



PERGAMON

Land Use Policy 19 (2002) 47–63

Land Use Policy

www.elsevier.com/locate/landusepol

Ecoregion-based conservation in the Carpathians and the land-use implications

David Turnock*

Geography Department, The University, Leicester LE1 7RH, UK

Received 28 July 2000; received in revised form 28 June 2001; accepted 20 July 2001

Abstract

The transition countries of East Central Europe have had to cope with some severe environmental problems inherited from the communist period when urban-industrial development accelerated and pressure from tourism increased; and while the balance between agriculture and forestry did not change greatly, intensification resulted in some degradation. However, biodiversity resources in ECE are still high in comparison with those of western Europe; yet there are dangers. First, although development pressures have relaxed during the transition, some unsustainable coping strategies have been induced. Second, development threats will become more intense as the enlargement of the EU proceeds and appropriate safeguards are called for. The Carpathians have been identified as a particularly vulnerable area and the World Wildlife Fund for Nature is playing a leading role in preparing a programme for ecoregion-based conservation. This paper examines the background to this Carpathian Ecoregion Initiative (CEI) and considers some of the implications of greater protection for core areas and encouragement of sustainable practices among stakeholder groups. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Biodiversity; Carpathians; Conservation; Land use; Large carnivores; Rural tourism; Stakeholding

Introduction

The transition in the former socialist countries of East Central Europe is becoming quite evident in land-use terms as in so many other ways. Improvements in infrastructure (international highways as well as local services), retailing and housing are taking up rural land and while much industrial change involves restructuring of former state-owned enterprises there is enough greenfield development to trigger new industrial estates (Gewerbeparks) around the larger towns, with particular emphasis on some special industrial zones and rural areas close to motorway junctions. Meanwhile, the traditional land uses are experiencing a general reduction of intensification. Much cropland is being converted to pasture in the hill and mountain country and some underused grazing land is reverting to woodland.

But there is also high tourist pressure in the mountains of Czech Republic, East Germany, Poland and Slovakia. The changes are being driven by market

forces, following the dismantling of the artificial pricing and central planning systems of communism. But there is also a significant influence arising through biodiversity conservation given the rise of the green lobby in the face of some severe pollution problems and the encouragement received from the international ENGOs and EU 'Birds and Habitats Directives' which include a 'Natura 2000' network of protected areas.

The region's record in conservation is by no means insignificant. Legislation to curb pollution was enacted during the communist years while substantial progress was made in setting up nature reserves, national parks and other protected areas. Unfortunately, laws were not properly enforced and some protected areas were degraded by air and water pollution. After 1989, conservation was assisted by deindustrialisation yet compromised by voluntarism as new-found freedoms brought adverse effects to environment through damage to sensitive areas by poaching and illegal cutting of timber. But there is now a mood for dialogue to enhance public awareness of threats to biodiversity and embrace initiatives for more sustainable development, including the proposed EU 'Natura 2000' network of protected areas that will incorporate existing designations and give

*Corresponding author. Tel.: +44-116-252-3826; fax: +44-116-252-3854.

E-mail address: dt8@leicester.ac.uk (D. Turnock).

rise to others. For while 'island' reserves may be buffered from areas of industrial or tourist development, they may not be effective in safeguarding rare species without integration into wider corridor systems. In this connection, the World Conservation Union (IUCN) has become much involved—through its European Mountains Forum—in the sustainable development of mountain regions and has worked with the Council of Europe (CoE) 'Euromontana' organisation in respect of areas like the Alps, Carpathians and Caucasus (Backmerhoff et al., 1996).

It is recognised that the mountain areas have special values in terms of scenery, biodiversity, water reserves and cultural resources which should be more adequately protected from harmful development pressures. Meanwhile the World Wide Fund for Nature (WWF) has embraced the concept of 'Ecoregion-Based Conservation' (ERBC) to ensure the conservation and sustainable development of large land units that are biologically coherent in terms of species, communities and environmental conditions. Such strategic biodiversity conservation projects may offer a coordinated response to immediate threats in the context of the socio-economic conditions and safeguard the future through a clear vision of the conservation goals and the participation required by stakeholders, working in partnership at all levels from international agencies to local communities—and with input from all relevant disciplines, for an adaptive programme of coordinated management interventions. WWF has selected the Carpathians as an

appropriate area for implementation which is now moving from reconnaissance into a more intensive phase (WWF, 2000a). This paper considers the significance of this initiative in the light of conditions in the Carpathian region and assesses the likely land-use implications.

The Carpathians comprise a mountain axis which is strongly arcuate in form where the high ground surrounds the Transylvanian Plateau (Fig. 1). The total length is some 1800 km on the outward side from northern Austria through Krakow and Bacau to the Iron Gates and Oradea; and 1150 km on the inner side from Bratislava through Bistrita, Brasov and Sibiu to Cluj–Napoca. At its narrowest in the Olt valley (Ramnicu Valcea to Sibiu), the range is just 75 km across compared with 100 km in the eastern Carpathians of Romania and Ukraine and 200 km in the north between Krakow in Poland and Miskolc in Hungary. There are numerous easy mountain crossings and the urban geography can be rationalised most easily through pairs of cities at either end of mountain routeways, such as Cluj–Napoca and Oradea, although urban growth also reflects local mineral endowment and commercial functions on national and international scales. The mountains are also a major source of water—still relatively clean—the bulk of which drains into the Black Sea, with only a tenth to the Baltic (Gastescu, 1990). But while there are several major rivers on the eastern side (such as the Dniester, Prut and Siret) taking water along separate channels to the Danube, the inner side drains overwhelmingly into

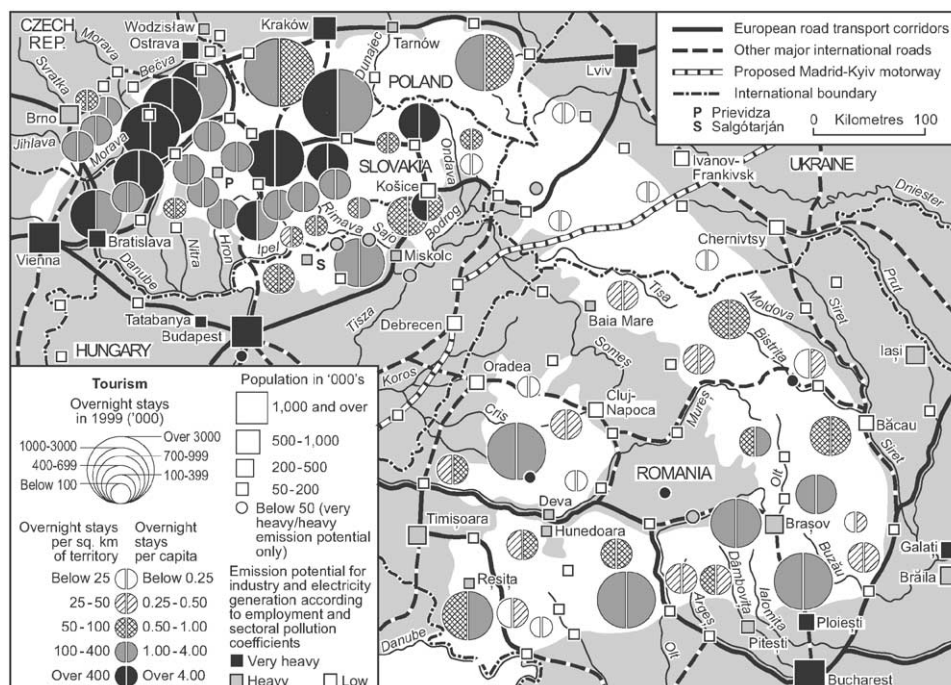


Fig. 1. The Carpathians: urban-industrial development, tourist pressure and major transport corridors (Source: Nefedova, 1992).

the Tisa which therefore experiences massive increases in discharge when mild weather in winter—with high rainfall and snowmelt—can give rise to catastrophic flooding. This is particularly evident in the northern part of the Pannonian Plain where a number of major tributaries are encountered over a short distance. Calculations of risk can also be scaled down to the local level as in the Fagaras Mountains where Florea (1996) contrasts high risk areas on the steep slopes of glaciated valleys in general with low risk on the ‘Borascu’ erosion surfaces above. Forested slopes lacking tourist pressure are stable but deforestation will enhance runoff and erosion turning the lower forested slopes into critically vulnerable areas. There is a high risk of flooding in corridors and depressions: the rapid melting of the snow cover in the eastern part of the Brasov Depression makes it particularly prone to flooding with serious consequences for agriculture.

Along with the Alps and Pyrenees, the Carpathians comprise the southern European montane forest—one of the continent’s 12 ecoregions. Not only does this region offer attractive mountain country rising to over 2000 m (the highest peak is Gerlach in Slovakia: 2665 m) and exhibiting glacial features in the Retezat and Tatra, but it constitutes the most valuable area still remaining within Europe’s temperate conifer and broadleaf forests, with fragments of natural mountain beech forest amounting to some 20,000 ha. Today about half is forested and a third consists of open, semi-natural habitats (predominantly grassland). Additionally, the area supports a remarkable species richness including many endemic species and medicinal plants. The region has not been seriously degraded and remains one of Europe’s most important biocentres. The region also provides Europe’s largest refuge for megafauna species—both predators and herbivores—that have become extinct in many other parts of Europe, such as the brown bear (*Ursus arctos*), the wolf (*Canis lupus*), the lynx (*Lynx lynx*), the wild cat (*Felis silvestris*). The region also functions as an important corridor for a range of animals: the wolf makes particular use of the Carpathian ‘bridge’ between the coniferous forests (‘taiga’) of northwest Europe and dispersal areas to the south and west (Witkowski, 1998). However, whereas the Carpathians were politically unified within the Habsburg Empire until the First World War (apart from a small area in the then Romanian state), they are now divided between six countries. In the context of the closed frontiers of communism (excepting the Czech Republic and Slovakia which were then unified as Czechoslovakia), there was little coordinated planning, although each country identified a number of protected areas which account for 6 per cent of the total area. But better management is needed, while more extensive continuous areas must be safeguarded in the interest of large carnivores.

Brief history of the socio-economic factors that have significantly affected biodiversity in the region

The Carpathians have seen substantial ecological changes in the past, especially in terms of deforestation and the creation of mountain grasslands with their own biodiversity value (Pietrzak, 1998). Celtic tribes developed agriculture in the Carpathian foothills and fertile lowlands of southern Slovakia; and the Romans advanced north from the Pannonian Plain (e.g. along the Vah valley) and exploited forests for timber to build fortified settlements on the northern borders. In the 12th–13th centuries, Saxon colonists were invited by Hungarian monarchs to resettle in areas depopulated by Tatar raids and further forest damage is attributed to their mining and metallurgical activities. Deforestation is also reported from Poland to extend fields in the valleys and pastures on the higher ground where the tree line was significantly lowered. At the same time, colonisation from the Vistula to the north pushed into the Sacz basin and reached the Podhale in the 14th century (meeting a complementary migration stream from the south). By the mid-16th century, the foothills were completely colonised by a dense network of settlements, though commercial exploitation of the forests was limited by lack of floatable rivers. Meanwhile, colonisation and trade through valleys like the Dunajec, Poprad and Wisloka laid the foundations for urban development at places like Dukla, Krosno, Nowy Targ, Nowy Sacz and Sanok. Following the Habsburg annexation of Galicia, with its consequent economic and fiscal pressures, land registers show fragmentation of landholdings, the conversion of meadows and pastures to arable and intense forest exploitation (fast growing pine and larch favoured over deciduous forest dominated by beech). Meanwhile, in Transylvania, extensive sheep grazing systems were based in the Brasov and Sibiu areas, with seasonal transhumance movements extending throughout the province and further afield. However, in the late 19th century, Romanian independence and subsequent tensions over the country’s policy of protecting domestic industries, made for stricter controls along the Carpathian frontier and the peasantry had to reduce their sheep flocks and take up work in commerce and handicrafts (Irimie et al., 1985).

Such restructuring contributed to the overdevelopment of Carpathian valleys taking place almost everywhere during the railway age, with additional consequences for biodiversity because of alien species diffused by modern transport. The commercialisation of agriculture and the forest economy followed the main line railways and the building of narrow gauge forest railways; as did the more selective growth of mining, manufacturing and tourism. The human impact depressed the timberline in the Tatra, with recovery possible only after the Tatra National Park was

established and human pressure was reduced (Krzemien et al., 1995). “Virtually all forests were opened to exploitation while permanent settlements and services (including tourism) appeared over much of what was previously a pioneer fringe” (Turnock 1991, p. 57). Large clearcuts were generally restocked with spruce to the extent of 95 per cent (with some larch and Douglas fir), at the expense of beech and oak, while the average age of the woodlands decreased sharply. There was also a tendency in the 19th century to use seed of foreign provenance (mainly Austrian) to re-afforest bare lands after wind and insect calamities (Voloscuk, 1998). The same tendencies towards monoculture have been reported from Ukraine since c. 1750 with the decrease of beech from 54.9 to 33.0 per cent (and oak and related woods from 13.3 to 10.1 per cent) and the increase of fir–spruce from 31.8 to 55.9 per cent. With heavy logging since the late 19th century, perpetuated in the communist period, 40.9 per cent of the forests now comprise saplings and 30.9 per cent are middle-aged, while only 28.2 per cent are mature or are approaching this condition. Under these circumstances, the Carpathian environment can hardly be described as natural and ERBC could not realistically contemplate putting the clock back.

But human pressure has been modest by comparison with lowland areas: the present biodiversity resources are considerable and merit conservation even where they are linked with artificial landscapes like the mountain grasslands (*‘poloniny’*) which have arisen out of sustained pastoralism and deforestation. These resources are now confronted by a mix of threats which are not overwhelming but are cumulatively significant enough to require coordinated management (Augustyn and Kozak, 1997). In some cases, less benign forms of industrialisation took place, with origins in the 18th-century expansionism of the Habsburg and Prussian empires which is reflected in the Upper Silesian industrial region and its relatively small Habsburg equivalents around Ostrava in Moravia, at Miskolc in northern Hungary (extending to Ozd, Salgotarjan—and Podbrezova in Slovakia) and the Resita–Anina and Hunedoara areas of the Banat Carpathians (Romania). In all these cases, there was coalmining, iron–steel production and engineering. Non-ferrous metals were also of some significance in most of these complexes, as they were also in Romania’s western Carpathians (Apuseni Mountains) at Zlatna and in Maramures at Baia Mare. Early oil working also impinged on the Carpathians through operations based on Dashava in the Ukraine and Ploiesti in Romania. Salt mines also have a historic importance: Solotvino in Ukraine and a range of locations in Romania (including Cacica in Bucovina, Costiui and Ocna Sugatag in Maramures, Targu Ocna in Moldavia and Telega in Wallachia). Some wasteland has resulted as well as pollution.

Tourism, traditionally based on mineral waters and climate stations, as well as cultural–historical and recreational resources, has also been a source of pressure, especially in the north (Groch et al., 2000).

Communism and the transition: determinants of land-use change

Biodiversity arises from the climate interacting at various altitudes with rocks, soils and relief (Donita and Ivan, 1998). In the Beskid Sadecki Mountains and Wielickie Foothills of Poland, mixed forests of pine and oak, alongside fir and beech, give way to spruce and sycamore. In the Tatra, climatic conditions force a change from this scenario for the lower subalpine zone (*‘dolny regiel’*) to an upper subalpine forest (*‘gorny regiel’*) at 1250–1550 m comprising fir—of a partially primeval character—with Siberian cedar, Carpathian birch and rowan at the upper limit. Then mountain pine at 1550–1800 m give way to pasture and meadow (*‘hale’*) at 1800–2300 m, above which there is little other than bare rock face (*‘turnia’*) (Groch et al., 2000, p. 10). However, limited change has been expressed historically through the erosion of woodland in favour of agriculture. The foothills are good for agriculture and have experienced severe deforestation (already referred to); trends that are evident through environmental reconstruction techniques. Over recent years, it is particularly easy to see where small adjustments are made because of land-use statistics. However, it is not possible to isolate the Carpathians without building up profiles from basic statistical units for which data are provided by the cadastral authorities: *Oficiul de Cadastru si Organizarea Teritoriului (OCOT)* in the case of Romania.

Agriculture

Communism brought a surge of intensification in agriculture through higher output, but in the process, arable land remained broadly stable (in Romania from 9.66 million hectares in 1955 to 9.92 in 1963 and then slowly downwards to 9.45 in 1989 and 9.34 in 1997). In Poland, agriculture extends to 1000 m in the Zakopane area, Gorce Mtns. and Beskid Sadecki; although pastoral farming predominates over 600 m, given the climatic constraints for crops with incidence of frost in spring and autumn. By contrast, the submontane zone is more attractive with loess-covered soils and also inter-mountain areas like Kotlina Sadecka. At the same time, the erosion of woodlands was halted and slightly reversed (in Romania 6.48 million hectares in 1955 but 6.68 in 1989 and 6.69 in 1997, reflecting slight increases in some areas) thanks to state management in the interest of timber production for an enlarged wood processing industry and increased attention to protec-

tion functions. Communist collectives introduced specialisation which tended to reduce arable farming in mountain regions. But the retention of private farms in Poland meant that a subsistence mixed farming mentality was strong. Gorz and Rajman (1988) refer to population pressure and deforestation e.g. inter-mountain basins, especially in eastern Poland where population growth has been linked with land-use potential. But in the west where there is more non-agricultural employment available, tourism is a stimulus for a high level of farm production (Gusik and Zborowski, 1988).

Agricultural land reaches 70 per cent in the Pogorze Foothills of Poland, while arable accounts for some 60 per cent of agricultural land in many communities—producing subsistence cereals and potatoes with some vegetables, fruit (especially apples) and industrial crops. Fruit and vegetable processing plants encouraged cooperative production at Jaslo, Nowy Sacz, Tarnow and Tymbark, while tourism also gave a boost to vegetable production in glasshouses in the Nowy Sacz area e.g. near Czchow Lake and in the southwestern part of Beskid Wyspowy (mostly in the communities of Lapanow and Zegocina). Meanwhile, podzol soils are now degraded and suffer sheet and gully erosion. The intensity of agricultural use has declined in both arable and livestock sectors due to reduced consumption of food and agricultural raw materials, combined with the withdrawal of subsidies on fertiliser and other inputs. Other problems include the breakdown of national marketing systems and competition from imports. Investment is not feasible when the cost of bank loans is considered against likely profits and foreign direct investment in agriculture has been restrained. A Study of the Carpathians in Romanian Banat using OCOT data for the 1980s and 1990s shows a decline from 313.0 thousand hectares to 276.2 (Cretan et al., 1999, pp. 347–349) which is reflected by every individual locality. So land is being abandoned and in some areas grazing densities are falling below the level needed to maintain unimproved species-rich grasslands and traditional orchards. Coarse species then become dominant, but there is also some re-forestation. In Poland, there is encouragement to shepherds in some key areas (like the Tatra) through the cachet applied to local cheeses in order to stimulate demand.

However, household survival strategies in high unemployment areas make only limited use of cash transactions (Varga, 1996). The result could be some intensification of farm production in line with available family labour. This does not necessarily affect cropping: for example at Corbu in the eastern Carpathians of Romania, the decline in cereals noted between the 1930s and 1970s has continued and most arable land is now used for hay, along with some potatoes (occasionally combined with poppies or vegetables) while fruit growing has become more prominent following land

restitution and the decline of cooperative farming (Turnock et al., 1980, p. 103). Similar trends are reported from the four provinces of Ukraine which cover the Carpathian area (Chernivtsy, Ivano-Frankivsk, Lviv and Zakarpatia), for cropland has increased although data is lacking for the Carpathians in isolation. However, land restitution in areas formerly cooperativised is resulting in a partial return of cropping to areas previously zoned for grazing (e.g. at Patarlagele in the Buzau Valley of Romania's Curvature Carpathians) on the hillslopes of tributary valleys, given the lack of flood-free terraces and the inherent fertility of moist young soils on stable landslides. Several villages survive in the hills after an explosive 19th-century settlement 'roirile' (dispersal) (Petrescu-Burloiu, 1978) although they were heavily marginalised under communism. However, the stress of the transition is driving some surviving farmers to grow subsistence crops like maize and potatoes (Badescu et al., 2000; Muica et al., 2001).

Grazing pressure also remains high in the Romanian Carpathians, for the reduction in livestock numbers is most evident through the demise of intensive rearing units in lowland areas. Livestock numbers may grow right up to the limits imposed by the local fodder supply and despite lower returns there is a temptation—where labour is available—to keep more animals and thereby compensate for lower non-farm income: this can result in overgrazing and push sheep into the forests where conflict is generated with large carnivores (Ioras, 2000). Muica and Balteanu (1995) see dangers in intensification where deforested slopes developed on clays and sandstones are prone to erosion through landslides and mudflows. Also the quality of grazing will decline with greater prominence for low-productive herbaceous associations. Yet, the risk of renewed instability can never be ruled out and in many cases it may be prudent to restrict agriculture to grazing and haymaking (Balteanu et al., 1996; Muica et al., 1993). Over the longer term, deforestation has contributed to erosion in the Subcarpathians, but in modern times it is inappropriate agricultural methods that have been most significant in aggravating the incidence of gullies, landslides and mudflows in areas with complex structures of sandstone, clays and shales like the Ramnicu Sarat and Ramna basins (Surdeanu and Ichim, 1991).

Woodlands

The forests were clearly overexploited under communism with annual production of the timber—as much as 38.0 million tonnes—considered by the WWF to be unsustainable (Bennet, 2000, p. 11). Forests are getting progressively younger and thinner, while extensive clear felling has resulted in accelerated runoff during heavy rainfall. In only one area did a substantial increase in woodland occur and this was in the

Bieszczady Mountains of southeastern Poland where persecution and resettlement of the Ukrainian Lemko population after the Second World War resulted in the disappearance of numerous villages and the planting of the former farmland (Groch et al., 2000, pp. 71–72). Now, there are tendencies for stability in Carpathian forests through protection functions (e.g. water catchments), conservation of valuable stands (e.g. the Kozi Katy protected area of mixed forest in the Wielickie Foothills of Poland) and the planting of eroded Subcarpathian areas: soil losses and torrential floods are reduced while employment maximised (Cliniciu and Lazar, 1997). There is also some growth through regeneration on abandoned mountain pastures (Hanouskova et al., 1999), notwithstanding continued high grazing pressure in some other areas.

However, woodlands will continue to be progressively thinned if animals are allowed to destroy young trees (Stoiculescu, 1990) and the forest line may be further depressed (Geanana, 1991–1992). It is important that the dwarf pine bushes are conserved (as provided for under Romania's environmental protection law of 1995–1996) because generally they offer protection against erosion and help maintain biodiversity. In some cases, they have developed through poor land management in areas that could be improved without risk of degradation; therefore, each local situation needs to be evaluated as the specialists have long appreciated (Sparchez et al., 1977). In this connection, it is evident that there are relatively stable woodlands in the south—regenerating naturally—compared with plantations in the north (Povara et al., 1999). In the Tatra, the natural woodland up to 1250 m (the lower subalpine zone) is fir–beech with some spruce and sycamore, but spruce is now dominant through human interference. Extending the more commercially desirable species beyond the appropriate ecological zones reduces stability and biodiversity, indicated by erosion, great runoff fluctuations and local climatic changes as well as many extinct or critically endangered species.

Forests artificially established are more prone to windblow: the 200 km/h storms of November 1995 (the worst winter weather for a half a century) led to catastrophic damage over 9000 ha in eastern Transylvania (Covasna, Harghita and Mures) (Stanescu, 1996). Ukraine has also established unstable monocultures, prone to wind and pest damage. Storms capable of substantial windblow damage must now be expected every three years rather than every ten as before. Poland is still recovering from forest damage occurring as a result of severe weather and poor habitats as well as improper management and air pollution—followed by infestation by insects and spread of parasitic fungi. By the 1960s, annual wood increment in Poland was down to 30–50 per cent of the level in the first half of the century. Damage will continue in the foreseeable future

because of the need for reduced emissions and changes in species so that there is reduced sensitivity to pollution and more compatibility with local habitats; also recultivation of degraded forests (Grodzinska and Szarek-Lukaszewska, 1997). Soil impoverishment (especially in the case of alkaline elements—reflecting flysch bedrock—in the west) may result in more permanent damage. Sulphur emissions from the Ostrava basin have badly damaged forest ecosystems (especially spruce monocultures above 800 m) in Beskydy and 70 per cent of all Moravian forests are damaged in some way. However, deindustrialisation is already having a beneficial effect in Slovakia through recovery from pollution (Oszlanyi, 1997).

There is less pollution damage in the south, but acid rain damage has become more noticeable in Romania in recent years: according to Vasile (1998): 6.37 million hectares of woodland (26.8 per cent of the national stock) were affected in 1996—58.5 per cent in mountains, 32.7 per cent in hills and 8.8 per cent in lowlands. However, forests will remain vulnerable as poverty leads to illegal cutting for fuel, while high demand for firewood is further encouraged by limited natural gas distribution networks. Foresters have been killed while trying to stop abuses in state woodlands. Since 1989 there has been much illegal cutting in Romania, peaking at 281,000 m³ 1992 and since falling to 195,000 in 1993 and 145,000 in 1994. Privatisation of woodlands is also a threat through fencing to hinder the movement of animals and increase the tendency for the gene pools of isolated populations to degrade. It will also lead inevitably to intensified logging—for short-term realisation of the cash value—in contravention of the Forest Code which places clear limits on clear felling.

The forest complexes will thus become fragmented and more intensive management may transform natural or semi-natural stands into even age monocultures. However, study by Badea et al. (1999), after some eight years of privatisation under the 1991 law, revealed that out of a total of 337.5 thousand hectares—mainly of trees of medium productivity—only 10.6 thousand hectares has been cut (mainly in Bacau, Neamt and Suceava counties; but also in Dambovita and Ilt). Meanwhile, the average age increased from 46 yr in 1992 to 52 yr in 1999 while the woodlands became slightly less homogenous in terms of age within particular parcels. However, the authors refer to privatisation carried out in a rather chaotic manner without an effective Forest Code in place. Seventy-two per cent of private forests were found to be in a good sanitary state, with a further 23 per cent only slightly or moderately damaged. Meanwhile, the Polish government is seeking to preserve the dominance of state management, although restitution claims will be settled through payment of rents rather than a change in regime.

Wood processing has been affected by deindustrialisation. Staddon (2001) whose work on Bulgaria has a wider relevance across the Carpathians, explains how the large complexes of socialism have been broken up and some former branch plants find themselves isolated with independent small ventures that are isolated ‘tombs in the desert’, lacking capital as well as entrepreneurial and marketing skill. Getting timber from the restructured logging networks—now subject to bids for raw timber coming from abroad—may require dealing through middlemen or setting up logging companies with entry into the timber auctioning process in order to win logging rights. Meanwhile, larger processors—some with foreign capital or ready access to domestic markets for wood products—have sometimes been slow to modernise and improve efficiency in raw material use. In Ukraine, the ‘Zakarpatis’ association has managed to obtain very large logging and processing capacities at low cost, while the remaining state companies are poorly equipped and funded. Although ‘special permits’ for commercial harvesting may lay down strict conditions (e.g. harvesting beech during the winter only) they are only valid for a year and companies seeking longer term arrangements have been able to use their close links with state forest agencies (from which they were privatised in the first place) to negotiate favourable leasing deals from the Ministry of Forestry in recognition of employment and value-added.

Urban-industrial development

Under communism, there was rapid conversion of farmland for the expansion of settlements, industrial-mining activities, infrastructure and waste. The Carpathians were marginal to the main growth axes of the communist era and remote from some of the leading markets—which helped to maintain the biodiversity resources. Remoteness from regional markets (a situation exaggerated by closed frontiers) meant an important role for multi-functional cooperatives in most rural areas. However, while some of the railways driven across the mountains by the Habsburg Empire did not retain a high priority, the Ukrainian section was of the greatest strategic importance (with routes leading the upper Tisza valley where the Soviet Union had a frontier with Hungary and Romania) and trans-Carpathian routes were essential for Romania’s national cohesiveness, with Brasov as the country’s most central city and a key location for engineering industries. River valleys have been comprehensively developed like the Bistrita in Romania and the Vah in Slovakia. The former had industrial origins in 19th-century wood processing and paper making which were enlarged by cement, engineering and synthetic fibre industries as well as a chain of hydropower stations (Giurcaneanu, 1988).

Meanwhile, central planning placed very heavy pressure on mineral resources so that many processing centres on the edge of the Carpathians saw further development through inputs arriving from the Soviet Union: not only Upper Silesia and Krakow but Hunedoara and Resita in Romania. A new metallurgical complex arose at Kosice in eastern Slovakia while an aluminium industry was planted in the same country at Ziar nad Hronom. Some small centres experienced rapid growth through the ‘wild’ mining of low-grade ores that would have been considered marginal in a global context. Oil in Romania continued to have priority in the Ploiesti–Targoviste and Onesti areas, while oil and gas in the Ukrainian Carpathians (Bytkiv, Dashava and Dolyna) was complemented by potassium salts (Kalus), sulphur (Yavoriv) as well as peat and building materials. In addition, the prodigious demands for energy under central planning meant that the hydropower resources of the area were fully exploited; leading to a considerable loss of agricultural land and forest and some relocation of villages. Damage in the Retezat Mountains (following the Raul Mare–Retezat hydropower scheme) has been deplored and there is regret over the ‘taming’ of the Lotru Gorges through the creation of the vast water storage of Vidra which supplies Ciunget power station through a tunnel bypassing the gorges altogether (Pop 1996).

Since 1989, losses for urban-industrial development have been very small and some rural areas have stagnated with the demise of the cooperatives (Varga, 1996) despite some improved cohesion in border areas where Euroregions have been created. Damage arising from mining activity has been more fully acknowledged (Bran and Zotta, 1997; Mac, 1993), including the pollution generated by non-ferrous metallurgical smelters (Palaseanu, 2000; Serban, 1993). Damage in the eastern Carpathians, an area of high tourist potential, has arisen from mining in the Caliman Mountains, now exhibiting lunar landscapes in places, although mining everywhere is creating problems of excessive tipping. The landscape around Anina in the Banat Mountains was transformed by the decision to work the bituminous schists as a power station fuel and a source of certain rare minerals. The cement factory at Campulung is proceeding to remove part of a mountain which has strong associations with military resistance during the First World War. The expansion of mining at Rosia Montana has overwhelmed a unique historic monument to the gold mining techniques of the Roman period (Bleahu, 1998). Fortunately, mining is now much reduced as uneconomic mines are closed. However, energy resources are a priority. New natural gas reserves may be sought in Poland where geothermal energy is already exploited in the Zakopane area. Mining in the Hungarian Carpathians (supervised from Miskolc) is no longer important since the major coalmines have closed

and the worst pollution blackspots have been improved. However there is still opencast quarrying in parts of the Bukk National Park (Belapatfalva and the Miskolc–Mexiko valley) and there is also opencast working of lignite for Matra power station in Gyongyos. While emission levels for carbon, nitrogen and sulphur have been reduced they are still high by West European standards. When considered against GNP, the intensity of energy use is particularly striking.

Hydropower is being reconsidered. After the revolution, great concern was expressed in Romania over the proposed dam in the Mures Valley at Rastolita, allegedly approved in 1989 without any local consultation. Diversion of streams draining the southern flanks of the Caliman Mountains will cause rivers to dry up and there will be particular damage to the gorges on the Mures in the Deda–Toplita section, much appreciated by the rural population and by the townspeople of Reghin and Targu Mures. However, small dams are more acceptable as in the case of the Zabala (a tributary of the Siret) in Vrancea. And in the case of the Olt (where work has been proceeding since 1970 on a total of 24 dams), the plan for a high dam in the gorge section near Racovita has been abandoned in favour of three small dams (at Racovita, Robesti and Caineni) which will allow a similar installed generating capacity but without flooding farm land and villages. Comsit (1998) has mentioned a proposal to divert 13 streams on the northern side of Fagaras Mountains into the Dambovita water management system, as the second stage of the scheme to enlarge Lake Pecineagu to serve Clabucet power station. In 1991, the Mayor of Fagaras objected on the grounds that there would be major ecological changes especially in dry years. It was agreed that the works were inefficient and in 1997 land temporarily expropriated was returned. Meanwhile, the Czorsztyn–Sromowce reservoir group on Dunajec has destroyed landscape and threatened Pieniny National Park in Poland. Arguably, planning on an ad hoc basis for artificial water storages to relieve flood damage should be resisted until better-coordinated control measures have been worked out. Further, river regulation is occurring under Ukraine's 'Complex Programme for Flood Protection 1994–2000' which includes dyking, bank reinforcement or adjustment to riverbeds over some 400 km of rivers in Zakarpatiya. On the other hand, permanent flooding occurs through dams.

The tourist industry has declined with the elimination of subsidised holidays formerly provided by the trade union organisations in the various countries. The main resorts are no longer competitive and they need to be reorganised and refurbished to cope with future domestic and foreign demands, as has already happened to a great extent in Czech Republic, Hungary, Poland and Slovakia (Cianga, 1998; Surd, 1988). Meanwhile, there has been a clear growth of tourism in the Beskydy

(Czech Republic) and the Tatra (Poland and Slovakia), with over three million visitors annually to the Tatra National Park acting as a powerful stimulus for more accommodation, winter sports facilities and transport. Excessive pressure in some scenic areas rendered more accessible by cable cars and by the promotion of winter sports has caused some degeneration of a once rich flora. Attention is also being drawn to thoughtless behaviour by tourists in the way they park cars and dispose of rubbish, to say nothing of more outrageous vandalism like forest fires and wilful damage to traditional wooden buildings. Newly won political freedoms must be blended with a sense of responsibility towards the environment. Zakopane and Poprad are being linked controversially with the Winter Olympic project (2006 or 2010) which would bring skiing to the national park and biosphere reserve. Sustainable tourism, linked with protected areas and with landscape, wildlife and cultural values of rural areas, should help to stabilise land-use patterns and encourage a labour-intensive sustainable agriculture in the more accessible mountain valleys. This could also impact positively on hunting now that the liquidation of large hunting areas reserved for VIPs opens the way towards more sustainable game management without hand feeding. However, the creation of small, privately managed hunting districts in the Czech Republic and Slovakia has made coordination virtually impossible. Activity has intensified, causing overexploitation and a general drop in population numbers.

Finally, aspects of infrastructure should be touched on. There are oil and gas leaks from pipelines in Ukraine, while the processing of sewage and used industrial water is inadequate. Sewage capacity in the tourist centres is already overloaded and so it is both ecologically and economically desirable that there should be more small centres of tourism. But a big problem arises from the mismatch—around 40 per cent in Hungary—between the proportion of homes with drinking water supply and sewage disposal (Varga, 1999). Water supplies have been damaged by eutrophication; also by sustained drainage and river regulation in Hungary throughout the modern period and by hot and dry conditions in the Carpathian basin over the past decade. Waste management in general is compromised by insufficient recycling and inadequate disposal sites. Even in the Carpathian area of Hungary, most small villages and recreation areas are lacking in regular waste collection. New road building in the context of the EU transport corridors is a further threat for the Carpathian 'bridge' (crucial for the exchange of genes between Europe's northern and southern refuges) which may be impeded by new highways like the proposed Madrid–Kyiv motorway through the Yablunetski and Vyshkivski passes. However, forest roads (as envisaged for Ukraine) are less damaging on account of lighter traffic

while better access to the timber resource will make for environmentally friendly harvesting technologies: cable logging, horse logging and the replacement of caterpillar tractors by wheel tractors. But roads can threaten species in small refuges. Electric power cables and badly designed and improperly located constructions also impede migrating animals.

The present socio-economic environment

Pre-1989 approaches to the environment did not show adequate concern for the dynamism of the environment and the potential consequences of human action. But the Carpathians are confronted by a mix of threats which are not overwhelming but are cumulatively significant enough to require coordinated management in the interest of biodiversity with greater powers of regulation to limit harmful trends. There is evidently a northwest–southeast contrast. In the northwest, there is a ‘virtuous circle’ where civil society and political stability attract investment to reinforce attractiveness; whereas in the southeast there is a ‘vicious circle’ through lack of investment (arising from lower spending power and greater distance from western Europe) which progressively inhibits civil society and compromises political stability. The differences are reflected in variations in investment (state budgets and foreign direct investment), unemployment, poverty and some ethnic tensions. Development threats are therefore greater in the northwest, including hunting. Forests are expanding (partly due to lower farming pressure), yet air pollution damage to forests is most evident in the Beskidy of Poland and pollution from Poland affects Ukraine. Mass tourism exists in some areas, road projects are very likely to be implemented and the demand for electricity will increase the need to proceed with the potentially damaging hydropower projects. Meanwhile, development pressures in the south are weaker; yet, the poorer countries with high unemployment generate threats to environment through illegal cutting of restituted forests and heavy grazing pressure by peasant farmers whose main source of income arises from the sale of livestock. These problems are not excessive at the moment but legislation passed in Romania in 2000 will eventually increase private ownership substantially and until the law is enforced, poverty is almost certain to result in higher cutting levels, given the experience with the first round of privatisation in 1991. Thus, while the output of basic agricultural commodities has fallen, implying reduced pollution damage (including trans-boundary pollution), rural economies may be less sustainable than before in the sense that small subsistence farms exert pressure on forests even where natural gas is available (and will not provide social stability over the longer term). This

combines with the reduced effectiveness of law enforcement in the aftermath of communism and a low level of public awareness over environmental issues. New legislation is important but cannot succeed without better law enforcement and environmental education; along with relief of poverty and measures to engage the interest of mountain communities—and their visitors—in conservation.

Biodiversity is clearly threatened by a range of factors responsible for shrinking habitats deriving from physical forces—landslides and avalanches, along with heavy rainfall and frost damage—as well as the systems of exploitation (Stoiko et al., 1997). However, while the current transition poses both a threat to the integrity of the Carpathian ecoregion it also provides an opportunity for sustainable development to fulfil both environmental and societal needs. Now that many of the worst problems inherited from the communist era have been addressed, the agenda is moving ahead quickly to anticipate threats from future development linked with EU membership and increased spending power; suggesting that the full range of EU environmental protection systems should be brought to bear as quickly as possible. As already noted, the EU has now embarked on an integrated network of protected areas (‘Natura, 2000’) with the somewhat grudging cooperation of member countries. Yet, delays in the Carpathian countries could be very costly in ‘units of biodiversity’ because there is so much more to lose. It is therefore essential that international assistance programmes—like the EU Structural Instrument for Pre-Accession Assistance and PHARE Large Scale Infrastructure Facility—should fully acknowledge the need for biodiversity conservation and sustainable development. In addition to its support of ‘Euromontana’ (already noted), CoE has joined the United Nations Environment Programme in promoting a Pan-European Ecological Network to safeguard natural heritage from rapid land-use change (Nowicki, 1998, p. 258).

There is an awareness of the need for conservation. The 1994 Slovak Act on Nature and Landscape Protection now provides five levels of territorial protection involving specific flora and fauna, minerals and fossils: working from the national level, through protected landscape areas (PLAs) with characteristic landscape or historical settlement forms; national parks where natural heritage protection carries overriding priority; small protected sites comprising biocorridors or biocentres of local or regional importance; and finally nature reserves and monuments of nature. Furthermore, there is now scope for tax concessions to private landowners who set aside land for conservation purposes. Other countries are working along roughly similar lines. Again, through its

1997 Nature Conservation Act, Hungary has created a legal basis for effective nature conservation. Regional plans will include inventories of unique landscape features and convergence with the EU means that land-use practices are now being reconciled with a system of Environmentally Sensitive Areas and a 'National Ecological Network' which is now being established. Meanwhile, a methodology to identify critical areas exists in the Czech 'Territorial System of Ecological Stability' which was researched in the 1980s before the concept was formalised in 1992. With comprehensive coverage across the Czech Republic, it is now possible to identify biocentres and biocorridors which can relate to the National Biodiversity Conservation Strategy.

Yet, the Carpathians on the whole are still well-populated, despite some areas emptied by resettlement (Perzanowski, 1999) and any approach to conservation must recognise the universal demand for growth and higher living standards in all the countries involved; also, the inevitability of investment pressure following EU accession which is now being negotiated in all the countries except Ukraine. There are communities everywhere that live comfortably through salaried employment and non-agricultural family businesses, but poverty is greatest in the south-east: low foreign direct investment, low domestic savings, limited state funds for investment and a low absorptive capacity for investment due to institutional deficiencies and the legacy of a workforce experienced more in heavy industry than in a market-oriented service economy with a large rural tourism sector which is the key to the future (Slee, 1999). The situation is complicated by the fact that Carpathian areas tend to be relatively backward in relation to the respective national economies (Suli-Zakar, 1999) and Rey (1995) has raised the spectre of marginalisation under communism giving rise to depopulation and abandonment of traditional agricultural activities without Western help. While Hungary's northeastern periphery conserves natural and cultural values, the villages in border areas have suffered depopulation since the Treaty of Trianon imposed a new border and disrupted existing patterns of production and trade. The transition has added to their backwardness for the share of industrial production has fallen and agricultural yields are relatively low, despite the reputation of the Bükk, Eger, Mátra and Tokaj wine districts. Unemployment is relatively high while per capita GDP is relatively low. Mountain conditions themselves impose constraints: Poland's Carpathian region suffers from high agricultural production costs arising from the harsh climate, poor soil and steep slopes; also, poor access to local markets, linked with the quality of the infrastructure (energy, transport and business services) and poor labour markets (Gorz and Kurek, 1999).

Agriculture

Romania is considering the management of some designated national parks as 'natural parks' which will attempt to compromise between conservation and the pressure for development by the local population. There is much local support for a 'natural park' in the Apuseni (Abrudan and Turnock, 1999), guided by a 'plan de amenajare ale teritoriului' (PAT) agreed by the county councils concerned and encouraged 'Centrul Regional de Supraveghere' in Oradea. This would safeguard access to woodland and grazing (already a source of conflict between several local authorities and the state silvicultural enterprise 'Romsilva' with regard to the high grazings of Padis). But it will require careful regulation of tourism with regard to the development of second homes and winter sports; already attempted on a piecemeal basis by Alba County Council which has designated 'zone de interes turistic necesar a fi protejate' e.g. in the area west of Alba Iulia where planning restrictions are now in force. And at the local level, there is a trend towards negotiation of a sustainable future with the setting up of 'Izvoarele Ariesului' to represent locals who have their own concerns over viable rural communities which need economic growth and better services to retain their population (Chauvin, 1997).

Governments have little experience in the use of incentive payments for farmers who accept environmental obligations. But the EU's 'second pillar' is being developed through rural development projects in the candidate countries. In the Czech Republic, a programme of support was launched in 1997 for non-productive functions of agriculture: maintaining landscape and supporting less favourable farming areas. Hungarian research has recommended optimum crop combinations in 'natural micro- and meso-regions' (Tirczka and Ferencsik, 1998). A vision for the Carpathian future would envisage more organic farming, with improved systems of credit and marketing. Improved arrangements would be needed to collect small agricultural surpluses for processing and marketing, while small meat packing businesses could help create competition over the sale of livestock which is still dominated by the state. Small, light tractors and machines suitable for small farms could solve the problem of technology, in the context of greater agricultural contracting, with the possibility of tractor hire to compete with the state's facilities. "Without intervention a further concentration of agricultural production on the best soils [would have caused] irreversible loss of high nature value farming systems which form an important part of the common European natural heritage" (Baldock et al., 2001, p. 9). But now EU SAPARD pre-accession funding will make a difference "at a time [post-1999] when agri-environment schemes have become a key policy instrument through-

out the EU” (Baldock et al., 2001, p. 6). However, there is some concern over the strength of the environmental component and the view has been expressed that SAPARD funding should be contingent on grass-roots’ participation and appropriate environmental safeguards including “the use of selected agricultural areas for biodiversity conservation as corridors linking protected areas” (Avis, 2000, p. 11). This requires capacity building through cultural change in institutions and training/advice for farmers.

Sustainable forest management

There is a parallel challenge to achieving sustainable forestry in the face of disintegration through fragmentation of woodland ownership (Gutkowski, 1997). This will require not only limits to cutting but administration in the interest of all woodland users (Milescu, 1990). There could be reintegration through community woodland management to link wood production and processing—and also to reflect the reality of forests as ‘nested’ sources of resources (pasture, food, fuel, building materials and recreation) with transparent procedures to reconcile the needs of the relevant stakeholder groups (Beckley, 1998). This highlights the ‘local’, reflecting the Grabher and Stark (1998) claim that localities themselves are central to the articulation of new industrial networks and not just passive recipients. Legislation is slowly adjusting to this agenda. The 1995 Czech Law on Forests gives the competent authorities rights to promote non-production functions in support of sustainable management and forest biodiversity in all woodlands (but especially in protection forests) while owners have the right to compensation for the loss of income arising. SAPARD will help finance forest management linked with rural development. The 1995 law also supports measures to restore forests damaged by air pollution. Currently, there is funding from nature protection authorities and municipalities for regeneration of landscape elements, trees and historic parks and gardens.

Forest management improved in Poland during the 1990s. Selective logging and immediate reforestation is now obligatory, the conservation function of forests is being more highly valued and it is appreciated that a variety of forest types within a small area makes for both attractive landscape and ecological stability (through protection against erosion); while economic functions should include recreation and water protection. Poland’s ‘Directives Concerning Improvement of Forest Management on Ecological Grounds’ provide for ‘nature inventories’ as a basis for reconstruction while protection of soils and waters involves the preservation of swamplands and the reforestation of mountain watersheds, as well as environmental education for community participation. Under the Hungarian For-

estry Law and Ministerial Decree of 1996–1997, the state seeks to expand and regulate forests (wooded areas exceeding 0.5 ha) in the public interest. The privatised state forestry service manages state forest and most private woodland (since private forests larger than 4 ha must have management plans detailing species composition and cutting regimes). Finally, Ukraine’s new multi-functional forestry code seeks to preserve the habitats of red-listed species. Instead of clear-felling, harvesting of beech in three phases at 7–10 yr intervals (taking 60, 20 and 20 per cent, respectively, of the mature trees) seeks to accelerate natural regeneration. Higher charges should discourage over-harvesting, while fir–spruce monocultures should be replaced by mixed woods for better disease control and protection against erosion linked with cutting and transport. New sawmill technology should reduce pollution and increase the amount of marketable wood derived from harvested trees (saving 10–12 million cubic metres per annum) (Hamor, 1998).

Rural tourism and large carnivore conservation

While tourism development could be approached through accommodation in growth centres with services and attractions nearby to limit visitor pressure on the high mountains, there is an alternative conception of small-scale operations closely integrated with natural resources (Kurek, 1996). For example, writing on the Stuzhitsa area of the future Ushanski National Park, Slee (1999) sees rural cultural tourism as highly appropriate—following the decline of communist industry—in an area of small-scale biological farming (with low fertiliser/pesticide application and absence of Chernobyl-related damage). Interest by the CoE Directorate of Environment & Local Authorities (Environment Conservation & Management Division) during 1997–1999 has also underlined the role of cross-border cooperation for tourism. Thus, there is a need for a management plan and trilateral programme covering Bieczszady and Poloniny as well as Ushanski, since “the furtherance of trans-frontier tourism makes both political sense in binding countries to a shared vision of sustainable tourism and economic sense in that the combined product of the different countries provides an additional attraction to visitors” (Slee, 1999, p. 3). Mention should also be made of the Environmental Partnership for Central Europe (EPCE) which comprises an NGO network relevant to the Carpathians through ecotourism initiatives that establish ‘best practice’ for sustainable development through cross-border ecological networks endowed with a system of ‘Amber Trails’. The tourist resources of the Banat Mountains have also been considered sustainably in a trans-frontier context (Olaru, 1995).

Romania is involved in a project for biodiversity and ecological reconstruction in the Ceahlau National Park

and in various schemes to reintroduce specific species: the beaver, chamois and marmot in such areas as the Bucegi Mountains and the Cerna Valley. Romania is also playing a key role with regard to a Carpathian Large Carnivore Project (CLCP). In 1993, Romania signed up to the 1979 'Convention on the Conservation of European Wildlife & Natural Habitats' and in 1997, the Romanian Ministry of Waters, Forest, and Environmental Protection received a grant from the World Bank Global Environment Facility (GEF) to prepare biodiversity conservation projects for 'Integrated Protected Areas & Conservation Management' in three model areas. One area will comprise the Retezat, the country's oldest national park where it is necessary to study the game (bear, chamois and red deer) and highlight natural forest areas where growth is difficult and where there will be no significant exploitation. The proposed road link between Baile Herculane and Petrosani (across the Cerna–Jiu watershed) will also have to be taken into account (Stanciu, 1998). However, the Bucegi and Piatra Craiului national parks near Brasov, are particularly rich in large carnivores and a link with the Munich Wildlife Society's 'Wolf Conservation Strategy for Europe' has attracted funding to develop a model for large carnivore conservation. Work started in 1999 after project preparation in 1997–1998 (Promberger et al., 1999).

Much thought is going into rural tourism in relation to these initiatives and especially the CLCP in the Piatra Craiului Mountains. Future woodland owners and highway authorities have a crucial role in maintaining critical habitats and corridors. However, the big question for the future concerns livestock grazing in the mountains. For the main reason why large carnivore stocks remain high is because the forest resources are supplemented to some degree by domestic animals on the summer grazings, along with beehives, orchards and urban refuse. The large carnivores enjoy protection but reduced tolerance by shepherds could be crucial. The key points seems to be that after about 60 days of grazing at current stocking level (out of a season that may last from 90 to 140 days) the high meadows are exhausted and sheep are forced into the forests to find food. As they disperse they become less well protected by the dogs and fall an easy prey to large carnivores (Ioras, 2000). The situation can only get worse if peasants continue to expand their flocks, which raises the possibility of a trade-off between reduced stocking levels and an expansion of rural tourism linked with observation of large carnivores. If an infrastructure of pensions and services can be built up, and if money generated by the hunting business goes at least in part to the community and not just to the forest administration, large carnivores could benefit mountain regions and contribute to more sustainable rural development by increasing support for large carnivore conservation.

Rural tourism is well established in the area but growth is now starting on the edge of Zarnesti which is particularly convenient for the Piatra Craiului. So far, costs exceed benefits but a growth in tourism could tip the scales and this would be particularly valuable in Zarnesti where there is high unemployment. More visitors could be accommodated through mountain activities (rock climbing and survival training) and a Large Carnivore Centre which would try and get around the problem that, apart from garbage dumps and bait sites, the animals are difficult to observe in their natural environment. A centre would provide information about the animals and, more generally, inform Romanians about the value of a Carpathian ecosystem in an international context. There is also a need for a management information system to facilitate quality management decisions by the authorities in charge of hunting and damage control leading to sound large carnivore conservation; also, to build confidence among stakeholders on the basis of more realistic estimates of the number of animals. Greater stakeholder involvement is also necessary to secure appropriate land-use planning in the sensitive Barsa valley above Zarnesti where the meadow vegetation should be safeguarded against a spate of housing developments which would lead inexorably to demands for electricity and a surfaced road.

Cross-border cooperation

Finally, cross-border cooperation has been greatly encouraged over the past decade for environmental reasons as well as socio-economic concerns related to permeable frontiers and the reinvigoration of peripheral areas (Gorka, 1991). Trans-border protected areas are considered valuable for the proper management of water resources, forest and agroecosystems and (especially) tourism. They also have importance for scientific and educational cooperation. Examples in the Polish–Slovak border area include the Tatra: with neighbouring national parks which have comprised an international biosphere reserve (IBR) since 1992–1993; and Pieniny: the oldest trans-border protected environment area in the world (established in 1932) with neighbouring national parks. All these parks were brought into the Tatra Euroregion in 1994. There is also a TACIS cross-border cooperation project 1999–2001 for a Carpathian Trans-frontier Environmental Network covering the Romanian and Ukrainian parts of Bucovina. The aim is to preserve biodiversity in active participation with stakeholders, with a pilot project for conservation management including a land-use management plan and strategy for sustainable ecotourism (also, refurbishment of a National Park building as an interpretative centre). Euroregions also have environmental interests. The Carpathian Euroregion's initiatives include a

Working Commission on Tourism & Ecology. The Regional Environmental Centre for Central & Eastern Europe in Szentendre (Hungary) is active on Carpathian cross-boundary projects through support of local NGOs conserving the Upper Tisa Meadows. Carpathian Bridge ('Priashev') is an international association of public ecological organisations. However, cross-boundary arrangements will be complicated, at least for the foreseeable future, because Ukraine is not a candidate for EU membership and strict frontier controls will remain in force under the Schengen system.

At the beginning of the transition phase, Langer (1990) drew attention to a series of potential cross-border conservation projects informally designated 'Ecological Bricks for our Common House in Europe' and several of these have now received funding. Outstanding is the eastern Carpathians trilateral initiative aided by GEF in 1997. The focus is on legal, institutional and administrative measures to connect the habitat fragments of isolated reserves to ensure the long-term presence of viable populations of flora and fauna that are sensitive to habitat loss. Work has involved an inventory of plant and animal wildlife, considering community, species, population and genetic levels of diversity. Knowledge of the biodiversity of all the massifs covered by the 'Trans-Carpathian Biodiversity Protection Project' has increased with the aid of a radio-telephone system and there are proposals for establishing a network of protected areas interconnected by ecological corridors. Some conflicts have been overcome through local negotiation. The project has laid a good foundation through raising awareness among local people and winning them over to sustainable management. It has also provided momentum for continued cross-border cooperation within an Eastern Carpathians Biosphere Reserve, conceived as a means of maintaining populations of large herbivores and carnivores which require extensive territories in order to survive.

However, these various initiatives have in some way to be combined into a strategy which can apply across the Carpathians as a whole. This requires better international coordination and a greatly improved supply of information in an area where the closed frontiers of communism have left a legacy of separate treatment for each national territory. There is little data on threats like invasive species and potential threats like climate change, while better procedures for environmental impact assessment (EIA) are needed to provide more detail on threats like woodland restitution. Much information is not exactly comparable in terms of time and method and conservation policies vary considerably in detail. Moreover, among a very wide range of stakeholders (governments and political institutions; the main public sectors and economic sectors whose activities affect the ecoregion; higher educational and research organisations; NGOs and societal

representatives; and donors) many do not fully appreciate the unique value of the resources of the Carpathians. Some people seem to have a natural empathy for their surroundings: Carpathian-Rusyn people (Ukraine) are credited with a love of the pristine beauty of the Carpathians. But others may be unaware of the importance of protection in general and the biodiversity value of areas they may take for granted.

The Carpathian Ecoregion Initiative (CEI) and its implications

Given strong commitment from the six countries, WWF has drafted a mission statement "to initiate and facilitate a process through which key stakeholders collaborate to secure conservation and sustainable development in the Carpathian region" (WWF, 2000b, p. 3). Reconnaissance in 1999 took account of all relevant expertise and involved contact with selected stakeholders and key actors in order to assess the biodiversity of the Carpathians in the light of current threats and conservation efforts. This work has established that while there are challenges which require urgent attention there is also a high level of commitment to achieve worthwhile objectives. During 2000–2001, a detailed biodiversity/socio-economic assessment has been undertaken, leading to a long-term biodiversity 'vision' and the initiation of specific projects in priority areas which are relatively numerous in the north, especially when allowance is made for existing levels of protection (Fig. 2). A 10–15 yr ecoregional conservation plan and an action programme for the next five years are now under preparation. A steering group will consist informally of a core team involved in practical decision-making about the project and other participants whose role is of a more 'ambassadorial' nature, while regional coordinators and country contacts will form the core of the biodiversity, socio-economic and GIS working groups. While biodiversity lies at the core of the initiative, a socio-economic perspective is needed to identify threats—such as national development plans and projects financed by global institutions—in the context of the natural resources and the institutional frameworks. It is also important to identify stakeholders and assess them in terms of motivation, power and influence.

While appropriate machinery is needed at the national level, the vision must also be scaled down to the grass roots though local community input, informed by expert guidance, through negotiation with environment managers. This should be feasible because the CEI does not stand in isolation and there are substantial opportunities for synergistic actions. Work by the IUCN European Mountain Forum on the Carpathians has done much to identify NGOs and stakeholders which is essential for

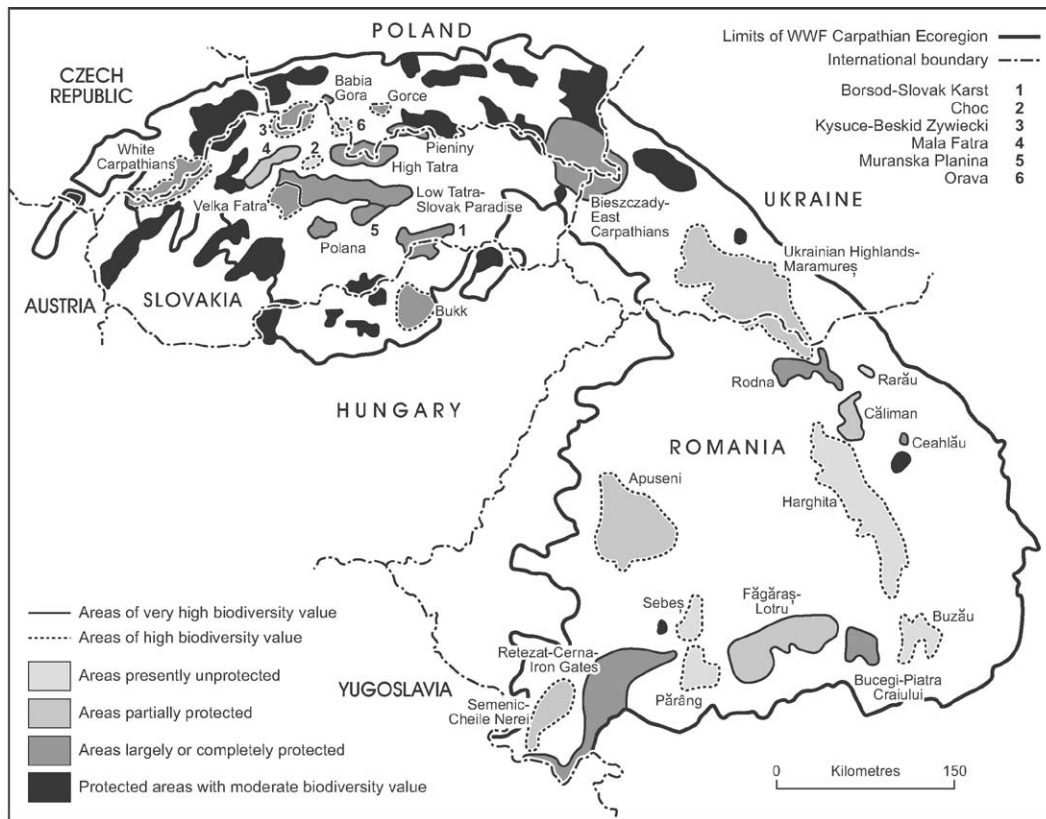


Fig. 2. The Carpathian vision: priority conservation and their current status (Source: World Wide Fund for Nature).

research on the ways in which community development can proceed in parallel with conservation programmes.

A large number of NGOs are available for inclusion in conservation networks. In Hungary, the work of NGOs (like Duna Kör, E-Miszio, Holocén, MME and Somogy)—also the Hungarian Ornithological Society (MME) and the Hungarian Society for Karst Research & Speleology—cannot be separated from the work of the statutory conservation organisation. An international dimension is provided by the Carpathian Heritage Society founded in 1999: an idea by young people at universities in southern Poland to appreciate and conserve the natural and cultural heritage in cooperation with mountain communities. These organisations will have an important role to play in profiling the situation in each area and in encouraging the adoption of sustainable options. New private owners should have an interest in sustainable management, but to realise this potential it will be necessary to develop a legal context, institutional arrangements and economic conditions through which a full range of incentives and disincentives operate.

Sustainable development strategies across the region are necessary in view of the need to raise the standard of living among the human population of the Carpathians (Turnock, 1998). However, the mountain regions have reached different stages in the demographic transition

and plans are needed for each area mountain massif or community group to respond to both the biodiversity issues and the social capital (Turnock, 1997). Land restitution—politically necessary—has served as a social policy, along with the small farms retained under communism (Pine, 1993), to relieve unemployment, with relatively little investment, but the EU SAPARD instrument to restructure and modernise agriculture now offers significant potential to integrate biodiversity concerns into development planning, with NGO participation, and to encourage appropriate forms of land stewardship in rural areas. Unfortunately, the SAPARD process has not worked satisfactorily so far and “evaluation has shown that the full range of possibilities offered by this instrument, including the promotion of agri-environmental schemes, have not to date been fully utilised” (Avis, 2000, p. 10). On the other hand, it is encouraging to hear that the European Parliament has approved a proposal that environmental aid to the candidate countries should double by 2006—with emphasis on biodiversity and nature conservation—in recognition of the ‘serious challenge’ posed by enlargement. The Commission is also required to negotiate an ‘environmental code of conduct’ for EU firms operating in the accession states; and to carry out and publish EIAs on all EU funds provided for accession states (including European Investment Bank projects) to meet

the representations of NGOs. The resolution also acknowledges that biodiversity is an 'economic resource' to be sustainably exploited for long term benefit.

Conclusion

This paper has concentrated on the Carpathians and the development of a concept of biodiversity conservation extending from small 'insular' nature reserves, sometimes grouped within parks, to a vision embracing the entire ecoregion which is divided among six countries with a history of separate development despite the recent shared experience over central planning and coordination within Comecon. There is now a political will to adopt new management concepts to protect the resources for the posterity in the interests of both Europe and the wider world and public awareness can no doubt be raised to a more conscious appreciation of what is widely taken for granted. In April 2001, the six governments formally agreed to cooperate in a programme of protection and sustainable development. However, western Europe will have to maintain its commitment and acknowledge the need for economic growth as well as sustainability throughout the Carpathian region. Consequently, there is a double challenge: evolving models of sustainable development and implementing them across the region.

General principles will have to be worked out in each locality where stakeholders examine the threats and the conservation objectives. Biodiversity interests will have to be balanced by the community's need to survive, for it will not be realistic to achieve conservation aims in the context of 'planned' depopulation. The human pressure on the land will be determined in part by the resources with the potential to attract outside investment like tourism or mining projects. But fundamentally, it is a question of the community's demand on local resources for subsistence. Where the demand is high, easement can only come through new employment which may be found through commuting to urban centres or through local industry concerned with food- and wood-processing or through activities in the tertiary sector. Thus, in the Piatra Craiului (Romania) where the conservation of large carnivore stocks hinges in part on the reduction of sheep stocks, progress depends on alternative income sources: perhaps through rural tourism linked to large carnivores. Without alternatives, however, there will not only be pressure on wild animals but also on the forests through illegal felling on state-owned land as well as heavy cutting in restitution woodlands when the law may require the sanction of the silvicultural authorities. These issues underline the importance of a socio-economic context for conservation where the policy is effectively negotiated among stakeholders and does not rely significantly on legal sanctions

What are the land-use implications? Clearly, there will be greater priority for conservation of the main biodiversity resources, but this does not translate into a firm land-use plan. After quite radical changes in the modern period with urban-industrial emphasis of the communist period, it is likely that there will be greater stability linked with thorough EIA of potential developments. It may be assumed that woodlands will be maintained and somewhat enlarged, but arguably it is more important to enhance the forest qualitatively through changes to the age and species structures and to management systems than to expand the wooded area. This raises the issue of agriculture, where there has been an all-round reduction in intensity over the past decade; evident in terms of both crops and livestock. In the southeast (Romania and Ukraine), deindustrialisation and unemployment have forced the peasants to intensify on a subsistence basis in some areas. But generally, the threats arise from further marginalisation of the poorer land and especially the mountain grasslands which could soon start reverting to scrub if incentives are not introduced to maintain sheep stocks. For the rest, it is clear that large developments concerned with manufacturing, mining, tourism and transport will need to be very carefully scrutinised and identifying potential 'hot spots' is an important task for the current phase of the plan.

References

- Abrudan, I., Turnock, D., 1999. A rural development strategy for the Apuseni Mountains, Romania. *GeoJournal* 46, 319–336.
- Augustyn, A., Kozak, I., 1997. The trends of anthropogenic pressure in the Polish and Ukrainian Carpathians. In: Perzanowski, K., Augustyn, M. (Eds.), *Selected Ecological Problems of Polish–Ukrainian Carpathians*. ICE PAS, Ustrzyki Dolne, pp. 15–22.
- Avis, C., 2000. WWF Agenda for Accession: the 'New' European Union. World Wide Fund for Nature, Budapest.
- Backmeroff, C., Chemini, C., La Spada, P., 1996. European Inter-governmental Consultation on Sustainable Mountain Development. Giunta della Provincia Autonoma di Trento, Trento.
- Badea, O., Iacob, C., Nitoi, I., 1999. Studiu-inventariere a Starii Actuala a Padurilor Private Privind Compozitia Varsta Starea Fitosanitara si Posibilitatile de Recoltare de Masa Lemnoasa. Institutul de Cercetari si Amenajari Silvice (ICAS), Bucharest.
- Badescu, I., Ghinoiu, I., Urucu, V. (Eds.), 2000. *Sociogeografia si Etnografia Comunitatilor Taranesti: Studii de Caz—Satul Colinar Buzoian Patarlagele*. Fundatia Nationala pentru Civilizatie Rurala 'Niste Tarani'/Institutul National de Cercetare pentru Civilizatia Rurala, Bucharest.
- Baldock, D., Bennett, H., Verschuur, G.W., 2001. *Agri-environmental Policy Development in CEE: Synthesis Report of a Multi-partner Project*. Avalon Foundation, Wommels, The Netherlands.
- Baltea, D., Cioaca, A., Dinu, M., Sandu, M., 1996. Some case studies of geomorphological risk in the Curvature Carpathians and Subcarpathians. *Revue Roumaine de Geographie* 40, 51–59.
- Beckley, T.M., 1998. The nestedness of forest dependence: a conceptual framework and empirical exploration. *Society & Natural Resources* 11, 101–120.

- Bennet, G., 2000. Ecoregion-Based Conservation: The Carpathians: Final Reconnaissance Report. WWF-International Danube-Carpathian Programme, Vienna.
- Bleahu, M., 1998. Turismul si Protectie Peisajului. In: Bleahu, M. (Ed.), *Ecologie Natura Om*. Editura Metropol, Bucharest, pp. 125–136.
- Bran, F., Zotta, B., 1997. Masuri de prevenire a daunelor de mediu cauzate de industria miniera. *Geographica Timisiensis* 6, 127–130.
- Chauvin, P., 1997. La Protection de la Nature au Service du Developpement Local: L'exemple de la Haute Vallee de l'Aries Dans les Monts Apuseni. Universite de Pau et des Pays de l'Adour, Pau.
- Cianga, N., 1998. Turismul din Carpatii Orientali: Studiu de Geografie Umana. Presa Universitara Clujeana, Cluj-Napoca.
- Cliniciu, I., Lazar, N., 1997. Efectele lucrarilor de amenajare a bazinelor hidrografice orientale. *Revista de Silvicultura a Sud-Estului Transilvaniei* 2 (2), 23–25.
- Comsit, G., 1998. O actiune locala care a salvat Tara Fagarasului de un dezastru ecologic. *Revista de Silvicultura a Sud-Estului Transilvaniei* 3 (1), 19–20.
- Cretan, R., Vert, C., Turnock, D., 1999. Land use change: major trends and characteristics. In: Turnock, D. (Ed.), *Geographical Essays on the Romanian Banat*. Leicester University Geography Department, Leicester, pp. 108–142, 347–349.
- Donita, N., Ivan, D., 1998. Sur la biodiversite des Carpates de la Roumanie. *Ecologie* 29, 155–157.
- Florea, M., 1996. Riscul geomorfologic in etajul alpin din Muntii Fagarasului. *Studii si Cercetari de Geografie* 43, 137–142.
- Gastescu, P., 1990. Water resources of the Romanian Carpathians and their management. *Revue Roumaine de Geographie* 34, 85–92.
- Geanana, M., 1992. The influence of geographical position on the upper tree line in the Romanian Carpathians. *Studii Universitatii Babes-Bolyai: Geographia* 40–41, 61–63.
- Giurcaneanu, C., 1988. Populatia si Asezarile din Carpatii Romanesti. Editura Stiintifica si Enciclopedica, Bucharest.
- Gorka, Z., 1991. Settlement in the Polish Carpathians. *Zeszyty Naukowe Uniwersytetu Jagiellonskiego, Prace Geograficzne* 87, 7–22.
- Gorz, B., Kurek, W., 1999. Variations in technical infrastructure and private economic activity in the rural areas of southern Poland. *GeoJournal* 46, 231–242.
- Gorz, B., Rajman, J., 1988. Contemporary development trends of agriculture in the Polish Carpathians. *Folia Geographica: Series Geographica-Oeconomica* 21, 5–23 (in Polish with an English summary).
- Grabher, G., Stark, D., 1998. Organising diversity: evolutionary theory network analysis and post-socialism. In: Pickles, J., Smith, A. (Eds.), *Theorising Transition: the Political Economy of Post-socialist Transformations*. London, Routledge, pp. 54–75.
- Groch, J., Kurek, W., Warszynska, J., 2000. Tourist regions in the Polish Carpathians. *Universitas (Krakow)*.
- Grodzinska, K., Szarek-Lukaszewska, G., 1997. Polish mountain forests: past present and future. *Environmental Pollution* 98, 369–374.
- Gusik, C., Zborowski, A., 1988. Influence of land use and that of selected socio-economic factors on the spatial differentiation of population growth in the Polish Carpathians. *Folia Geographica: Series Geographica-Oeconomica* 21, 25–40 (in Polish with an English summary).
- Gutkowski, R.M. (Ed.), 1997. *Restoration of Forests: Environmental Challenges in Central & Eastern Europe*. Kluwer Academic Publishers, Dordrecht.
- Hamor, F.D., 1998. Regional aspects for the introduction of a sustainable development strategy. In: Hamor, F.D. (Ed.), *Issues of Sustainable Development in the Carpathian Region*. Open, Rakhiv, pp. 44–49.
- Hanouskova, I., O'Sullivan, P.E., Witkowski, Z., 1999. Perspectives in the sustainable land use of marginal areas: land abandonment and restoration. In: Farina, A. (Ed.), *Perspectives in Ecology*. Leiden: Backhys, pp. 295–308.
- Ioras, I.F., 2000. The impacts of livestock grazing on plant communities and soil structure on semi-natural Norway spruce stands in the Piatra Craiului Massif. Ph.D. Thesis. Forest Products Research Centre Faculty of Technology, Buckinghamshire Chilterns University College/Brunel University.
- Irimie, C., Dunare, N., Petrescu, P. (Eds.), 1985. *Margineni Sibiului: Civilizatie si Cultura Populara Romaneasca*. Editura Stiintifica si Enciclopedica, Bucharest.
- Krzemien, K., Libelt, P., Macka, T., 1995. Geomorphological conditions of the timberline in the Western Tatra Mountains. In: Heikkinen, O., Obrebska-Starkel, B., Tuhkanen, S. (Eds.), *Environmental Aspects of the Timberline in Finland and the Polish Carpathians*. *Zeszyty Naukowe Uniwersytetu Jagiellonskiego, Prace Geograficzne (Krakow)* 98.
- Kurek, W., 1996. Agriculture versus tourism in the rural areas of the Polish Carpathians. *GeoJournal* 38, 191–196.
- Langer, A., 1990. *Ecological Bricks for our Common House in Europe: Global Challenges Network*. Verlag fur Politische Okologie, Munich.
- Mac, I., 1993. The mining on Toroioaga Massif and its impact upon environment. In: Muica, C., Turnock, D. (Eds.), *Geography and Conservation*. International Geographical Seminars, Vol. 1. Geography Institute, Bucharest, pp. 88–92.
- Milescu, I., 1990. *Padurile si omenirea*. Ed. Ceres, Bucharest.
- Muica, C., Balteanu, D., 1995. Relations between landslide dynamics and plant cover in the Buzau Subcarpathians. *Revue Roumaine de Geographie* 39, 41–47.
- Muica, C., Zavoianu, I., Muica, N., 1993. Landscape changes on the Buzau Subcarpathians. In: Muica, C., Turnock, D. (Eds.), *Geography and Conservation*. International Geographical Seminars, Vol. 1. Geography Institute, Bucharest, pp. 136–142.
- Muica, N., Turnock, D., Urucu, V., 2001. Coping strategies in rural areas of the Buzau Subcarpathians. *GeoJournal* 50, 157–172.
- Nefedova, T., 1992. Use of environment and resultant problems in Central & Eastern Europe. In: Jordan, P. (Ed.), *Atlas Ost- und Sudosteuropa*. Österreichisches Ost- und Sudosteuropa-Institut, Vienna, 1.2-G4.
- Nowicki, P., 1998. *The Green Backbone of Central and Eastern Europe*. European Centre for Nature Conservation, Tilburg.
- Olaru, M., 1995. *Muntii Banatului: Resursele Turistice Naturale si Antropice*. Editura Hestia, Timisoara.
- Oszlanyi, J., 1997. Forest health and environmental pollution in Slovakia. *Environmental Pollution* 98, 389–392.
- Palaseanu, M., 2000. Studies of heavy metal contamination in soils from Baia Mare city, northern Romania. Master's Thesis. University of South Florida Dept. of Environment Science and Policy, Tampa.
- Perzanowski, K., 1999. Long term ecological research in the Bieszczady Mountains. In: Bijok, P., Prus, M. (Eds.), *Long Term Ecological Research: Examples Methods and Perspectives for Central Europe: Proceedings of the ILTER Regional Workshop, Madralin*. International Centre of Ecology, Polish Academy of Sciences, Warsaw, pp. 131–135.
- Petrescu-Burloiu, I., 1978. *Subcarpatii Buzaului: Relatii Om-natura*. Editura Litera, Bucharest.
- Pietrzak, M., 1998. Development of settlement and farming from the Neolithic period to date in the marginal zone of the Carpathian Foothills between the Raba and Uszwica rivers. In: Chelmicki, W. (Ed.), *The Carpathian Foothills Marginal Zone*. Jagiellonian University Geography Institute, Prace Geograficzne (Krakow) 103, 15–44.

- Pine, F., 1993. The cows and the pigs are his, the eggs are mine: women's domestic economy and entrepreneurial activity in rural Poland. In: Hann, C.M. (Ed.), *Socialism: Ideals, Ideologies and Local Practice*. Routledge, London, pp. 227–242.
- Pop, G.P., 1996. *Romania: Geografie Hidroenergetica*. Presa Universitara Clujeana, Cluj-Napoca.
- Povara, R., Mateescu, E., Oprisescu, R., 1999. Researches on the climatic elements with significant impact in the regeneration and evolution of forest ecosystems in the Banat Mountains. In: Gruia, C., et al. (Eds.), *Proceedings of the Regional Conference of Geography: Danube-Cris-Mures-Tisa Euroregion—Goeconomical Space of Sustainable Development*. West University of Timisoara, Timisoara, pp. 157–164.
- Promberger, C., et al., 1999. *Carpathian Large Carnivore Project Annual Report 1998–1999*. CLCP, Brasov.
- Rey, R., 1995. La cooperation internationale—bilan et perspectives: un exemple de cooperation—les Carpates: Montagnes d'Europe—Nouvelles Cooperations Pour un Developpement Durable: Conference Internationale Organisee par Euromontana a Cracovie, Euromontana Edition. Euromontana, Paris, pp. 97–105.
- Serban, R., 1993. Impactul uzinei 'Ampellum' Zlatna asupra calitatii aerului: present si perspective. *Mediul Inconjurator* 4 (1), 41–48.
- Slee, B., 1999. A tourism development plan for the Stuzhytsa-Ushanski Park, Ukraine. University of Aberdeen Department of Agriculture, Aberdeen.
- Sparchez, Z., et al., 1977. Necesitatea declararii jnepenisurilor din Carpatii Romaniei ca monument ale naturii a administratia organelor silvice. *Ocotirea Naturii Maramuresene*, Academia RSR Edition. Academia RSR, Cluj-Napoca, pp. 226–240.
- Staddon, C., 2001. Restructuring the Bulgarian wood-processing sector: linkages between resource exploitation, capital accumulation and redevelopment in a postcommunist locality. *Environment & Planning A* 33.
- Stanciu, E., 1998. Retezat National Park: Short Presentation. Romsilva, Deva.
- Stanescu, V., 1996. Observatii si propuneri privind doboraturile de vant din padurile judetului covasna. *Revista de Silvicultura a Sud-Estului Transilvaniei* 1 (1), 4–6.
- Stoiculescu, C.D., 1990. Influenta exercitata de pasunat asupea radacinilor de gorun. *Revista Padurilor* 105, 127–128.
- Stoiko, S.M., et al., 1997. Rare Phytocoenoses [Plant Communities] of the Western Regions of Ukraine Regional Green Book. Polli, Lviv (in Ukrainian).
- Suli-Zakar, I., 1999. Socio-geographical transition in the rural areas of the Carpathian Euroregion. *GeoJournal* 46, 193–197.
- Surd, V., 1988. Tourist monograph of the Carpathians: the Romanian Carpathians. *Zeszyty Naukowe Uniwersytetu Jagiellonskiego, Prace Geograficzne* Krakow, Zeszyty, 74.
- Surdeanu, V., Ichim, I., 1991. Alunecurile de teren din bazinele subcarpatice ale riurilor Rimnicu Sarat si Rimna ca surse de aluviuni. *Terra* 23 (2–4), 33–35.
- Tirczka, I., Ferencsik, I., 1998. Establishment of crop production database for natural regions and its role in cropping. *Landscape & Urban Planning* 41, 99–105.
- Turnock, D., 1991. Forest exploitation and its impact on transport and settlement in the Romanian Carpathians. *Journal of Transport History* 12, 37–60.
- Turnock, D., 1997. The Romanian Carpathians in Transition: Human Resources and Development Potential in the Context of National Demographic Trends. University of Leicester Faculty of Social Sciences Discussion Papers in Geography G97/1, Leicester.
- Turnock, D., 1998. Human resources for regional development in the Romanian Carpathians. In: Heller, W. (Ed.), *Romania: Migration Socio-economic Transformation and Perspectives of Regional Development*. Sudosteuropa Studien, Vol. 62. Sudosteuropa-Gesellschaft, Munchen, pp. 90–115.
- Turnock, D., GFG Members, 1980. The Human Geography of the Romanian Carpathians. Geographical Field Group, Nottingham.
- Varga, Z., 1996. Changes in Hungary's agrarian sector with special reference to the northern hill region. *GeoJournal* 38, 137–149.
- Varga, Z., 1999. The Hungarian diversification strategy: constraints and opportunities. *GeoJournal* 46, 215–219.
- Vasile, I., 1998. Geographical distribution of the drying phenomenon in Romania's forests. In: Erdeli, G., Dumbraveanu, D. (Eds.), *Romanian-British Geographical Exchanges: Proceedings of the Third Romanian-British Colloquium*. Corint, Bucharest, pp. 199–203.
- Voloscuk, I., 1998. Ecological stability in the Tatra Mountains forests. *Ecology* 17, 39–48.
- Witkowski, Z., 1998. The Carpathian mountain range as an ecological system within the Pan-European Ecological Network. In: Nowicki, P. (Ed.), *The Green Backbone of Central and Eastern Europe*. European Centre for Nature Conservation, Tilburg, pp. 161–73.
- World Wildlife Fund for Nature, 2000a. The Carpathians: Final Reconnaissance Report. WWF, Vienna.
- World Wildlife Fund for Nature, 2000b. The Carpathian Ecoregion Initiative: Ecoregion-Based Conservation: Working Strategy for Phase Two. WWF, Vienna.