Biodiversity and Conservation **14:** 1641–1661, 2005.
DOI 10.1007/s10531-004-0536-z

Towards sustainable land use: identifying and managing the conflicts between human activities and biodiversity conservation in Europe

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Received 10 June 2003; accepted in revised form 26 January 2004

Key words: Biodiversity, Conflict, Conflict management, Conservation, Participation, Stakeholder, Sustainable development

Abstract. Conflicts between biodiversity conservation and human activities are becoming increasingly apparent in all European landscapes. The intensification of agricultural and silvicultural practices, land abandonment and other land uses such as recreation and hunting are all potential threats to biodiversity that can lead to conflicts between stakeholder livelihoods and biodiversity conservation. To address the global decline in biodiversity there is, therefore, a need to identify the drivers responsible for conflicts between human activities and the conservation of European biodiversity and to promote the management of these conflicts. Here, the drivers of biodiversity conflicts are analysed in a European context for five habitat types: agricultural landscapes, forests, grasslands, uplands and freshwater habitats. A multi-disciplinary approach to conflict management is described, with active stakeholder involvement at every stage of conflict identification and management as well as a range of other approaches including stakeholder dialogue and education, consumer education, improvement of political and legislative frameworks, financial incentives, and planning infrastructure.

Introduction

Human activities can, in many ecosystems, be beneficial to biodiversity. In grasslands and agricultural landscapes for example, low-intensity management can lead to high densities of species (Bignal and McCracken 1996, 2000; Farina 1997; Pain and Pienkowski 1997b; Blanco et al. 1998; McCracken and Bignal 1998; Robinson et al. 2001). In Europe, the evolution and maintenance of the biodiversity of many ecosystems depends directly on traditional types of land use (Mühlenberg and Slowik 1997; Dömpke and Succow 1998). However, there is increasing evidence of a global decline in biodiversity (Myers 1993; Pimm and Raven 2000; Myers and Knoll 2001; Novacek and Cleland 2001; Brooks et al. 2002; Singh 2002). Although many factors are responsible for this decline, the root cause is invariably some form

of human activity, mainly associated with changes in land use. To address the global decline in biodiversity there is, therefore, a need to identify the drivers leading to conflicts between human activities and the conservation of biodiversity, and to promote the management of these conflicts.

This paper is a review of the main conclusions from a multidisciplinary project to identify and analyse conflicts occurring between human activities and biodiversity conservation in Europe in five broad habitat types: agricultural landscapes, forests, grasslands, uplands and freshwater habitats. This paper will primarily examine circumstances where human activities (mostly geared towards economic growth) clash with the conservation of certain aspects of biodiversity, focussing primarily on the drivers behind the conflicts, that is, influences common to a few or all habitats, rather than the conflicts themselves. These drivers include agricultural and forest policies, EU environmental Directives and other land uses such as recreation activities. The term 'conflict' used throughout this paper will refer to the situations where people deliberately, with or without knowledge of the consequences of their actions, destroy biodiversity particularly when to do so has a perceived positive impact on their livelihoods. Although the concept of latent conflicts is recognised, it will not be specifically addressed in this paper. A generic approach to conflict management will be identified in this paper, but it is acknowledged that all conflicts have to be dealt with in a unique manner, according to the species, habitats, people and cultures involved.

The first part of the paper will identify human-related drivers of biodiversity change in Europe, which can lead to conflicts between biodiversity conservation and stakeholders. We will then identify approaches to conflict management, with an emphasis on inclusionary stakeholder networks and a range of approaches towards sustainable land use.

Drivers of biodiversity change in Europe

Agricultural policy drivers

Due to geographical, historical and political factors, major land use changes have resulted in a very heterogeneous landscape with large differences between European countries (see Table 1).

Agriculture including arable land and permanent grassland is one of the most important forms of land use, covering about 43% (137 million ha) of the European Union, with 12 million or more people depending on agriculture directly (Potter 1997). The European Union's Common Agricultural Policy (CAP), set up in 1962 to deal with food shortages following the Second World War, is now the main policy driver behind conflicts between agricultural practices and biodiversity. The CAP initially aimed to increase productivity and provide more food at a lower cost for EU countries, while also achieving a fair standard of living for farmers. This was achieved through stabilisation of markets (through a single market with common prices) and a more autonomous approach with less reliance on imports

Table 1. Evolution of land use in Europe by country, 1960–1990, as % of total country area (land and water). Source: Europe's Environment Statistical Compendium (1995).

Land use	Arable and permanent crops		Permanent meadow and pasture		Wooded area		Other land uses	
Country/year	1960	1990	1960	1990	1960	1990	1960	1990
Austria	20.9	17.9	27.4	23.8	37.5	38.5	12.9	18.4
Belgium	29.9	25.7	25.2	19.0	19.7	20.2	24.3	34.3
CSFR (former)	42.4	39.8	14.5	12.8	34.4	36.1	6.9	9.2
Cyprus	17.2	17.0	0.5	0.5	13.3	13.3	68.9	69.1
Denmark	65.4	59.7	8.0	5.0	10.2	11.4	14.8	22.2
Finland	7.9	7.2	0.3	0.4	64.4	68.7	17.5	13.8
France	38.8	34.8	23.8	20.6	21.1	26.9	16.1	17.5
Germany	35.7	34.8	18.6	15.7	28.6	29.1	15.3	18.2
Greece	28.0	29.6	39.5	39.8	18.7	19.8	11.4	8.4
Hungary	60.5	56.8	15.7	12.7	14.3	18.2	8.8	11.4
Iceland	0.1	0.1	22.1	22.1	1.0	1.2	74.2	74.0
Ireland	22.7	13.4	57.6	66.8	2.6	4.9	15.2	13.0
Italy	51.8	39.7	16.8	16.2	19.4	22.4	9.6	19.3
Luxembourg	29.2	22.2	24.9	26.6	33.4	34.3	12.1	16.4
Netherlands	28.4	24.4	35.6	29.4	7.4	8.0	21.6	29.1
Norway	2.6	2.7	0.5	0.3	20.4	25.7	71.2	66.0
Poland	51.7	47.1	13.3	13.0	24.8	28.0	7.7	9.3
Portugal	32.9	34.3	9.1	9.1	32.1	32.1	25.5	24.0
Spain	41.1	40.0	24.8	20.4	25.6	31.3	7.6	7.3
Sweden	7.9	6.3	1.5	1.2	61.4	62.3	20.6	21.6
Switzerland	10.2	10.0	42.2	39.0	23.8	25.5	20.5	21.9
Turkey	32.2	35.5	14.5	10.9	25.8	25.9	26.0	26.4
United Kingdom	29.8	27.2	51.1	45.7	7.0	9.8	10.8	16.0

and preference given to member states as well as free movement of goods. Habitat degradation or loss (Pain and Pienkowski 1997b), food overproduction, social discontent leading to rural depopulation (Comins et al. 1993; Grove and Rackham 2001) and the cost associated with the accession of a further 10 countries to the EU in 2004 all led to pressure for the reform of the CAP (Bignal 1999).

Starting in the mid-1980s, pressure has been increasing to redirect money away from direct subsidies for production and into environmental protection and rural development and this trend is likely to continue for the foreseeable future. As early as 1985, and then with the reform of the CAP in 1992, a combination of environmental and income policies including agri-environmental measures (under Regulation 2078/92 and later under Rural Development Regulation 1257/99) such as the Environmentally Sensitive Areas Scheme and the Countryside Stewardship Scheme were introduced to protect and enhance habitats and landscapes valuable to biodiversity by providing financial incentives to farmers. Despite great variations between EU member states, agri-environment schemes now cover a total of 20% (27 million ha) of the agricultural land in the EU (European Commission 1998) but

only receive about 4% (1.7 billion euros) of the European Agricultural Guidance and Guarantee Fund (Donald et al. 2002).

Although the agri-environment scheme in the UK, for example, has been successful in terms of biodiversity (Carey et al. 2002; Evans 1997; Hanley et al. 1999; Hodge and McNally 1998; Wakeham-Dawson and Aebischer 1998), the schemes have been found to have certain limitations (Morris and Young 1997). At present, only a relatively small proportion of farms are adopting the scheme and a 'halo effect' is occurring where small parts of the farm are functioning under the scheme while the majority still remain intensively farmed, thereby restricting the development of wildlife corridors and other potential benefits (Hanley et al. 1999). The schemes are still under-funded compared to other farm support systems, and are voluntary, which implies that farmers will need extra incentives to adopt them (Pain and Pienkowski 1997a). Another major problem is that although agri-environmental contracts can range from 5 to 20 years, the farmers can adopt any kind of farming practice once the contract is over, thereby potentially annulling all ecological benefits accrued during the contract period (Hanley et al. 1999). Similar conditions apply in most other EU countries (Akademie für Natur- und Umweltschutz 1993; Mühlenberg and Slowik 1997). Since there is little evidence that the agri-environmental approach has been consistently successful throughout Europe and removal of direct production subsidies has a big potential to adversely impact on smaller, often biodiversity richer, farms throughout Europe, it is unclear whether this approach, as currently applied, will have the desired effects or not.

Enlargement of the EU with 10 Central and East European Countries (CEEC) and three Mediterranean countries joining will increase the agricultural area by 40% and will bring many areas rich in biodiversity under EU legislation. In its current form, it is likely that the CAP could result in huge biodiversity loss. Nine of the 10 CEEC plan to implement pilot agri-environment schemes under the pre-accession Special Assistance Programme for Agriculture and Rural Development (SAPARD) that aims to align accession countries with EU agriculture. However, funding for these schemes is limited, ranging from 1 to 5% of total SAPARD funding (Petersen 2003). To give an example, of the 7.05 million hectares (12.3% of agricultural land) of biodiversity-rich semi-natural grasslands in the 10 CEEC, only 0.1–0.3 million ha would be covered by agri-environment schemes under SAPARD.

It seems highly unlikely, if financially possible at all, that the CEEC will receive the same subsidies as those received by the present member states of the EU. This implies that, unless the subsidies they receive are shifted radically and immediately towards agri-environment schemes, the CEEC will receive a low amount of money for implementing these schemes and run the risk of either returning to an intensive form of agriculture on the one hand and the abandonment of traditional low-intensity agriculture on marginal land (Kapfer 1993b) on the other hand, thus threatening the high biodiversity habitats of the CEEC.

Table 2 summarises the impact of past and future developments in agricultural policy on biodiversity.

Table 2. Summary table providing indication of whether past and future developments in agricultural policy are considered to be positive, negative, or neutral in terms of biodiversity impact. +++ very positive impacts; ++ positive; -/+ neutral; – negative; — very negative.

	Agricultural policy issues					
	Intensification		Extensification		Abandonment	
	Past	Future	Past	Future	Past	Future
Agricultural landscapes	—	–	-/+	-/+	-/+	-/+
Grassland	—	—	++	++	–	—
Uplands	–	—	–	—	—	—
Freshwater	—	—	++	+++	++	++
Forests	NA	NA	-/+	-/+	++	++

Forest policy drivers

Total forested areas in Europe (including the Russian Federation) cover approximately 2,260 million ha of total area Europe (including the Russian Federation) has, of which 1007 million ha of natural forest and 32 million ha of plantations (FAO 2001). Conflicts with protection of forest biodiversity in Europe are mostly due to changing demands concerning forests and forestry.

Major conflicts can be linked to overall changes in forest management, such as changes in ownership patterns, transportation systems or even changes in planning strategies. Silvicultural systems have also changed significantly with intensive harvesting methods, the shortening of crop rotation times, plantation forestry (often using exotic species) and the increased use of biocides. As with agriculture, technological advances have also been instrumental in enabling a wider use of machinery for timber harvesting, and the development of new infrastructures such as roads for easier transportation of timber. This intensification of forestry practices and the increasingly multi-purpose role of forests have all contributed to a number of initiatives to better understand the status of forests in Europe, their threats and priorities in conservation. Examples include the work programme on Forest Biological Diversity at the sixth Conference of the Parties in The Hague in 2002 and the work undertaken by the Ministerial Conference on the Protection of Forests in Europe (MCPFE).

Although the Treaties of the European Union make no provision for a comprehensive common forestry policy, the management, conservation, and sustainable development of forests are nevertheless vital concerns of existing common policies such as the Common Agricultural Policy and rural development, environment, trade, internal market, research, industry, development cooperation, and energy policies. Forests are also a component of specific environmental issues such as the EU Biodiversity Strategy, Natura 2000, and the implementation of the Climate Change Convention. Accordingly, several Directives and Regulations have been established. Most recently, a new Regulation has been proposed establishing an expanded Community monitoring scheme ‘Forest Focus’. This will include a continued monitoring of forest condition in response to the United Nations

Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution and information about forest fires but also address new issues such as forest biodiversity. Unsurprisingly, these policy developments relating to forestry have a major impact on the exploitation of forest resources, and therefore also on conflicts related to forest biodiversity.

It is difficult to assess how the European developments described above have impacted on the frequency and type of forest-related conflicts. In addition to the European level agreements, important drivers of forest policy at the national and regional scale are public criticism of forest management and its ecological consequences. At the national level, many European countries have expanded their forest-related legislation to integrate various uses of forests.

Voluntary commitments to produce environmentally friendly wood products are becoming increasingly important. The importance of so-called 'market pressure', that is, consumers demanding changes in forest management by using their consumer power in selecting the most environmentally friendly products, cannot be overlooked. However, there are contradictory views about whether 'market pressure' is exerted by ordinary consumers demanding wood products from forests treated with environmentally friendly logging methods or created by vocal and strong environmental groups acting as 'representatives' of consumers. The same environmental groups are often parties in forest conflicts. This pressure has been influential in a number of companies like the furniture business and newspaper groups introducing environmental standards (eco-labelling) of their forest based products. Forest certification has evolved since late 1980s and now covers substantial areas of European production forests. Forest certification involves a certifier (third-party inspector) giving a forest enterprise a written assurance that the quality of forest management practised by the enterprise conforms to specified standards. In Europe, several certification systems exist, for example the Pan-European Forest Certification (PEFC), the Forest Stewardship Council (FSC), and systems based upon ISO Environmental Management System standards.

EU Directive drivers

The Directive on the Conservation of Wild Birds (79/419/EEC), also referred to as the Birds Directive, aims to maintain populations of naturally occurring wild birds, to regulate trade in birds, to limit hunting to species able to sustain exploitation, and to prohibit certain methods of capture and killing. The Directive also requires Member States to conserve the habitat of certain listed threatened species through the designation of Special Protection Areas (SPA). Although the directives provide protection for bird species and their habitat, they can also be at the root of conflicts between birds and human activities. A few examples include the reintroduction to Scotland of the white-tailed eagle (*Haliaeetus albicilla*), listed in Annex I of the Birds Directive, which has sparked off a conflict with farmers who claim that the eagles are responsible for a significant number of lamb deaths (Mick Marquiss, personal communication). A more widespread and acrimonious conflict exists

between fishermen and conservationists regarding the great cormorant (*Phalocrocorax carbo sinensis*), also listed under Annex I of the Birds Directive. This protected species has increased in numbers over recent decades (Lindell et al. 1995), worrying recreational and commercial fishermen who believe fish numbers and catches to be decreasing as a consequence.

The Directive on the conservation of natural and semi-natural habitats and of wild flora and fauna (92/43/EEC), referred to as the Habitats Directive, aims to conserve fauna, flora and natural habitats of EU importance. This is done through the Natura 2000 network, designed to be 'a coherent European ecological network of special areas of conservation' encompassing Special Areas of Conservation and the Special Protection Areas designated under the Birds Directive, and ultimately aiming to maintain distribution and abundance of threatened species and habitats. As in the case of the Bird Directive, this policy that aims to conserve biodiversity can also be the root cause of many conflicts. In the Vosges region of northeastern France, for example, the proposal for a Natura 2000 site extending over already protected core areas as well as fragmented patches of chalk grasslands forming interstitial habitats between vineyards and secondary habitats sparked off opposition from local wine producers (Alard et al. 2002). These interstitial areas are the most productive in terms of wine making and many local stakeholders regard the Natura 2000 designation in an area that is already protected to a certain degree as 'extremist'.

The Directive Establishing a Framework for Community Action in the Field of Water Policy (2000/60/EC), or the 'Water Framework Directive', aims to create a unified and integrated approach to improving and maintaining water quality throughout Europe. It brings together the aims of several previous Directives addressing specific aspects of water quality, and expands the conception of water quality from chemical content to one that also embraces ecological characteristics. Two particularly significant aspects of the Water Framework Directive are the emphasis on integrated river basin management, rather than treating rivers, groundwater, lakes and estuaries independently; and the explicit statement that Member States must encourage 'the active involvement of all interested parties' in the implementation of the Directive (Article 14). In combination, these two aspects have been taken as an indication that the Directive requires an approach to planning which will involve stakeholders in the production of the integrated River Basin Management Plan, in which specific actions for each River Basin District will be set out. As such, conflicts between, for example, conservation groups and those whose actions have an impact on water quality, will need to be addressed in developing the plan. As the 'Programme of Measures' to be determined in each of these plans will not enter into force until 2012, it will be some time before the impacts of the Water Framework Directive can be properly examined.

Recreation and hunting drivers

Globally, tourism, and more recently eco-tourism, is a fast growing economic sector due to the fact that, now more than ever, European societies can afford to

spend more time and money on leisure activities. These activities require space and infrastructures, forcing habitats to become increasingly more multi purpose to cater for the recreational needs of citizens. Although the rise in visitor numbers can be highly beneficial in terms of biodiversity awareness and conservation, it also create conflicts with biodiversity. While most recreational impacts may be of minor long-term significance, some recreational developments especially those with associated infrastructure, for example, skiing developments (including the creation of ski lifts, snow cannons, large networks of roads, car parks and housing), may have severe and lasting impacts on biodiversity such as increased risks of floods and erosion, pollution, loss of vegetation, and abandonment of agricultural practices in the area (McGowan et al. 1999).

Activities such as large-scale habitat management for hunting can also have an important impact on biodiversity. The managed heather moorlands of northern England and Scotland are such examples. As with most activities, the impact on biodiversity is not clear-cut. On the one hand, grouse management leads to the conservation of heather moorlands (Robertson et al. 2001), which have in the past been threatened by conversion into grasslands and afforestation (Grant and Hunter 1971). On the other hand, management involves rotational burning that can cause severe and permanent damage to blanket bog, wet heath, and peat soils. Furthermore, the illegal killing of birds of prey which are perceived to cause economic losses to game managers can lead to conflicts with conservationists (Green and Etheridge 1999).

Impacts of major drivers on habitats

Impact on agricultural landscapes

A number of studies have shown that agricultural landscapes can potentially offer a range of ecological conditions suitable for biodiversity (Bignal and McCracken 1996; Farina 1997; Blanco et al. 1998; Robinson et al. 2001). Open habitats, such as heath, scrub, dry calcareous grasslands, dry siliceous grasslands, humid grasslands, and mesotrophic grasslands, are particularly rich habitats in terms of plant species (Thomas et al. 1995), invertebrates (Drake 1988; Willems 1990), and vertebrate species (Stanners and Bourdeau 1995; Benstead et al. 1997).

Intensive agriculture, however, is less conducive to biodiversity. Availability of artificial fertiliser, technological advances in machinery and policy-driven intensification of agriculture have all contributed to the advent of the modern form of agriculture characterised by a minimal input of labour, highly mechanised production, and the clearance of large areas with resulting loss of biodiversity (Krebs et al. 1999; Luedecke and Reusswig 1999; Stoate and Boatman 2001). A wide range of species is affected by this intensification of agriculture, especially ancient weeds. Over 400 species of vascular plants in Germany have declined because of habitat loss or fragmentation due to agricultural intensification (Agra-Europe 1991). In the

UK, there has been a greater decrease in plant diversity in arable habitats than any other habitat (Rich and Woodruff 1996). Farmland invertebrates have also suffered, with total insect abundance, including moths, butterflies, sawflies, spiders, parasitoid wasps, and aphids decreasing (Donald 1998). This trend also affects many populations of farmland birds (Siriwardena et al. 1998; Krebs et al. 1999; Robinson and Sutherland 2002), with an estimated 42% of declining species affected by agricultural intensification (Tucker and Heath 1994).

From the 1960s onwards, intensification was associated with an increasing use of extensive monocultures of crops and the adoption of more productive varieties of cultivated plants that were more susceptible to diseases which in turn require large-scale pesticide treatment. These chemicals caused the decline of species especially those higher up in the food chain such as raptors (Conrad 1977; Rüger and Neumann 1982). With the replacement of particularly harmful pesticides with more 'benign' ones, some of these species have started to recover, such as the peregrine falcon (*Falco peregrinus*) (Cade et al. 1988). Nevertheless, agro-chemicals still threaten sensitive species, such as amphibians (Schneeweiss and Schneeweiss 1997). Likewise, with the adoption of more productive varieties of cultivated plants, many local varieties were lost. The loss of this genetic diversity is a major concern not only for the conservation of biodiversity but also for the sustainability of food production.

Entire agricultural landscapes have been radically changed through the removal of woodlands, hedges, and alley trees or fruit trees on tracks, and the conversion of natural ecosystems into fields and intensively used pastures. The mechanisation and modernisation of agriculture to produce more for a growing urban society has gradually led to removal of hedges to enable large-scale monocultures to develop. In addition, modern methods of keeping animals such as barbed wire and electric fences have contributed to the demise of hedges. The result was that in less than a century, over 65% of all hedges in France for example had been removed (or 3.2 million km) with an average of 4% a year still being unearthed (Pointereau and Bazile 1995) despite their important roles in controlling physical, chemical, and biological fluxes (Baudry et al. 2000) and their high biodiversity value (Ouin and Burel 2002; Russ and Montgomery 2002; Tattersall et al. 2002).

Elsewhere in Europe, agricultural land is increasingly being abandoned, especially when the landowners find themselves unable to make a living from farming alone. Abandonment of agro-ecosystems (with associated afforestation) can increase the risk of forest fires (Goldamer 2001; Moreira et al. 2001) and the possible loss of biodiversity (Hansson 2001). In North Savo (Finland), for example, abandonment of agro-ecosystems has resulted in a decline in open space species such as the grey partridge (*Perdrix perdrix*), the corncrake (*Crex crex*), butterfly species and vascular plants associated with arable farming (MacDonald et al. 2000). In Germany, most structurally diverse vineyards on steep slopes have been abandoned due to high labour costs resulting in a strong decline of xerothermic species such as the butterfly *Iphiclides podalirius* or the common wall lizard (*Podarcis muralis*) (Henle et al. 1999).

Impacts on grasslands

Loss of grassland habitats is a major concern for biodiversity conservation. The drainage of wet grasslands like the Marais Poitevin area (western France) for example, has caused permanent grasslands to decrease from 63,770 ha in 1979 to only 28,540 ha in 1994 (Simon 1998). This has led to a significant decrease in the number of wading birds, especially pintail (*Anas acuta*), mallard (*A. platyrhynchos*), teal (*A. crecca*), shoveler (*A. clypeata*), and gadwall (*A. strepera*) (Duncan et al. 1999). Other grassland habitats like juniper heaths in southern Germany have seen a 48–87% decrease (Kapfer 1993a). Similarly, 40% of lowland heaths in southern and eastern Britain have decreased due to afforestation and agricultural conversion since the 1950s, with only 31,000 ha left in England (Farrell 1993).

Species have had to adapt to these changed landscapes and many endangered and threatened species in Europe now depend on the diminishing areas of traditional forms of agriculture (Sukopp et al. 1978; Kaule 1991). Semi-natural grasslands, for example, require regular management in order to maintain their high biodiversity. Grassland reduction to only 5.7 million ha in Europe (Stanners and Bourdeau 1995) has resulted in the decline of species like the corncrake (*Crex crex*), dependent on hay meadows (Green and Stowe 1993), the redshank (*Tringa tringa*), and the snipe (*Gallinago gallinago*) declining due to the amelioration of wet grasslands (Binot-Hafke et al. 2000) and the lapwing (*Vanellus vanellus*) declining due to grassland loss and increased stocking densities (Shrubb 1990).

Impact on upland habitats

Biodiversity in the uplands is intimately linked to farming systems and is dependent on sensitive management, especially environmentally sustainable levels of grazing by sheep and cattle and associated management practices such as mowing, burning and shepherding. The CAP has played a major role in defining the current status of agriculture in upland areas of Europe. The financial incentives provided by the CAP for sheep and cattle production have been responsible for increased stocking densities, other intensive farming practices, specialisation, and a move away from mixed farming. Despite these financial incentives, the number of people employed in upland agriculture has decreased substantially with a corresponding decline in labour-intensive management practices. There is now a real crisis in the industry with upland farmers struggling hard to retain viable businesses. While ‘abandonment’ of land is becoming an increasingly common occurrence in mainland Europe, intensive livestock production and overgrazing is still a serious environmental issue and can result in a direct loss of habitats, soil compaction, and eutrophication.

Impact on freshwater habitats

Throughout most of Europe nitrogen input and generally the input of agro-chemicals creates one of the most important conflicts associated with the

intensification of agriculture. In central Europe, for example, the input of fertiliser has increased exponentially throughout the last 100 years leading to a surplus of 40 to $\geq$150 N per ha of agricultural production land in most parts of Germany (Ellenberg 1991). Resulting surface runoff of fertilisers, pesticides, and other biocides leads to nutrient enrichment, or eutrophication, and contamination of grassland, wetland, and forest habitats. Increased stocking densities can also lead to soil compaction and eutrophication. All these threats can lead to various degrees of habitat alteration, degradation, or destruction with subsequent effects on biodiversity. In nutrient rich systems, a small number of plant species usually dominates, and the majority of plant species of central Europe prefer nutrient poor conditions (Ellenberg 1985, 1991). As a consequence habitats on nutrient poor soils and species depending on such habitats belong to the most threatened components of biodiversity in central Europe (Ellenberg 1991).

Although the nitrogen and phosphorus inputs from point sources (such as power plants, sewage plants, or industrial plants) have a severe impact on freshwater environments, arable farming is the most important non-point source of water pollution in the European Union (Potter 2002), especially in western, eastern, and southern Europe. Manure and slurry are used as fertilisers, providing organic matter to the soil and thereby increasing crop yields. However, in areas where intensive pig farming takes place (e.g., Brittany in the northwest of France and north-western Germany), manure is spread in vast quantities and at concentrations higher than the soil is capable of processing. Although runoff into water bodies can be treated in various ways, and can result in a significant removal of nitrogen, other elements such as phosphorus, potassium, copper, and zinc are more difficult to remove through treatment (Daumer et al. 2001). The application of manure and slurry, especially from intensive pig and poultry farms, can therefore result in vast quantities of highly concentrated manure flowing into water systems causing eutrophication.

Turbidity due to increased algal blooms, changes in community composition and oxygen deficiency in lake bottoms and the consequent loss of biodiversity, such as bacteria, algae, protozoa or crustaceans, salmon, trout, cormorants, etc., can be the direct consequences of nutrient inputs from the catchment area, although not always from agricultural practices. For instance, in lake Baldegg, Switzerland, 80% of the lake's catchment area is used for agriculture. A shift in agricultural production, from traditional low input farming to more intensive farming as well as other factors, gradually led to eutrophication of the lake in the 1970s. Though agriculture was a component of the problem, it was by no means the only factor leading to eutrophication of the lake. A marked local population increase, inadequate sewage treatment and increased detergent use all contributed to the increase in algal blooms, fish mortality, and insect plagues.

Impacts on forest habitats

As with agriculture, the intensification of forestry practices has been responsible for a number of conflicts between biodiversity and human activities (Hellström 2001).

In 1995, forest cover was estimated at about 33%, with large differences between countries, mostly due to historical reasons (e.g., 6% in Ireland and 66% in Finland) (Stanners and Bourdeau 1995). Forests are mostly beneficial in terms of biodiversity, soil quality, water regulation and their role as wind barriers, but the intensification of forestry operations, especially in northern and western European countries can be detrimental to biodiversity. The problems associated with silvicultural intensification are very similar to those relating to agricultural intensification and can consist of shortened crop rotation times, increased transportation of wood products to industries, removal of dead wood, the use of potentially more productive exotic wood species, the use of fertilisers (especially in western and southern parts of Europe), pesticides and herbicides and the alteration of natural drainage systems. As with agricultural intensification, the intensification of forestry practices can result in loss or degradation of habitats and the loss of species (Pedrini and Sergio 2001; Andres and Ojeda 2002).

Conflict management

In this part of the paper we discuss how policy and legislation, nature protection and environmental assessments can all have an important role to play in conflict management.

People will not usually object to conserving biodiversity, providing it does not clash with personal or institutional goals. When conflicts directly affect the livelihood of stakeholders, a solution can be to conserve biodiversity while encouraging individual stakeholders' economic growth. Policy can provide such incentives for the conservation of biodiversity. However, especially in the case of conflicts with institutional interests, legal regulations may be the only option to solve conflicts. When particularly valuable habitats and species are at stake, the set-a-side of areas as protected may be the only suitable option for conflict resolution. In both cases however, the conflict may persist and require additional measures. In the case of infrastructure plans, environmental impact assessments can help solve or reduce conflicts by explicitly identifying potential conflicts and by averting negative effects by searching for alternative planning options.

Policy, incentives, and legislation

In Europe, both policies providing incentives for biodiversity conservation and Directives aiming to legislate for the conservation of biodiversity are used in attempts to reduce conflicts. The most important incentives are agri-environmental schemes that have been in place since 1985 under the Common Agricultural Policy to transfer financial incentives towards environmental measures rather than production support (Ovenden et al. 1998). These schemes can be effective ways of preventing over-production, increasing, or at least maintaining, the biodiversity of

farmland areas with less financial strain on landowners. In the UK, the Environmentally Sensitive Areas (ESA) initiatives and the Countryside Stewardship Scheme (CSS) are the most important agri-environmental schemes. A few studies have shown an increase in population numbers of sensitive species in areas covered by these schemes (Ovenden et al. 1998; Peach et al. 2001), and a higher ecological quality of land inside the CSS compared to the countryside as a whole in the UK (Carey et al. 2002). From a social perspective, these schemes have also proved successful at creating new jobs and increasing farm income (Morris and Young 1997). However, cooperation with landowners and the monitoring of biodiversity in these areas will have to be improved to evaluate the exact impact of these schemes on biodiversity as budgetary considerations are prominent for agri-environmental schemes under the Common Agricultural Policy (Potter 2002). A more cost-effective approach might be the combination of agri-environment schemes with large-scale habitat restoration projects (Sutherland 2002).

The Convention on Biological Diversity (CBD) signed at the Rio de Janeiro Earth Summit in 1992 requires states to establish national biodiversity conservation plans, use biodiversity in a sustainable manner, and set protected areas aside for the conservation of biodiversity. The EU has signed the convention and developed the European Community Biodiversity Strategy and legislation in order to implement the CBD. Important Directives include the Water Framework Directive, providing an immediate and effective response to developments threatening aquatic ecosystems, and the Natura 2000 scheme based on the Habitats and Birds Directives. Natura 2000 is often a mixed blessing, as discussed above, with the potential to both resolve nature conservation conflicts and to cause social conflicts. Practical measures implemented through the Water Framework Directive have yet to come into effect, and it is therefore too soon to evaluate the Directive's impacts on biodiversity.

Legislation can be a powerful tool in conflict management. Legislation to reduce eutrophication and to ban environmentally damaging chemicals certainly has been crucial to protect and regenerate freshwater habitats (Friese et al. 2000; Geller et al. 2000) and to save raptors and other species high up in the food chain (Conrad 1977). A further example is the Polish Mountain Bill designed to aid the development of social, economical, and agricultural activities in mountain and upland regions. Other examples are legislation tools in forest management in certain areas of Germany (Bavaria, for example) where environmental priorities are valued higher than user interests. In Finland, biodiversity has to be taken into account in forestry operations: for example, ten forest 'key habitats' must be set aside whenever encountered (Virkkala and Toivonen 1999).

A major drawback of using legislation to alleviate conflicts is the difficulty to implement or police the legislative instrument. This is particularly important in the case of environmental problems, where the offence can often be diffuse and hard to detect. The other problem is that laws are often implemented on large scales, with little or no prior consultation with stakeholders. This can lead to the laws being ignored, resisted, as well as creating antagonism amongst stakeholders.

Protected areas

When particularly valuable habitats and species are at stake, setting land aside for protection may be the only suitable option for conflict resolution. Protected areas are often designated outside the scope of Natura 2000. The other alternative to set aside land for biodiversity conservation is for Governmental or Non-Governmental Organisations (NGOs) to buy, lease or maintain buffer zones, abandoned habitats (such as grasslands or heathlands), sensitive areas, or other areas where biodiversity needs to be conserved. This is the case in the Lizard candidate Special Area of Conservation (cSAC) in Cornwall (UK), where English Nature, the National Trust and the Cornwall Wildlife Trust have all bought land. This combined ownership, knowledge and resources have proved to be an effective conservation strategy in this sensitive area. However, this option may only be possible where no other realistic option for habitat protection and management is available, or is desirable for particularly threatened and highly valued habitats. It is also important for these new landowners to ensure that the local communities and visitors to the sites continue to be effectively engaged in the decisions affecting the use and management of the land.

Environmental Assessments

Environmental Assessments (including formal Environmental Impact Assessments and Strategic Environmental Assessments) can be significant in identifying and averting negative effects of infrastructure projects and can defuse conflicts. In Estonia, for example, Environmental Assessments are compulsory for each afforestation project in order to minimise adverse effects on biodiversity in species-rich grassland habitats. Environmental Assessments usually include a description of the project and the environment, a judgement based on appropriate research as to how the project will affect the environment, and a review of alternatives. These can be highly beneficial in considering both long-term and short-term effects of the project but many aspects still need to be thought through, especially when they are applied to a pan-European scale. Other shortcomings are the financial commissioning of the Environmental Assessments, the fact that cumulative or interactive effects and effects extending beyond the planning area as well as direct effects in some cases can be particularly challenging to analyse and that subsequent management is not taken into account (Potschin and Haines-Young 2003).

Stakeholder participation

The active participation of local stakeholders and communities is essential in the decision-making and management process (Mauro and Hardison 2000). Before any dialogue and participation between stakeholders through a participatory approach can take place, relevant stakeholders have to be identified. The potential number of

stakeholders has increased in recent years due to different factors, with local participants, NGOs and the media now more actively involved. It is important to bear in mind that stakeholder representation is highly dynamic, with possible discord amongst and within groups, and shifting of stakeholders between groups. Prior histories of conflict between particular groups can further exacerbate conflicts in which they are involved. For instance, conservationists are often thought to develop management strategies that are incompatible with the local context just as local stakeholders are often perceived by conservationists as being incapable of understanding the importance of protecting biodiversity and putting up strong resistance to any proposed changes in traditional land-use practices. This is usually because the local stakeholders feel that they have no 'ownership' in the matter and that their knowledge is not taken into account. These stereotypes are critical and can negatively affect communication among groups, sometimes so much so that certain groups will face disapproval before any direct contact has taken place (Stoll-Kleemann and O'Riordan 2002).

Once the definition of the conflict has been established by the relevant stakeholders (McCool et al. 2000), communication between stakeholders has to be actively promoted (Mahanty and Russell 2002), as well as cooperation in order to work towards win-win situations. Local level planning and the improvement (or creation) of regional scale planning can be instrumental in conflict management. In grassland habitats, for example, it is impossible to plan on a purely local level, as a grassland habitat can be owned by a number of stakeholders. Multi-scale planning actively involving private landowners is crucial for biodiversity conservation in grasslands, forests and upland habitats. Cooperation between landowners and other stakeholders is best done in parallel with biodiversity assessment methods and technical planning tools.

As conflicts are becoming more global, more cooperation and wider scales will have to be considered in conflict management. One such example of a complex wide-scale conflict between biodiversity and human activities is the Baltic Sea. Untreated human waste, toxic materials, and metal (e.g., lead) pollution mostly from industries in the former Soviet Union and East bloc and agriculture in western European countries, has now affected a total of 14 countries in the catchment area, involving numerous stakeholders and impinging on a wide range of habitats and species (Breitholtz et al. 2001; Elmgren 2001; Kononen 2001; Ojaveer and Lehtonen 2001).

With many conflicts, a fundamental aspect will be to raise awareness of, and provide objective information on, the habitats or species concerned, their requirements and the measures required to conserve them as an integral part of the cultural landscape. It is undeniable that scientific research can play a significant role in conflict management. In the case of the white-tailed eagle (*Haliaeetus albicilla*) conflict in Scotland, research has quantified the impact of white-tailed eagles on lamb mortality (Marquiss and Madders 1999) and the livelihoods of local farmers. However, better communication of scientific results to managers (Underwood 1995, 1998) and to local stakeholders, as well as research targeted to the needs of stakeholders, using methods and research groups accepted by stakeholders should

form the basis of cooperation between scientists and stakeholders. The scientific community and local communities have to understand, accept and benefit from each other's knowledge and cultural backgrounds.

Conclusions

The main threats that can lead to conflicts between human activities and biodiversity conservation are identified as (1) agricultural and silvicultural intensification or abandonment, (2) recreation and hunting activities, and (3) policy related threats, often related to points 1 and 2. These can impact in many direct or indirect ways in terms of scale and intensity on agricultural landscapes, forests, inland waters, grasslands and uplands of Europe.

The best way to resolve conflicts is to prevent them arising in the first place. In this respect, there is a need for increased understanding and raised awareness of the requirements of the habitats and species affected, and the social and cultural context of both the conflict and the options for managing it. Perceptions of potential or real conflicts can often be confused by our lack of understanding of certain components of the conflicts, such as the mechanisms and drivers of biodiversity loss and the social dynamics underlying the conflict. Neglecting certain components, like cultural differences, may be the reason behind conflicts associated with initiatives to preserve biodiversity (e.g. Natura 2000 forest certification).

Once the components of a conflict have been identified, it is essential to work in an inter-disciplinary manner, with a complete integration of social and natural elements. The interests of local stakeholders should be taken into account in all management stages and management tools should involve a range of approaches. Although generic tools for conflict management have been identified in this paper, it has to be stressed that each conflict will be different in terms of scale, culture and intensity. Therefore, management tools and information exchange will be beneficial, but will need to be adapted carefully to each conflict.

Finally, conflicts in themselves should not necessarily be regarded as negative because, if handled carefully, they can be a very productive way of highlighting problems, increasing understanding and promoting the creation of sustainable solutions. Inclusive stakeholder approaches are the most likely to lead to sustainable management of conflict providing there is early involvement of all key stakeholders, effective communication between parties, awareness raising and supported processes for their continued involvement, including feedback, monitoring and review.

Acknowledgements

The authors acknowledge the help of all BioForum participants for their expertise and support: Mihai Adamescu, Mark Andrew, Beatriz Arroyo, Jan Baan, Linas Balciauskas, Ion Barbu, Sandra Bell, Gordana Beltram, Debbie Burroughs, Craig

Campbell, Dave Carss, Jennifer Cawdron, Nesho Chipev, Alister Clunas, Paul Cobb, Linda Davies, Steven Declerck, Dessislava Dimitrova, Pavol Eliáš, John Forster, Eeva Furman, Karen Gilbert, Bernard de Galembert, Iuliana-Florentina Gheorghe, Timo Goeschl, John Goss-Custard, Lubos Halada, Maria Hardy, Lennart Hansson, Jac Hendriks, Edward Idle, Richard Jefferson, Philip Scott Jones, Tessa Jones, Gus Jones, Tatiana Kluvánková-Oravská, Marek Kopacz, Ryszard Kostuch, Tiiu Kull, Antoni Kuzniar, Jan Kvet, Endre Laczko, Tor-Bjorn Larsson, Stanislav Lazarov, Marco Lauteri, Liisa Lepistö, Saskia Ligthart, Czeslaw Lipski, Mick Marquis, Mariella Marzano, Pedro Mateus, Joan Mayol, John Miskelly, Ruth Mitchell, Robin Moritz, Robert Moss, Bernd Munier, Maarten van Nederveen, Stanislaw Niemtur, Gunilla Almered Olsson, Július Oszlányi, Ingmar Ott, Rosa Paiva, Emma Parkes, Kevin Peace, Valentina Pencheva-Cholakova, Lyubomir Penev, Vlada Peneva, Sandrine Petit, Hubert Piorkowski, Laszlo Podmaniczky, Nico Polman, Luigi Portoghesi, Isabelle Poudevigne, Diana Pound, Valerijus Rasomavicius, Felix Rauschmayer, Michael Rebane, Steve Redpath, Janny Resoort, Caspian Richards, Irene Ring, Geta Risnoveanu, Paul Rose, Christoph Scheidegger, Marek Sammul, Katerina Scharffova, Andrej Seliskar, Martin Sharman, Marinus Smulders, Daniela Soier, Reto Soliva, Alan Stevenson, Susanne Stoll-Kleemann, Urmas Tartes, Mika Tonder, Andreas Troumbis, Stanislaw Twardy, Alius Ulevicius, Yordan Uzunov, Angheluta Vadineanu, Milan Valachovic, Sybille van den Hove, Riku Varjopuro, Fiorella Villani, Frank Waetzold, Dirk Wascher, Adam Watson, Jenny Watson, Bogdan Wertz, Cynthia Whitehead, Eva Willen and Zdenka Zajickova. This paper is an output from the BioForum project: European Biodiversity Forum – Implementing the Ecosystem Approach – Project EVK2-CT-1999-2006. More information about the project can be found at www.nbu.ac.uk/bioforum

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