

# Habitat Fragmentation and Ecological Networks in Europe

*In Europe, the network Natura 2000 and other nature conservation initiatives aim at connecting habitats. The impact of existing initiatives is too low. Hence, co-ordinated activities of governments and civil society are needed. How can they be linked?*

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GAIA 14/2 (2005): 119–123

### Abstract

This article describes the status quo of habitat fragmentation and gives an introduction to nature conservation initiatives on the European scale. The main focus lies on the concepts of ecological networks and the *EU COST 341 Action (Cooperation in the field of Scientific and Technical Research)* as a programme comprising expertise on the effects of linear transportation infrastructure on habitats. The discussion of this subject is still in its infancy, as is the exchange of information which could optimize “de-fragmenting” measures. It is recommended that an international forum be established on the basis of an initiative at the European scale as a *COST Action*. Such an on-going international forum would facilitate bilateral co-operation for the designation of trans-boundary ecological corridors, which is one of the major challenges of European habitat protection.

### Keywords

biodiversity, COST 341, ecological networks, habitat fragmentation, Natura 2000, Pan-European Ecological Network, transportation infrastructure

## International Initiatives against Habitat Fragmentation

There is increasing political awareness of the urgency of measures to avoid, mitigate, and compensate for ecological losses due to habitat fragmentation. The United Nations Convention on Biological Diversity held in Rio de Janeiro in 1992 points out fragmentation by land use, including infrastructure, as a major threat to habitats and species populations. This is also reflected in the Pan-European Biological and Landscape Diversity Strategy of 1995 (Council of Europe and UNEP 1996), one section of which deals with habitat fragmentation and the possibilities of setting up a Pan-European Ecological Network (PEEN). The idea of eco-functionally connected habitats as a second priority (after the protection of prominent nature conservation sites) is incorporated in both the *EU Habitats Directive (92/43/EEC, 1992)*, which requires EU members to set up a coherent network of sites for nature protection, and in the Emerald Network. In addition to initiatives on the European level to set up an ecological network, the *EU COST 341 Action Habitat Fragmentation due to Transportation Infrastructure* was specifically dedicated to the study and review of the impacts of transportation infrastructure on ecosystems.

## Habitat Fragmentation in Europe

Between 1970 and 1996, the Trans-European Transport Network (TEN-T) almost doubled in length and now covers 1.2 percent of the land surface. This network consists of 75 000 kilometres of motorways (20 500 kilometres of which are planned) and 79 000 kilometres of conventional and high-speed railway lines (23 000 kilometres of which are planned) (De Vries and Damarad 2002). More than ten hectares are being paved in the EU every day in the course of the expansion of the TEN-T alone (figure 1).

The road network, traffic volume, and speed will keep growing in the foreseeable future. Between 1970 and 2000, the number of cars in EU15 increased from 62.5 to 175 million. The reference

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scenario that serves as a basis for the traffic policy of the European Commission (EC) predicts that the dependence on cars, distances driven, and the demand for long-distance travel will have increased greatly in 2020 in comparison to 1995. The EC assumes there will be a rise of more than 20 percent in kilometres per person. Ton-kilometres in the freight sector will rise by 40 percent until 2020 (European Commission 2001). Germany has an average of 125 cars per square kilometre on the road, Northrhine-Westphalia even 280.

Wildlife-traffic collisions are among the most obvious indicators of the conflict between transport infrastructure and nature, and their number has risen in recent years in many European countries.<sup>1</sup> No exact figures, however, are available on wildlife-traffic collisions in Europe. Human and wildlife injury and mortality and vehicle damage and the loss of working time arising from road or railway accidents incur economically significant costs. According to the Federal Statistical Office, in Germany 30 people die and more than 3 400 are injured every year in wildlife-traffic collisions. The national German organisation of insurance companies (GDV) paid 456 million Euros in compensation for damages resulting from accidents with wildlife, not including the deductible amounts paid by the insured (GDV 2003).<sup>2</sup> Public awareness of the impact of transportation infrastructure on nature is focussing on this obvious effect because it can be quan-

tified and experienced by anyone. There has as yet been no attempt in any European country to make a financial evaluation of other aspects or of the entire complex of negative external effects of habitat fragmentation on biodiversity. Only recently has the whole set of negative external effects of habitat fragmentation on the environment become the focus of various investigations considering the broader spatial, temporal and ecological context.

## Ecological Networks

Areas of conservation value are usually isolated “islands” within an intensively used cultivated landscape. “Ecological communication” between natural or semi-natural areas and between scattered sub-populations is increasingly inhibited by distance and by anthropogenic obstructions. The amount of land designated as national conservation areas is low and in most European countries does not exceed 100 hectares per unit (figure 2).

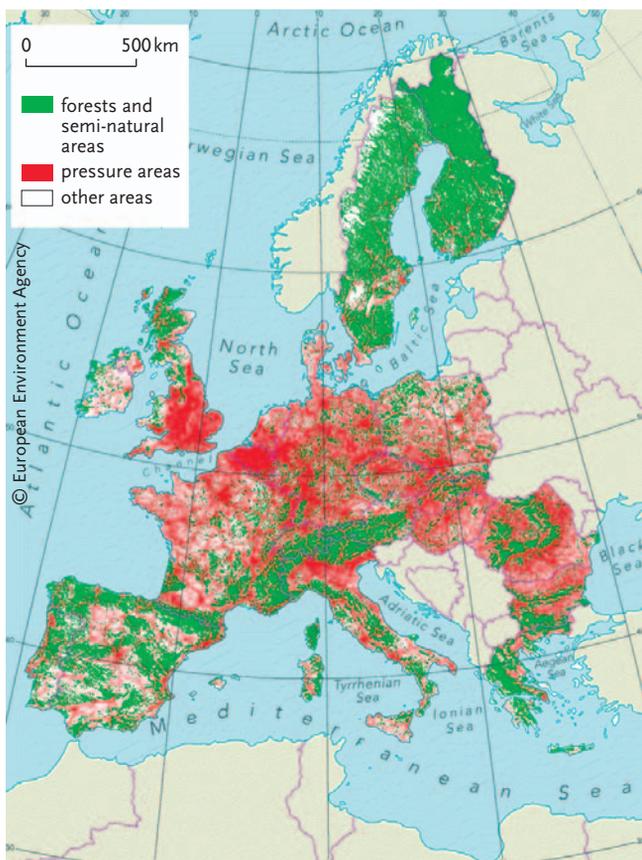
The mean distance between areas designated as biotopes under *CORINE* (EU Coordination of Information on the Environment) is around 13 kilometres, and the distance between similar biotopes is even greater (Tillmann and Bouwma 2005).

Growing awareness of the threat of habitat fragmentation for biodiversity has led to the nature conservation strategy of ecological or habitat networks (Wilcox and Murphy 1985, Fahrig and Merriam 1985). Barrier-free corridors are set up to guarantee ecological flows in the landscape. In combination with mitigating measures such as green bridges over linear transportation infrastructure, these corridors are intended to preserve or re-facilitate biological movement, ecological processes, and evolutionary adaptations in a changing landscape.

The most important part of the ecological network strategy is the conservation and restoration of corridors that (eco-)functionally and physically join habitats at local, regional, national and international levels. An ecological network usually consists of the following elements:

- core areas: comparatively large areas of biodiversity, ecosystem, and landscape conservation with a high probability of sustainable survival of local populations.
- ecological corridors: linear elements which connect the core areas and serve as migrating and dispersal routes, i. e. as stepping stones.
- buffer zones: zones around the network which protect its basic elements from external impacts and support or enlarge the ecological capacity of the network.
- zones of ecological reconstruction: areas with current low nature conservation value but with potential in the course of the rehabilitation.

Hungary, the Netherlands (see Van der Grift 2005, in this issue) and the Czech Republic were among the first countries in which this strategy was investigated and promoted in the early 1980s (Rientjes and Roumelioti 2003). Since then, ecological networks have received attention in more and more European countries



**FIGURE 1:** Pressures exerted by urban areas and transport networks on forest and semi-natural areas in EU25. Source: EEA (1999).

as a national nature conservation strategy. However, there still is great variation in the legal status of landscape planning and thus in its implementation status – not only between countries but also between different administrative units within countries.

Ecological networks not only have to be adapted to site-specific conditions, but also to the requirements of certain species and of landscape culture, and to concepts within scientific and planning traditions in different countries (Jongman, Külvik and Kristiansen 2004). Diverse concepts for ecological networks can mutually obstruct each other as they compete for funds, stem from different scientific or practical backgrounds, or focus on different species and sites. This can lead to corridor networks within administrative districts, which are not linked to the ecological corridors of the adjacent district.

Out of a total of 41 different ecological networking initiatives registered in Europe (Bennet and Wit 2001), three networks stand out:<sup>3</sup>

- The Pan-European Ecological Network (PEEN) under the aegis of the Council of Europe (CE), the United Nations Environmental Programme (UNEP) and the European Centre of Nature Conservation (ECNC). The PEEN is intended to serve as a framework for initiatives, existing agreements and programmes like the ones described below in the field of ecological networks in Europe.
- The Network *Natura 2000*, established by the *EU Habitats Directive*. *Natura 2000* comprises Special Areas of Conservation (SAC) of the *Habitats Directive* and Special Protection Areas (SPA) of the *EU Birds Directive (79/409/EEC, 1979)*. The network stipulates that the size of specific habitat types be relative to the size of the nation, aiming at the protection of prominent sites similar to the Emerald Network. However, it does not require linking corridors between SPA and SAC; it simply recommends that “ecological coherence” be established.
- The Emerald Network, also known as Network of Areas of Special Conservation Interest, was launched in 1989 by the CE. It aims at conserving important sites for nature conservation while encouraging the protection or rehabilitation of ecologi-

cal corridors between such sites. It includes sites of the *Natura 2000* network as well as sites in further central and eastern European countries.

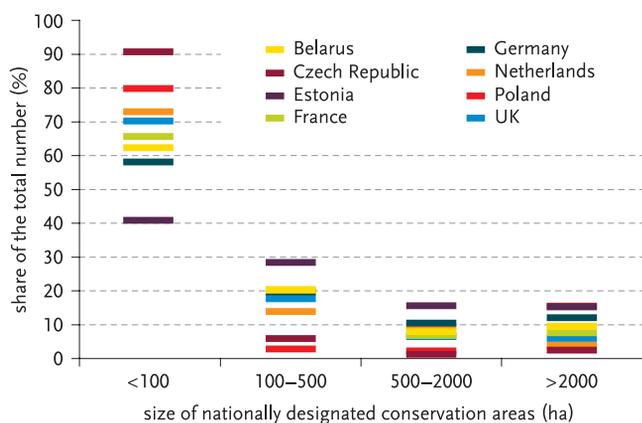
Ideally, the PEEN should integrate all networking initiatives, of which the *Natura 2000* and the Emerald Network are most prominent. In practice, the latter two programmes focus on the conservation of important habitats rather than on the large-scale networking of habitats. One promising initiative in this regard is the European Green Belt (IUCN 2004). The Green Belt is intended as continuous corridor from the Barents Sea to the Bosphorus and contains important areas for Europe’s natural and cultural heritage. The Green Belt is also a good example of the combination of segregative and integrative conservation approaches, particularly in those parts of the corridor where the continuity is disrupted. The typical biodiversity of Europe’s cultural landscapes can only be saved by the “interaction” of conservation efforts integrated in land-use systems on the one hand and the segregation of conservation lands from human impact on the other. Ecological corridors should consist of a spatial patchwork of integrated and segregated nature conservation approaches to guarantee their ecological continuity.

### ***COST 341 – Habitat Fragmentation due to Transport Infrastructure***

The first European conference on the fragmentation of habitats by linear transport infrastructure and its implications for the conservation of biodiversity was *Habitat Fragmentation, Infrastructure and the Role of Ecological Engineering*. It was held in the Netherlands in 1995, the Year of European Nature Conservation. As a result, the Infra Eco Network Europe (IENE)<sup>4</sup> was initiated. IENE is an expert group consisting of researchers, policy-makers, planners, and implementers for the discussion of the conflict between conservation of biodiversity and increasing habitat fragmentation due to transport infrastructure as well as for the exchange of information and knowledge in Europe. This led to the development of the *COST 341 Action* in 1998 (IUCN 2004). Sixteen EU countries were involved in this project, as was the European Centre for Nature Conservation as an NGO.

The main objective of *COST 341* was to promote a safe and sustainable pan-European transport infrastructure to conserve biodiversity and reduce accidents resulting in fauna casualties. *COST 341* produced the following results:

- state-of-the-art reports of twelve of the participating countries on their situation of habitat fragmentation, its impact on biodiversity and measures undertaken to avoid or mitigate it; >



**FIGURE 2:** Share of nationally designated conservation areas of a certain size in percent of their total number. Source: Tillmann and Bouwma (2005).

1 See Frank et al. (2005), as well as Jaeger and Holderegger (2005), in this issue.

2 For information on damage in British Columbia, Canada, see Sielecki (2004).

3 See Rientjes and Roumelioti (2003) for a comprehensive description.

4 For more information see [www.iene.info](http://www.iene.info).

- a state-of-the-art report (European Review) on habitat fragmentation due to linear transportation infrastructure in Europe (Trocmé et al. 2003);
- the *European handbook on habitat fragmentation due to linear transportation infrastructure* contains best practice providing methodologies, indicators, technical design, and procedures for avoidance, mitigation and compensation of adverse effects on nature (Iuell et al. 2003);
- the online-database IENE informs on European expertise and literature, and provides a glossary of terms;
- the final conference in November 2003 presented research findings in road ecology, mitigation measures, political trends, and information on ecological networks.

Only recently was *COST 350 Action Integrated Assessment of Environmental Impact of Traffic and Transport Infrastructure* initiated. Its main objective is to establish a concept to integrate all environmental aspects of traffic and land-transport infrastructure at the regional level in relation to the decision-making process. This four-year action is directly linked in content to *COST 341*. The *COST Actions* described above are a fundamental basis for the exchange and collection of information on the impact of habitat fragmentation on nature and of information on counteractive measures.

## Recommendations for Next Steps

Decision-makers differ significantly in their positions on ecological networks as a major nature conservation goal, as do national legislations. Accordingly, the incorporation of ecological networks into national or sub-national conservation strategies varies as well as the realisation of this concept in the nations of Europe.

PEEN provides only a voluntary framework for the establishment of a transboundary ecological network into which national activities could be linked and within which ecological corridors could be spatially connected. Cross-border ecological continuity is restricted by barriers that are not only spatial, psychological, and physical, but also political. Therefore it is essential that current praxis and concepts are included, discussed and evaluated in a programme like the *EU COST Actions* outlined above.

*COST 341* and *350* are important steps toward solving the problem of habitat fragmentation, but they should be integrated into a comprehensive and explicit strategy for habitat de-fragmentation. Because of the high costs of making transport infrastructure sustainable in the sense of minimising its fragmenting impact on habitats, it is essential that this be undertaken as part of a supra-regional and transnational integration of biotopes. Furthermore, economic efficiency is important, particularly in the construction of expensive green bridges. This should be possible in most cases, as local conservation efforts are understood to be part of regional measures. Any project to combine biotopes should be legally anchored in regional planning schemes. A case from Austria (Völk, Reiss-Enz, Walcher, and Schacht 2005) – as well

as other cases from other countries – shows that the purpose of green bridges can be completely defeated when such measures are not integrated in local and regional landscape planning, for example when adjacent areas are declared building land.

As a result of EU accession, the trend towards increasing habitat fragmentation is particularly acute in most of the ten new EU countries, where the size of non-fragmented land parcels still is significantly larger than in EU15. Most of those states still harbour a higher degree of semi-natural or even natural habitats and the associated biodiversity. The goal of the Trans-European Transport Infrastructure Network (TEN) is to connect all European markets and make mobility sustainable. The expected rapid extension of the transport infrastructure network and intensified land use systems will impact on some of the most pristine nature areas in Europe.

The necessity for concerted nature conservation action on the European level is demonstrated by the present implementation status of ecological networks on the one hand and by the expanding infrastructure network with its pressure on habitats and biodiversity on the other hand. An official international forum for discussion and information should be initiated immediately and maintained continuously. Participation should be obligatory for all European countries and for international NGOs and EU decision makers involved in transboundary nature conservation in

*We need an international forum to identify and conserve cross-border ecological corridors.*

order to avoid parallel efforts and confusion about different legal and conventional statuses. The existing IENE could serve as this forum, which ideally should be hosted by the Council of Europe with support from UNEP, ECNC and the World Conservation Union (IUCN).

This forum should include all governmental and non-governmental efforts concerning de-fragmentation of landscapes at the national and sub-national levels, including policy, legal, planning, technical, and other measures. This would facilitate international co-operation in order to identify and conserve cross-border ecological corridors in the context of the Pan-European Ecological Network.

The information flow should reach the lowest, most concrete administrative and planning level to ensure that local, regional, and national ecological networks are perceived as part of the PEEN. Expertise should be maintained at a relatively low administrative level for two reasons. The habitat cohesion concepts could then be co-ordinated at the lower levels as part of a network and this expertise could be applied – for example to the Strategic Environmental Assessment and the Environmental Impact Assessment

along with the construction and expansion of linear infrastructure. The spatial projection of very expensive mitigation measures like green bridges over linear transport infrastructure could be optimised both locally and supra-regionally by combining expertise on the requirements for an ecological corridor system both on the large and small scale. Currently, the spatial projection of constructions like landscape bridges and wildlife bypasses is in many cases based on an investigation of ecological requirements in the direct vicinity without evaluation of the requirements of the broader ecological context. For example, long-distance migration routes of certain species might be neglected if an environmental impact assessment of a road is limited to a single habitat; in that case, its impact at the landscape scale might be overlooked (Seiler 2002). On the other hand, large-scale impact assessments can lead to the disruption of ecological relationships of small, localised areas worthy of protection.

Such a forum should be open to all interest groups and serve as a central source of information. Starting from *COST 341 Action* and complemented by the current *COST 350 Action*, this forum would provide a continuous, long-term conflation of know-how and experience.

I thank Dr. J. McAlister-Hermann for assistance with the English manuscript, three anonymous referees, and the editors of this *GAIA* issue for their valuable comments.

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Submitted November 8, 2004; revised version accepted April 20, 2005.



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