of land use in the Carpathians is a result of natural, social and economic conditions. In lower slope areas, the land is mostly used for agricultural purposes. In certain areas however, this can have a damaging impact on biodiversity when ploughed land is located on steep slopes and shallow stone soils, chemical fertilisation (N, P, K in the range 150-250 kg/ha^{-1}) is unbalanced, or when the application of manure is too concentrated (Krajcovic et al. 2001). Land abandonment due to economic migration from mountain and remote places nowadays in Bulgaria is an important issue and leads to loss of traditional knowledge of cattle breeding and agricultural practices and loss of indigenous local breeds and varieties of plants. The contamination with pesticides, fertilisers and manure is not a problem caused by extensive agricultural practice. Decreasing grazing pressure in high mountain pasture causes the replacement of important grass communities by juniper.

With the increase in altitude, the pattern of agricultural land use changes. Grasslands increase and the arable land decreases. Generally this is a favourable phenomenon, resulting in less soil erosion and a better protection of the soil-water environment (Kopec 1999, Kurek 1979).

It is anticipated that free market and liberalization of food imports as well as capital and human resource flows will transform Central European countries. Apart from socio-economic conditions, there will be the impact of non-productive aspects connected with recreation. In the Carpathians, the significance of production of agriculture land will be gradually limited and adjusted to the requirements of sustainable and multifunctional development of these areas. Non-productive roles particularly in reference to erosion control, as well as aesthetic and landscape function will be given higher priority. The quality of products will be better controlled, resulting in less quantities being produced but emphasis put on varieties of vegetables, fruits and berries valuable in terms of taste and health requirements. Hopefully there will be a more gradual move towards environmentally friendly low-input agricultural production.

Based only on organic fertilising, rational organisation of hay making, pasture conservation for winter and proper grazing, the move to organic farming is expected to help in the conservation of biodiversity through the maintenance of biodiversity rich feature such as permanent grasslands. This more labour intensive form of agriculture should also benefit local population by creating more employment.

7.2.2. Forestry

Effects of trans-boundary atmospheric pollution have heavy consequences for mountain forests in general. The situation in the Polish Carpathians is more favourable than that in the Sudeten, due to the lower pollution levels and more fertile forest sites. The process of degradation of upper mountain spruce stands is stronger in the artificial stands, which are not genetically adjusted to the conditions of the upper mountain zone. In recent years, a slight decrease in the value of mean indicator SO2 and dust in mountainous areas has been recorded. Air pollution was a main reason of the ecological disaster in Sudeten that started at the end of the1970s, when an area of more then 160 sq. km was deforested. Afforestation of this area was a great success for foresters. In recent years the artificial and

natural regeneration of trees improved, and it is undoubtedly due to limitation of pollution emission to the atmosphere.

Long-term studies on climatic data have shown a recent deviation from the average long-term temperature values. The predicted climate changes are expected to have negative repercussions on existing mountain spruce stands, as well as cause severe floods, soil erosion, landslides and the increased occurrence of pests. The improvement of quality of forest ecosystems is necessary for better natural water retention and in order to limit floods and erosion processes in mountain forest watersheds. This can be achieved by limiting air pollution and by elaborating long time climatic forecasts that can facilitate acceleration of naturalization species composition of stands adapted to mountain forest sites and changing climatic condition.

Sustainable development of mountain regions depends primarily on technical infrastructure as well as on the economic and social situation of particular provinces and villages. In mountainous villages, particularly in those situated relatively high, technical infrastructure is very poor, considerably poorer than in the rest of the country. The further development of mountain regions is greatly conditioned by changes in the infrastructure.

One of the most important priorities of the mountain forest watersheds management should be the inclusion of private forests into more ecologically friendly management schemes and afforestation of the post agriculture areas programmes, as stated in the National Program of Forest Cover Increase.

A serious conflict in Bulgarian forests is the incidence of forest fires. In Central Balkan National Park for example 18 fires were registered in 2000 alone (44% caused by man and 50% of unidentified origin). The forest fires have importance especially for coniferous, juniper and mountain pine communities caused by the high content of resins, lack of natural barriers and difficult access. High mountain fires are responsible for superficial erosion and increasing avalanche incidences.

7.2.3. Game hunting

The principal game species used for hunting in the Carpathians are deer (*Cervus elaphius* and *Capreoplus capreolus*) and wild boar (*Sus scrofa*) (Warszynska, 1995). The smaller game species are foxes (*Vulpes vuples*) and hares (*Lepus europaeus*). There are seasonal periods of hunting for partridges (*Coturnix coturnix*) and pheasants (*Phasianus colchicus*). In the past, capercaillie, black grouse, hazel grouse and woodcock were hunted. Nowadays they are under strict protection. In Poland for example, according to the Main Statistical Office (2002), the number of culled game animals (in the hunting season 2001/2002), were as follows: 149,000 deer, 105,000 wild boars, 107,000 foxes, 91,000 hares, 96,000 pheasants, and 22,000 partridges. Simultaneously 2,000 hares and 67,000 pheasants were caught and transferred to another locations.

The present distribution and population size of the above species is strongly influenced by the impact of man through hunting (including poaching), forest management, pasturage, and tourism thus causing an imbalance between different species populations. The heavy exploitation of forests as well as mining operations have also had a significant bearing on this problem. On the one hand, the numerous cleared areas that soon became overgrown with grass and shrubs provided favourable conditions for the development of game. On the other hand, the large scale grazing of cattle and sheep had a detrimental effect on the feeding grounds of game species and opened up the areas to increased hunting pressure.

7.2.4. Tourism

Although tourism can be dated back to the 16th century, the intensive development of tourism only began in the second half of the 19th century (Szafer, 1962). The socio-economic changes at the end of the 1980s made the existing tourist base accessible for all. The uplands in the ACC are used for a wide range of outdoor recreation including skiing, rock climbing, walking, paragliding, hang-gliding, and

bird watching. In water environments, canoeing and rafting are popular. The biggest recreation areas are observed in the Western Carpathians, e.g. Tatra Mountains famous for resorts in Zakopane (Poland) and Ščrbskie Pleso (Slovakia). There is frequent overlap of tourist arrivals at different times causing excessive concentrations and overloading of the infrastructure during the weekends, in an area primarily designed for long-term visitors. The weekend movement is spreading on relatively pristine mountain regions causing their devastation, soil trampling, compaction and eutrophication. In addition the excessive concentration of buildings and the lack of harmony between the architectural style of the tourist complexes and the surroundings landscape create significant problems as well. New infrastructure creation in the ACC, transport corridors, road building, supporting other activities together with uncontrolled and illegal building contribute substantially to the conflicts. Overbuilding in mountain areas with big hotels cause high anthropogenic pressure, waste accumulation, sewage pollution, commercialisation, and thus provoke loss in local identity and local traditions.

7.3. Identifying resolution strategies

7.3.1. Guidelines

The relationship between mountain agriculture and nature conservation can be complex, delicate and sensitive to local conditions. Sometimes, minor changes in management can be significant for particular species. Stoll-Kleemann (2001) differentiates two approaches to biodiversity management, the "people-included" approach versus the protection or "ecology-first" approach. It is believed that protecting habitats and species should be the priority of biodiversity management (Matouch 2003).

Analysis of the main type and sources of conflicts in uplands showed their complexity and needs of holistic approach in proposing the resolution strategies (see table 7.3). Often conflict resolution requires implementation of more than one strategy. Although there are some differences between countries, all of them have historical, economical and cultural reasons. Therefore, general resolution strategies could be applied through: i) legislation and control measures, ii) subsidies/incentives; iii) training, education and dissemination of information; iv) technology measures; v) specific measures.

7.3.2. Agro-environmental measures and afforestation

Financial instruments may not be used in a systemic way to encourage farmers to maximise environmental benefits resulting from the implementation of good agricultural practices and activities protecting the nature and landscape. Agri-environmental pilot projects have recently been set up in selected regions of high natural value or in regions liable to environmental threats. These schemes aim to promote, on a pilot scale, practices and agricultural production methods related to landscape conservation thus limiting environmental threats resulting from marginalisation or intensification of agricultural production. Similarly, afforestation pilot projects can be set up in regions with a high percentage of poor and marginal soils in order to promote activities aiming at afforestation enlargement on private agricultural land taking into consideration optimisation of landscape structure, reduction of erosion processes and greenhouse gases. Under these schemes, farmers can earn an extra income while complying with the requirements provided for in the stipulated contract. The PHARE and SAPARD programmes provide several opportunities in this direction.

7.3.3. Legislation & Legislative Instruments

In the last few years, many important documents and acts connected with forest and water management have been developed in Central European states, mostly in the frame of the accession process. In Poland for example these include the Programme of Conservation of Forest Gene Resources and Selection Breeding of Forest Trees (1993), Guidelines on the improvement of forest management based on sustainability principles (1995), the National Programme for Expansion of Forest Cover (1995), National Policy on Forest (1997), Water Act (2001) and the Polish Mountain Bill. For Bulgaria: National Strategy for Biodiversity Conservation (1993); Act on Forests (1997); Act

on Restoration of Ownership of the Forests and Lands in the State Forest Area (1997); Act on Protected Area (1998); Act on Hunting and Game Conservation (2000); Water Act (2000).

Table 7.3. Types of priority conflicts between human activities and the conservation of biodiversity and guidelines to resolve these in the Central and South-Eastern European Uplands

Type of priority conflict between upland biodiversity and other activities	Guidelines for resolving conflicts (refer to number in conflict column)
A. Land use change A.1. Agriculture/Livestock A.1.1. Abandonment (5,17) A.1.2. Improving of grasslands (10,14) A.1.3. Heavy Stocking (overgrazing, increased tracks, burning) (6,12,14) A.1.4. Improving of animal production (11,12,14) A.1.5. Change in the type of grazing (2,8,9,14) A.1.6. Specialisation (over dominance of sheep and goats) (2,5,14,15) A.1.7. Afforestation (4,6,15) A.2. Forestry A.2.1. Deforestation including logging and forest fires (2,4,5) A.2.2. Forest management activities (4,5) A.3. Infrastructure A.3.1. Construction (3,7, 21) A.3.2. Road building (3,21) A.3.3. Waste management (1,5,12,20) A.3.4. Soil erosion and land sliding (1,18,20) B. Direct use of resources B.1. Extraction (minerals etc.) (1,3,18,20) and hydroelectric power (3,19) B.2. Game management B.2.1. Illegal persecution of raptors (5,13,16) B.2.2. Introduction of birds (16) B.2.3. Poaching and culling (2,5) C. Access and Recreation C.1. Access (2,3,7,15) C.1.2. Sports (1,2,12) C.1.3. Recreation (3,15) C.1.4. Hunting (2,12) D. Indirect pressures D.1. Atmospheric pollution deposition (2,21)	1. Regulation strategy and control 2. Legislation measures and/or legal protection 3. Environmental Impact Assessment 4. Prohibition on wood exports 5. Effective control measures 6. Controlled burning 7. Maintenance of existing infrastructure e 8. Subsidies/incentives- CAP-Paying farmers for caring for the countryside 9. “Decoupling” subsidies and production 10. Financial incentives for grassland maintenance and restoration in disadvantaged areas 11. Financial incentives for extensification 12. Training and Education 13. Education of the custom officers 14. Improve communication with farmers and professional advisers to optimise biodiversity 15. Promote awareness of uplands as habitat for biodiversity 16. Game farms 17. Ownership of abandoned lands 18. Re-cultivation 19. Water management on regional scale 20. New technology applications 21. Assess the ecological importance of uplands in respect to lowlands

7.4. Case studies

7.4.1 The Sola river, (Upper Vistula, Poland): Conflict between river control and draining and conservation of biodiversity

The Regional Water Authority is in favour of engineering works consisting of lining the riverbed with concrete and logging of the floodplain forests. They argue that dense floodplain forests create particular threats during unusually high rates of discharges, because the river flow is impeded, which can lead to scouring and breaking of the embankments. The extensive system of tree roots may also weaken the flood embankment bedding by building up the seepage paths. The large and uniform trees and shrubs complex reduces cross-sectional area between flood embankments, which decrease the flow capacity and leads to additional water levels. Hydrologists from the Water Authority are against crediting a great importance to flood plain forest. They frequently mention a particular flood when in a four day period, 220 million cubic meters of rainfall water fell in the catchments of Tresna dam (The Sola River) and the forest was unable to avoid the flood. They also argue that small dams (local retention) are not applicable to the mountain conditions, where the dam reservoirs should be constructed based on detailed hydrological analyses.

The Green Federation is now in conflict with the Water Authority over the proposed engineering solutions. From a biodiversity point of view, floodplain forests are the richest of the continent, equivalent in terms of species number to some tropical rain forests. Conducting river engineering would mean a total degradation of the river environment by increasing flood threats as well as limiting the natural self cleaning capacity and lowering the ground water table. They argue for a management of the Sola valley that will maintain its nature values and keep the ecological equilibrium. They also highlight the important role of trees and shrubs in absorbing the huge amounts of Nitrogen and Phosphorus (biogenic) from the soil and water systems. The Green Federation suggest that the new flood embankments should be permitted only at the large distance from the river, that beavers should be re-introduced to the Sola river catchment and that a nature- landscape complex should be created in order to develop a so called "life corridor" for migration of valuable plants and animals species.

7.4.2 Bieszczady National Park (Poland), East Carpathians Biosphere Reserve

The 29,200-hectare park was established in 1973 as part of the trilateral Polish-Slovak-Ukrainian cooperation for nature conservation and sustainable development that also encompasses Poloniny National Park in Slovakia and Uzhansky National Nature Park in Ukraine. This is the second largest European mountain biosphere reserve accounting for 213,211 hectares. This protected area, which is located in the south-eastern part of Poland, was designated UNESCO Man and Biosphere Programme. The vegetation zones in the Park have a specific character resulting from climatic and anthropogenic factors. The upper zone of forests run at the elevation 1150 m. a.s.l, whereas the main part of the park is located in the lower sub alpine zone (500-1150 m a.s.l.). The area is almost 90% forested and contains the largest European natural beech forest complex. It constitutes one of the most important refuges for large predators such as the brown bear (*Ursus arctos*), wolf (*Canis lupus*), lynx (*Lynx lynx*) and big native mammals like roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), European beaver (*Castor fiber*), bison (*Bison bonasus*), and reintroduced Hutzul Horse. One can find the last viable Aesculapian snake (*Elaphe longissima*) population in Poland.

Conflicts in the park have emerged due to land ownerships and demands for restitution of property that had previously been confiscated by the government. Other conflicts include poaching, gathering ground cover and the fact that farmers find compensations for livestock or crop damage too low.

There is also a conflict between the growing wolf population and peasant farmers in the Bieszczady area. Whereas only 30 wolves live in the protected area, the total number of wolves in the south-eastern region of Poland reaches 400. This causes a serious problem for local farmers, whose property

is damaged by wild animals. The municipal offices responsible for paying compensations demand complicated proofs of losses from farmers, which prove impossible to provide when wolves don't leave any traces of preying on domestic animals. Similarly, the Hunting Association are accused of delaying the procedures and of complicating administrative processes. Other wild animals, such as wild boar and deer, are causing losses in grain and root crops. Evaluation of the losses by responsible officers usually comes too late and is often underestimated. The losses caused by animals lying over growing cereals are quite considerable but compensation paid is very modest. Therefore, the subsistence farmers feel bitterness because they are forced to purchase food products for the winter period. It seems that government and local government units do not solve all conflicts between the National Park and the farmers.

This region is known to have extremely high unemployment because numerous state farms were dissolved due to an economic transformation. Illegal forest exploitation such as poaching, gathering ground cover, logging etc. is in permanent conflict with protection policy in the Park.

7.4.3. The Blatov grassland (Czech Republic)

- General framework of the problem

"The countries of Central and Eastern Europe which liberated themselves from Communist rule … have inherited a weak economy and a severely deteriorated environment" (Kvet 1993). Concerning the agricultural landscape this is particularly true for grassland habitats. Several significant changes in land use occurred after World War II with vast changes in terms of property ownership in former Czechoslovakia. As a consequence, traditional management of semi-natural grasslands declined significantly. Areas of the Czech and Slovak Republics, Eastern Germany and Hungary were particularly struck by similar symptoms, such as changes in the hydrological balance of the landscape due to the drainage over large areas, vast eutrophication and air / water / soil pollution etc (Kvet 1993). One such example is the significant decline of grasslands of wet habitats, which belong to the order of Molinietalia (in the framework of the Braun-Blanquet system) in the last few decades within the whole Czech Republic. This occurred mostly due to large-scale draining, as mentioned above. Moreover, in dense-settled areas (Prague for example) there is extreme pressure to destroy such natural habitats by building sites; hence, occurrence of this type of ecosystem in the landscape is rather fragmented nowadays, both in lowlands and in uplands. Remaining localities are strongly endangered by numerous human activities concerning the whole spring area.

There are plenty of rare and endangered species that are confined to meadows of wet habitats with low nutrient content. Such ecosystems disappear continuously from the landscape and these species become more and more endangered. Some valuable localities represent communities of *Molinion* (wet meadows). These are among the most threatened plant communities (Moravec 1995) and are threatened by extinction due to human activities such as systematic drainage, as mentioned before. Near the settlement of Blatov (east of Prague) there is a *"locus classicus"* – a grassland well known from the 19th century when an eminent botanist, Celakovský, discovered a tiny fern *Ophioglossum vulgatum* there which is a strongly threatened taxon mentioned in the Red list of the flora of the Czech Republic (Holub et Procházka 2000). This species is now confined to two remaining places within the whole Prague area. Other species, such as *Trollius altissimus, Dacytlorhizamajalis, Isolepis setacea* etc. are also threatened taxa of the Red list (Šprynar et Rezác 1995, 1996). Since this locality is no longer mown, *Phragmites communis* (common reed) has begun to colonize the site. The measures to stop this succession are relatively simple and would mean mowing the meadow regularly in June, as *Phragmites* stands reach their vegetative maximum before they start to blossom. Nevertheless, permission of stakeholders would be necessary for such management, and this becomes a serious problem because there are several owners. Some of them are keen to collaborate with conservationists and scientists while others show distrust and lack of understanding.

- Why?

Some of the owners hoped to use their part of the locality as a building site. State administration however has not permitted such activities because of the scientific and biodiversity value of the

meadow. Other stakeholders would be glad to sell their part of grassland, but the price is too low to be reasonable. As a consequence, they have not decided how to carry out any proceedings.

- The problem
The problem of lack of care within the cultural or semi-natural grassland ecosystems is quite general and widespread in the Czech Republic. The solution depends on many different factors such as presence of local conservationists or NGOs, willingness of owners to let these people to carry out the management etc. In this case, cooperation amongst the authorities/NGOs and the stakeholders is too weak (or missing all together) and no good personal relationships have been established until now.

- Possible solutions of the problem on different levels
A mayor of the town district could play a positive role; he might publicize the value of the area, its significance for nature conservation and its role within the landscape in the vicinity of the capital, etc. There are also state funds (of the Ministry of Agriculture, Ministry of Environment) that could allocate a grant for stakeholders who care for their grasslands in a sufficient and an appropriate way. It is necessary to improve communication between stakeholders and local authorities, as well as with the conservationists and scientists so that the owners can trust these personal relations and take advantage of a financial support of the state institutions and/or foundations. There is also a necessity to improve possibilities of being well informed about funds dedicated to the landscape care and conservation management. A final important consideration is to have a stable state policy acting as a framework that concentrates on long-term effects.

7.4.4. Sinaia case study (Romania)

Sinaia is located in the Southern Carpathians, at an altitude of about 750 m a.s.l., on the Prahova River valley, between the Bucegi and Baiului massifs. Since it is close to Bucharest (only 120 km north), many residents from Bucharest own holiday houses in the area. Bucegi is a protected area and Prahova valley is the buffer zone were traditional activities are permitted.

Dominant ecosystem types in this area are grasslands and forests. However, while residents from Bucharest prefer grassland areas for housing and development purposes, both local residents and conservationists want to maintain these grasslands in a natural state and use them for grazing. These differences in opinions and interests generate conflicts between local population, managers and landowners.

The new buildings also need associated infrastructure such as water supply, more waste water treatment, solid waste management, electricity, access roads. Water resources in this area are limited because the Bucegi mountains are a calcareous massive and very permeable. The extensive water capture causes drainage in wet grasslands severely disturbing this ecosystem type. The increasing amount of waste water exceeds the existing capacity of waste water treatment facilities and pollutes the Prahova River. The engendering of solid waste is increasing too, with a growing need to extend existing landfills and create new ones. New landfills, existing access roads and new access may reduce and divide in fragments natural ecosystems (hayfields, pastures, forests).

7.4.5. Pirin National Park (Bulgaria)

The Pirin National Park is a state owned Natural World Heritage Site located in the Pirin Mountains, South-west Bulgaria and covers a total area of 40,060 ha, including the Baevi Doupki-Djindjiritza Biosphere Reserve (2,873ha) and Yulen (3156,2 ha). The park lies at an altitude of 1,000 m to 2,915 m, mostly composed of granites and slates although local areas of limestone lie between the summits of Vikhren and Kamenitza, as well as in the central part of Pirin. The mountain ridges are generally of early Pliocene age but in some localities between 1,200 m - 1,600 m are of old Pliocene age. The denudation of the area occurred more widely during the Quaternary period when the snow cover descended to 2,200 m - 2,300 m. Limestone rocks, marble, south Bulgarian granites etc., karst formations, and typical glacial features (over 100 glacial lakes, deep valleys, circuses, crags etc.) are

present. Pirin Mountain stretches from northwest to southeast between the valleys of the Rivers Strouma and Mesta. There are many rivers and waterfalls.

- Biodiversity & Conservation Values

The Pirin National Park (with an area of 40,447 hectares) is included in the UNESCO Convention for the Preservation of World Natural and Cultural Heritage Sites. The park includes unique ecosystems, rare endemic and relict animal and plant species. The forests cover 60 % of the territory. The 100 peaks over 2000 m asl, the 186 glacial lakes, cirques, moraines, waterfalls, caves, the rich flora (over 1089 species) and the variety of fauna (172 vertebrate species) represent nature's generosity. Vertebrate species occurring in the park include 4 fish, 10 amphibians, 14 reptiles, 102 birds, and 42 mammals. 114 of these species are listed as threatened to varying extents. Five species are included in the World Red Data Book-the Greek turtle, the Big night bat, the Gray wolf, the Pole cat, and the European otter. Four species in Pirin are threatened with extinction in Europe- the Long eared bat, the Brown dormouse, the Mole, and the Brown bear. Among the mammals and birds listed as threatened within Bulgaria are the Brown bear, the Gray wolf, the Pine marten, the Rock marten, the Polecat, the European otter, the Wild cat, the Balkan chamois, the Golden eagle, the Capercaillie, the Hazel grouse, the Eagle owl, the Black woodpecker, and the Three-toed woodpecker.

The presence of limestone rocks, the southerly position of the range and close proximity to the Aegean, coupled with its relative isolation, has made Pirin Mountains an important refuge. Forests in the park are mainly coniferous with endemic Macedonian pine *Pinus peuce* being widespread and forming the treeline in the granite part of the mountain. Endemic Bossnian pine (*Pinus heldreichii*) occurs in the highest zone of the karst area. Unique stands of *P. peuce* and *P. leucodermis*, up to 250-300 years old and 30-45 m high, are found in Baevi Doupki-Djindjiritsa Reserve. Some individuals of *P. leucodermis* tree are over 500 years old. Silver fir (*Abies alba*), Austrian pine (*Pinus nigra*), spruce (*Picea abies*), Scots pine (*Pinus silvestris*), and beech (*Fagus sylvatica*) form a mixed coniferous-deciduous forest type. Generally, the tree-line has developed as a result of man's interference over a long period and descends as low as 2000 m asl, but in some places reaches 2200-2300 m asl. In the subalpine zone there are thickets of dwarf mountain pine *Pinus mugo* and *Juniperus sibirica*. Above 2400m-2600 m is a layer of alpine meadows, stony slopes, screes, rocks etc. The flora of the Pirin Mountains, comprises of many rare species and is of great interest and beauty. One of the most active flora speciation in Bulgaria is situated in the limestone part of the mountain. The Pirin Mountains have a mixture of central European, Alpine, Balkan Mountain and Sub-Mediterranean species; in addition there exist about 30 local endemic species. There are about 70 Bulgarian endemic species, over 10% of vascular plants of Pirin are Balkan endemics, and about 20% of all plant species in the Bulgarian Red Data Book occur in the park.

The area has a management plan and is under an effective management regime. There are five different management zones: nature reserve zone where human activity is prohibited; tourism, recreation and sport zone; a primitive nature zone at about 2,000 m altitude where no construction is allowed and only traditional managed pastoral activities are permitted; and a zone above 2,000m altitude where the natural environment is slightly modified. In order to prevent unauthorized camping, it is proposed to renovate existing chalets and build new ones and two campsites along tourist routes. Ski slopes and lifts have been constructed at Chiligarnika-Todorka, above the town of Bansko. To date four slopes, two chair lifts and two t-bar lifts have been constructed. Recreation sites with benches and fountains etc have been installed along tourist routes. The park comprises an ecological/recreational zone surrounded by a buffer zone beyond the perimeter.

- Conflict identification

Human interference occurs in the area near the chair lifts and especially in the regions of Banderishka Poljana and Tzarna Mogilla. Litter disturbance is a problem around the huts and ski lifts. Also, conflicts arise as a result of intensive tourism, car traffic, grazing, collecting herbs, construction activities (buildings, roads etc).

The main source of conflict, however, is the construction of 3 additional ski runs in the Valley of Banderitza River. The effects on uplands ecosystem and biodiversity of these ski runs include the clear-cutting of significant areas (20 ha) covered with century old spruce trees, Macedonian pines and Mountain pine forests including *P. peuce* - a Balkan endemic species – the only tree species in Bulgaria included in the World red book. The direct destruction and loss of habitats of rare and protected species will ultimately lead to the extinction of the species. Populations of animal and plant species in the area will be threatened including species from the IUCN Red List and the Bern Convention. As the Yulen nature reserve is bordering the reconstruction activities, it is anticipated that this will cause disturbance and that steep slopes will be threatened by erosion and pollution. Overall, the new ski runs will have a very negative effect on the landscape of the biggest valley in the Park, which could result in the park being excluded from the list of World Nature Heritage sites. As the project is in violation of the Protected Areas Act and the Nature Protection Act, legislation measures will have to be put in place and implemented. The constructions are also in disagreement with the management plans, which could lead the small land owners to be excluded from the management of the lands and create a considerable social tension between the local population and corporative capital.

Other conflicts will arise from these development plans. The land use change will entail a change in ownership, as well as increased tourism and urbanization, leading to a negative impact on plant and animal communities located close to the ski runs. Easy access to the area will increase anthropogenic pressure, trampling and pollution. Possible resolution strategies here could be to devise alternative tourism such as eco-tourism and the development of traditional crafts and traditional agriculture. A range of other resolution strategies will have to be put in place including legislation and regulations, anti-erosion measures, planting or allowing the forests to recover and monitoring through the system of limits of acceptable change (LAC).

7.4.6. Kresna Gorge (Bulgaria)

This case study envisages future possible conflicts between biodiversity and human activity arising from inappropriate planning on behalf of the Bulgarian government, which plans to build the Struma Motorway (which is a part of the Trans European Corridor N 4 Sofia - Athens) directly through the Kresna Gorge and the town of Kresna.

- Background

The Kresna Gorge is located in the southeast part of Bulgaria, along the banks of the Struma River. The river passes between the Pirin and Malashevska Mountains for 18 kms and forms the steep and picturesque slopes of the ravine. The gorge is on the border between the continental and Mediterranean climatic zones, resulting in extremely high abundance of species in a territory smaller than that of Rila Mountain.

- Conservation value

A number of plant and animal species occurring here are included in Red Data Books of Bulgaria, and are covered by the European Laws and Conventions for the Protection of Natural Heritage. The ravine is also a biological corridor for the migration of large mammals between the mountain ranges of the Balkan Peninsula as well as a very important bird migration route (via Aristotelis). Part of its territory is defined as an ornithological important place according to Bird Life International criteria. The ravine is also a CORINE site, according to the Bern Convention, and will be part of European Ecologic Network Emerald and Natura 2000. Of the 141 CORINE Biotopes sites found in Bulgaria, the gorge is rated seventh in terms of biodiversity protection.

There is a great diversity of plant communities: In the South part of the ravine, the evergreen Mediterranean forests of Greek juniper *Juniperus excelsa Bieb* (also referred to as tissa) are present, while in the North forests of oak and lime-trees prevail. Along the riverbanks, the riparian forests of oriental plane tree, black poplar and willow trees dominate, and oak forests occupy higher altitude places. There are 457 plant species found in the Kresna Gorge, a large number of them endemic or relict. The Kresna Gorge is of worldwide importance for the preservation of the arboreal juniper

forests and the oriental plane tree forest. Kresna Gorge is also home to 58 mammals, including bears, wolves, otters, stone martens, red deer, wild cat; 17 different bat species (more than in the whole of Central Europe); 232 bird species, of which 135 nesting, such as the Golden eagle, Short-toed eagle, Hobby, owl, Black Stork and Mediterranean species: the Olive-tree warbler, Masked shrike, Black-eared Wheatear, Rock partridge; 31 species of amphibians and reptiles (the gorge is extremely important for the conservation of the two Mediterranean tortoise species, the leopard snake and the four-lined snake); 14 fish species; 942 species of butterflies and moths, some of which are endemic for the gorge.

- Conservation management
Less than 5% of the territory of the gorge, including its most valuable habitats, is under the protection of the Tissata Reserve and its buffer zone.

- People
The town of Kresna is situated at the southern end of the gorge. Most people in the region live from agriculture and cattle breeding. The arable land is mostly in the valley of the Struma River and its tributaries. Local agriculture consists mainly of vineyards from which several famous brands of wine such as Keratzuda and Melnishko are produced. The Kresna Gorge and its surroundings have great potential for the development of rural and eco-tourism. The villages in the region have maintained traditional local architecture and livelihoods. In the nearby village of Vlahi, locals still breed the disappearing Karakachan dogs, horses and sheep for which the area is famous and there are ongoing efforts to turn it into an eco-village. Tourist routes for entering Pirin National Park start from the town of Kresna and the villages of Senokos, Oshtava and Vlahi. There are numerous mineral springs in the region with healing qualities, but only the Gradeshkite Mineral Baths are popular among tourists. The Struma River, flowing through the Kresna Gorge, is the best place in Bulgaria for extreme water sports (such as rafting).

- The consequences
The current international road Sofia – Athens E-79, passes through the Kresna Gorge and the town of Kresna. The 9-meter-wide road is already responsible for the death of hundreds of animals during their migration to the Struma River. The future motorway is planned to be 25 - 29 meters wide and pass through nearly the same route. The construction of the motorway through the ravine will destroy the slopes and the riverbanks of the Struma River. The motorway can be constructed through the gorge only if it passes through the Tissata reserve, which is in a violation of the Bulgarian protected area legislation. The plants may never recover due to the crumbly and unstable nature of the rock in the gorge. The Struma Motorway will lead to air contamination, noise and safety risks for the population of Kresna. The motorway through the gorge will turn into an insurmountable ecological barrier for most of the small mammals, causing an increase in their death rates. This will result in the extinction of many of these species.

The project has not considered that by following the current construction plans, the motorway will eliminate hundreds of rare plant and animal species. The slopes and the riverbanks of the Struma River will turn into a building site. Plant populations destroyed under these circumstances may never recover.

The construction will undercut and probably ruin the large Melo Sand Hill, which is one of the landmarks of the town. A large portion of the fertile arable land currently used for agriculture in the region of the Struma River will be converted into asphalt. Small family-run businesses along the current road will disappear. The rapids of the Struma River, presently favoured by rafters and kayakers of all levels, will no longer be suitable for river sports.

The motorway will pass 30 meters from outlying homes and the local school. The people of Kresna are going to lose their most fertile agriculture lands, their clean air, and the possibilities of tourism development in the region. In order to reach their fields the inhabitants of Kresna will have to go across the motorway, as there is no planned secondary road. Under these circumstances they will lose

the possibility of using slow-moving means of transport such as tractors and horse drawn carts which are vital to their livelihoods.

- Alternative solution

More than 15 national and international organisations have been involved in the "Save Kresna Gorge" campaign since 1997. An alternative project for motorway building is proposed avoiding this conflict. Diverting the motorway out of the gorge and away from the town will protect the natural environment and will turn the existing road into a tourist route, as opposed to a massive transportation corridor. In 2001, a coalition of Bulgarian environmental organizations sought help from independent engineers (Voltan Consult), who designed an alternative plan for a route, passing outside of the gorge. The alternative passes nearly 5 kilometres east of the defile and 2 kilometres away from the town, through an even site, situated on the slope of Pirin Mountain, at an altitude of 500-600 m and avoiding villages, arable lands, the most precious natural habitats and biological corridors and the mineral springs in the region of the existing gas pipeline. The route passes 6 km away from the Pirin National Park and does not affect it. It includes tunnels and viaducts that enable the migration and the traffic of all the wild animals, and at the same time keep the identity the landscape. The extension of the international road would be no more than 1-2 km.

The number of rare animals killed on the road will significantly decrease. The noise and the contamination in the gorge and the town of Kresna will decrease to a minimum level. At the same time, the existing road in the gorge will turn into a local tourist route, giving access to all sites, attractive for tourism, and to the local villages in the region. Diverting the transit traffic outside of the gorge will only improve the possibilities for tourism development. Most of the territories in the gorge, which are now exposed to contamination and strong noise, will be relieved from the impact of the transit traffic. The road through the gorge will be only of local and tourist importance. The whole territory of the gorge and the mountains in the direction of the Macedonian border will have the opportunity to form a nature park, offering a variety of tourist services, independent from the east link with the territory of the Pirin National Park. The town of Kresna can become one of the main centres for this area. The link with the high parts of Pirin will not be significantly affected. The tourist routes in this direction will cross the motorway in such places where the motorway goes through tunnels and viaducts.

The motorway will not affect most of the mountain villages (Brezhani, Senokos, Oshtava, Vlahi) situated on the slopes of the Pirin Mountain. These villages will have the opportunity to develop as tourist centres in the contact zone between the Kresna Nature Park and the Pirin National Park. The opportunities for the development of the other three villages in this direction (Rakitna, Mechkul and Old Kresna) will unfortunately not be as bright. However, unlike the proposed route through the gorge, the effect of the noise contamination can be significantly decreased through the construction of the noise protecting walls.

Bulgarian environmentalists are working on the issue of proclaiming the entirety of the Kresna Gorge as a protected area, which may facilitate its expansion into a Trans-border Nature Park in cooperation with the Republic of Macedonia.

8. References and further reading

Adamowski W., Keczyñski A. 1998. Czynna ochrona zbiorowisk leúnych BPN przed wkroczeniem Impatiens parviflora. (Active protection of forest communities in Bialowieza National Park against Impatiens parviflora invasion). Parki Narodowe I Rezerwaty Przyrody 17.1 (49-55).

Adamowski, W. 2002. Atlas of alien woody species of the Bialowieza Primeval Forest. Phytocoenosis Vol. 14 (N.S.) Supplementum Cartographiae Geobotanicae 14. Warszawa-Bialowieza.

Annual report, 2002. Ministry of Agriculture and Forestry, Bulgaria.

Antipa, G. 1910. Regiunea inundabila a Dunarii – Starea ei actuala si mijloacele de a o pune in valoare (Danube floodplains: Actual status and means of valorification). – Institut de Arte Grafice Carol Gobl, Bucuresti, pp.317.

Balciauskas, L., Balciauskiene L. 1999. Results of Corncrake survey on the Nemunelis River valley . Acta Zoologica Lituanica 9, 3, 80- 85.

Balciauskas, L., Balciauskiene L., Trakimas G. 2000. Beaver influence on amphibian breeding in the agro-landscape. In: Czech, A. & Schwab, G. (eds.) The European beaver in a new millennium. Proceedings of 2nd European Beaver symposium, pp.105-112.

Balciauskas, L., Balciauskiene L., Volodka, H. 2002. Preliminary assessment of damage caused by the wolf in Lithuania. Acta zoologica Lituanica 12 (4), 419-427.

Baltic Forest Mapping, 2003. http://www.inspirit.ee/bfm/

Bulgarian Environmental Strategy Update and Follow-Up. 1994. World Bank Report No 13493-BUL, Washington, pp. 97.

Choinski, A. 1995. Aktualne tendencje zmian powierzchni jezior w Polsce [Modern tendencies in changes in Lake surface area of Poland] Bad. Fizjogr. nad Polska Zach. vol; XLVI.

Convention on Biological Diversity. 1992. Text of the Convention on Biological Diversity. http://www.biodiv.org/

Convention on Biological Diversity, Subsidiary Body on Scientific, Technical and Technological Advice, 1999. Development of Indicators of Biological Diversity. UNEP/CBD/SBSTTA/ 5/12.

Cristofor, S., Vadineanu, A. & Ignat, G. 1993. Importance of flood zones for nitrogen and phosphorus dynamics in the Danube Delta. – Hydrobiologia, 251: 143-148.

Dumitru, M., Ciobanu, C., Carstea, S., Manea, A. 2001. Romania's soil resources and aspect of strategy concerning their uses. Ed. Univ. Alexandru Ioan Cuza –Iasi, vol. III: 7-20.

Etverk, I. 2003. 20th century on Estonian Forests. Estonian Society of Foresters, pp. 193.

European Communities. 1997a. Study on European Forestry Information and Communication System Reports on Forest Inventory and Survey Systems. Volume 1 - Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein. Luxembourg: Office for Official Publications of the European Communities. 680 p.

Faliñski J. B., Muùenko W. (eds.). 1997. Cryptogamous plants in the forest communities for Bialowieza National Park. Ecological Atlas (Project CRYPTO 4). Phytocoenosis Vol. 9 (N.S.) Supplementum Cartographiae Geobotanicae 7. Warszawa-Bialowieza..29

Faustmann, H., F. 1999. Forest Economics in Eastern Europe. - Journal of Forest Economics, 5, 3, pp 337-340.

Forest Encyclopaedia. 1985. Vol 1, Soviet Encyclopaedia, Moscow, page 503.

Gregus, C. 1996. Development of Forestry Philosophy in Slovakia, Zvolen, pp. 20 (in Slovak).

Gutowski J. M., Jaroszewicz B. (eds.). 2001. Catalogue of the fauna of Bialowieza Primeval Forest. Instytut Badawczy Leúnictwa. Warszawa.

Hardalova, R. 1997. The use of medicinal plants in Bulgaria and their protection. Proceedings of Planta Europa, 2-8 September 1995, Hyères, France 184-187.

Harrison, R .P. 1992. Forests. Flammarion.

Heinsoo, K., Sild, E., Koppel, A. 2002. Estimation of shoot biomass productivity in Estonian Salix plantations. Forest Ecology and Management 170, pp 67–74.

Holub et Procházka. 2000. Red list of vascular plants of the Czech Republic. In: Preslia 72, Praha, pp 187-230.

Ilnicki, P. 2002. Restoration of carbon sequestrating capacity and biodiversity in abandoned grassland on peatland in Poland, Wyd. Akad. Roln. im. Augusta Cieszkowskiego, Poznan.

Iremonger, S., Costello, M. J. and Giller, P. 2002. Biodiversity - A Natural National Resource. Introduction. Proceedings of the Royal Irish Academy 102B (3), pp 119.

Järvekülg, R. 2003. Influence of dams to the fish fauna of rivers. In: Problems of contemporary ecology. Estonian Ecology in the Globalising World, pp 56-64.

Kaligaric, M. 1997. Rastlinstvo Primorskega krasa in Slovenske Istre (Vegetation of Karst of Primorje and Slovene Istra-Meadows and Pastures).- Zgodovinsko društvo za južno Primorsko: Znanstveno-raziskovalno središce Republike Slovenije, Knjižnica Annales majora, Koper.

Karoles, K. (comp.). 2003. Forest management and protection in Estonia. Estonian Ministry of Environment, Center of Forest Protection and silviculture, pp 58.

Kartsov, G. 1903. Belovezhskaya Pushcha. Sankt Petersburg.

Kathe, W., Honnef, S., Heym, A. 2002. Medicinal and aromatic plants in Albania, Bosnia-Herzegovina, Bulgaria, Croatia and Romania. WWF Deutschland / TRAFFIC Europe-Germany.

Kavuljak, A. 1942. History of Forestry and Wood Processing Industry in Slovakia, Bratislava, pp 245 (in Slovak).

Kawecka, A. 1960. Park Botaniczny w Bia¢owieýy. (Botanical garden in Bia¢owieýa). Rocznik Dendrologiczny 14, pp 119-127.

Kireev, D.M. 1984. Ecological and Geographical Terms in Forestry. Reference Glossary, Nauka, Novosibirsk, pp 63.

Köhl,M., and Päivinen, R. 1996. Definition of a system of nomenclature for mapping European forests and for compiling a Pan-European Forest Information System. EUR 16416. Luxembourg: Office of Official Publications of the European Countries. 238 p.

Kopec, S. 1999. Rolnictwo Karpat Zachodnich na przykladzie Beskidu Wyspowego iZywieckiego. Probl. Zagosp. Ziem Górskich PAN Kraków, z. 45.

Koppel, A., Perttu, K., Ross, J. 1996. Estonian energy forest plantations: General information. In: Perttu, K., & Koppel, A. (eds.) Short Rotation Willow Coppice for Renewable Energy and Improved Environment. Swedish University of Agricultural Sciences, Department of Short Rotation Forestry 57, pp 15-24.

Kotowski, W. 2002. Fen communities, ecological mechanisms and conservation strategies van Denderen BV, Groningen, PhD thesis.

Krajcovic, V., Todorov, M.M., Twardy, S. 2001. Low-input systems for grassland. Wyd. IMUZ, pp 244-252.

Kranjc, A. (Ed.). 1997. Kras: Slovene Classical Karst.- Znanstvenoraziskovalni center SAZU, Založba ZRC, Ljubljana.

Kukk, T. & Kull, K. 1997. Wooded Meadows. Estonia Maritima 2, pp 1-249.

Kurek, S. 1979. Przyrodnicze podstawy uzytkowania ziemi w Karpatach. IMUZ, Mat. Instruktazowe 25, pp 44.

Kuusemets, V., Koppel, A., Heinsoo, K., Sild, E. 2001. Short rotation willow plantation for wastewater purification: case study at Aarike, Estonia. Ecosystems and Sustainable Development 3, pp 61-67.

Kvaraciejus, A. 2001. The research on renaturalization processes of drained land. PhD-thesis. Lithuanian University of Agriculture.

Kvet. 1993. Ecological Crisis in Post-Communist Central Europe. Journal of Aquatic Plant Management 31, pp 13-17.

Lange, D., Mladenova, M. 1997. Bulgarian model for regulating the trade in plant material for medicinal and other purposes. In: Bodeker, G., Bhat, K.K.S., Burley, J., Vantomme, P. (eds.). Medicinal plants for forest conservation and healthcare. Non-Wood Forest Products, 11, pp 135-146. FAO, Rome.

Lund, H. Gyde (coord.). 2000. Definitions of Forest, Deforestation, Afforestation, and Reforestation. Manassas, VA: Forest Information Services. Available from the World Wide Web: http://home.att.net/~gklund/DEFpaper.html

Matouch S. et al. 2003. 8. Uplands. In: Conflicts between human activities and the conservation of biodiversity in agricultural landscapes, grasslands, forests, wetlands and uplands in Europe. A report of the Bioforum project, August 2003.

Meine, C. (Ed.). 1998. Bulgaria's Biological Diversity: Conservation status and needs assessment, Volumes I and II. Washington, B.C.: Biodiversity Support Program. 839 pp.

Moravec et al. 1995. Red list of communities of the Czech Republic and their endangerment. Praha.

Muller, J., Rosenthal G., Uchtmann H. 1992. Vegetationsveranderungen und Okologie nordwestdeutcher Feuchtgrunlandbrachen, Tuexenia 12.

Murcott, S. 1997. What is sustainability? Appendix E: Some conceptual frameworks. In: Proceedings of the AAAS Annual Conference, II ASA "Sustainability Indicators Symposium", Seattle, WA. http://www.sustainableliving.org/appen-e.htm

National Action Plan for the Conservation of the Most Important Wetlands in Bulgaria. 1995. MOE, Sofia, pp 55.

National Commision of Statistics. 1998. Aspects regarding agriculture evolution in Romania, Bucharest.

National Strategy for the Environment and Action Plan 2000-2006 (PHARE BG98/IB-EN-01-01). 2001. Council of Ministers, Sofia, pp. 156.

Okruszko, H. (ed.). 1991. Bagna Biebrzanskie, Zesz. Probl. Post. Nauk. Roln. [in Polish]

Okruszko, H., Wassen, M. (eds). 1994. Towards protection and sustainable use of the Biebrza Wetlands: exchange and integration of research results for the benefit of Polish-Dutch Joint Research Plan, IMUZ Falenty.

Oszlányi, J., Greguš, C., Kontriš, J., Bublinec, E., Kontrošová, O., Kodrik, M., Guziová, Z. 1996. National Ecological Network and Forestry, In: IUCN, 1996: Implementation aspects of the National Ecological Network, Foundation IUCN - Slovakia, Bratislava, in the frames of the project of regional European Programme IUCN in Gland, Switzerland, 294 pp.

Oszlanyi, J., Guziova, Z. 2002. Development of Nature Protection Areas in Slovakia - Role of Landscape Ecology. In: Effects of Air Pollution on Forest Health and Biodiversity in Forests of the Carpathian Mountains. Eds: R.C. Szaro, A. Bytnerowicz, J. Oszlanyi. NATO Science Series I: Life and Behavioural Science. Amsterdam: IOC Press, pp 53-58.

Ott, I., Kõiv, T. 1999. Estonian Small Lakes: Special Features and Changes. Tallinn, 128 pp.

Päivinen, R., Lund, H.G., Poso, S. and Zawila-Niedzwiecki, T. (eds.). 1994. IUFRO International Guidelines for Forest Monitoring. In print to IUFRO World Series. 34 pp.

Panov V., Timm T. & Timm H. 2000. Current status of an introduced Baikalian amphipod, Gmelinoides fasciatus (Stebbing), in the littoral communities of Lake Peipsi. Proc. Estonian Acad. Sci. Biol. Ecol. 49(1), pp 71-80.

Pencheva, V. 1992. Form and intensity of anthropogenic impact in the region of Troyan. Summaries of International scientific conference "Current problems of environmental protection ECO-Russe'92".

Pencheva, V. 1998. Problems of mountainous agriculture and animal breeding in the region of Troyan. Journal of Mountainous Agriculture on the Balkans, 1, 5, 355-365.

Pencheva, V., Kalcheva, P. 1992. Landscape and environmental features of mountainous geo-eco-systems in the region of Troyan. Summaries of International scientific conference "Current problems of environmental protection ECO-Russe'92".

Pencheva, V., Stefanova, N., Petrov, P. 2002. Land mapping of Water Erosion Intensity and Control Measures on the Territory of the Municipality of Troyan. International Symposium on Space Information – Technologies, Acquisition, Processing and Effective Application, Sofia, 07-08 November 2002, pp 232- 237.

Pencheva, V., Stefanova, N., Petrov, P. 1998. Classification and mapping of lands according to the fitting for effective agricultural and anti-erosion use of plain, semi-mountainous and mountainous regions of Lovech district (Troyan and Letnitza municipalities). Geodesy, Cartography and Land management, UGLMB, 1, pp 24-26.

Pencheva, V. 1999. State and evaluation of land fund of Troyan municipality. Geodesy, cartography and land management, UGLMB, 4, pp. 28-31.

Piórkowski H., Rycharski M. 1997. Zróznicowanie przestrzenne I dunamika sukcesji zbiorowisk lesnych I zaroslowych w dolinie Biebrzy na podstawie analizy zdjec lotniczych [Spatial

differentiation and succession dynamic of forest and scrub communities in the Biebrza Valley, based of aerial photographs] in Aktualna problematyka mokradel, Mat. Sem., IMUZ 43
Ploetz, K. 2000. An ethno-botanical study of wild-herb use in Bulgaria. Master thesis. Michigan Technological University.
Popov, A. & Meshinev, T. (Eds). 2000. High mountain treeless zone of the Central Balkan National park. Pensoft Publishers, Sofia, 562 pp.
Rajšp, V. (Ed.). 1995. Slovenija na vojaškem zemljevidu 1763-1787 (Slovenia in military map 1763-1787), ZRCS, SAZU, Ljubljana.
Rousseva, S., Lazarov, A., Tsvetkova, E., Marinov, I., Malinov, I., Krumov, V., Stefanova, V. 2003. Soil Erosion in Bulgaria. In: Boardman, J. and Poesen, J. (Eds.) Soil Erosion in Europe, John Wiley Publishers, London.
Russev, B., Petrova, A., Janeva, I., Andreev, S. 1998. Diversity of zooplankton and zoobenthos in the Danube River, its tributaries and adjacent water bodies. – In: (C. Meine ed.) Bulgaria's Biological Biodiversity: Conservation Status and Needs Assessment, Vol. I and II, Washington D.C. Biodiversity Support Program, pp 261-292.
Savev, S. 2003. Study on non-woody resources in West Balkan with a view to their rational use. PhD Thesis. University of Forestry. Sofia.
Schmidt, A., Piórkowski, H., Bartoszuk, H. 2001. Remote sensing Techniques and Geographic Information Systems for wetland conservation and management: monitoring scrub encroachment in Biebrz National Park, Alterra-rapport 174, Wageningen.
Sepp, K. 1999. The methodology and applications of agricultural landscape monitoring in Estonia. Dissertationes geographicae universitatis Tartuensis 9. Tartu: Tartu University Press.
Sokoùowski, A. W. 1995. The flora of vascular plants in the Bialowieza Forest. Bialowieza National Park. Bialowieza.
Šprynar et Rezác. 1995. Blatovská louka vPraze – ohrožený zbytek mokradního ekosystému. In: Muzeum a soucasnost, série natur., 9, pp 55-60.
Šprynar et Rezác. 1996. Výskyt a ohrožení kapradiny Ophioglossum vulgatum vPraze vminulosti a soucasnosti spoznámkami kcelkovému stavu jeho lokalit. In: Muzeum a soucasnost , série natur. 10, pp 69-82.
State of Europe's Forest Protection. 2003. WWF report, Vienna.
State of the world forest. 2003. FAO publication.
Stoll-Kleemann, S. 2001. Reconciling opposition to protected areas management in Europe. Environment 43, pp 32-44.
Svazas, S., Drobelis, E., Balciauskas, L., Raudonikis, L. 1999. Important wetlands in Lithuania. Vilnius, 'Akstis' Publ.
Szafer, W. 1962. The Tatra National Park. Krakow, PAN.
Timm, T. 1977. Uustulnukaid Võrtsjärve põhjaloomastikus [Recent invaders in the zoobenthos of Lake Võrtsjärv]. Eesti Loodus 20(9), pp 572-576 [In Estonian].
Timm, V. 1990. Peipsi järve suured karbid (Bivalvia) [Big clams (Bivalvia) of Lake Peipsi]. Proc. Estonian Acad. Sci. Biol. Ecol. 39(1), pp 46-54 [In Estonian].
Twardy, S., Kopec, S. 1994. Comparaison de la produktivite de pâturages exploites par des bovins avec et sans fauche des refus. Food and Agriculture Organization of the United Nations, Rome.
Twardy, S., Kuzniar, A., Kopacz, M. 2001. The characterization of agriculture in the Polish Carpathians. Miedz. Konf. Nauk. nt. Trwala okrywa roslinna jako podstawa zrównowazonego rozwoju rolnictwa w zlewniach karpackich. 9-11 pazdziernika 2001 r. Wyd. IMUZ, pp 230-237.
Ulevicius, A. 1999. Density and habitats of the beaver (Castor fiber) in Lithuania. Proceedings of the Latvian Academy of Sciences, Section B. Vol. 53, No. 2, pp 101-106.
Uri, V., Tullus, H., Lõhmus, K. 2002. Biomass production and nutrient accumulation in short-rotation grey alder (Alnus incana (L.) Moench) plantation on abandoned agricultural land. Forest Ecology and Management 161, 1/3, pp 169–179.
Uzunov, Y., Yaneva, I., Kumanski, K., Varadinova, E., Stoichev, S. (in print) Long-Term Changes of the Bottom Invertebrate Fauna of the Mesta River in Southwestern Bulgaria.