



European Co-Operation in the field of Scientific and Technical Research

Habitat Fragmentation due to Transportation Infrastructure



Findings of the **COST Action 341**



European Commission Directorate General Transport



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Foreword

Infrastructure builders are inconvenienced by nature, and nature is inconvenienced by infrastructure and traffic. The COST 341 products offer tools for integration of transportation infrastructure in the environmental context. The presence of nature areas, especially, a nature reserve or protected wildlife site, creates more and more challenges for infrastructure projects. More infrastructure is needed to transport people and goods, which leads to more traffic across Europe. Mountains, valleys, rivers, steppes and coastal plains are criss-crossed by arterial routes. In turn, infrastructure stimulates new development, such as the creation of residential and industrial areas. Natural habitats are severed into fragments, which are too small to sustain viable populations. Natural processes are hampered and animals and traffic clash.

Politicians and the general public, conservationists and naturalists all recognise that the fragmentation of nature and landscape is an important issue. In 1998, this central idea gave rise to the COST 341 Action. Representatives of many European countries have worked in close collaboration, exchanging; developing and improving their knowledge, tailoring it to specific situations. Amongst other things, the COST 341 Action has increased understanding and awareness of the problems caused by fragmentation and of the importance of providing adequate mitigation measures. There has been dialogue between civil engineers and biologists, between landscape-oriented and species-oriented ecologists, and between theorists and practitioners. Information about specific projects and field trips has led to fruitful discussion and a better mutual understanding.

Teamwork and open dialogue have helped to create valuable products. Members of the COST 341 Management Committee and many national working groups have contributed to the success of this Action. The products of COST 341 cover the broad scope of habitat fragmentation issues in the planning, construction and use of transportation infrastructure, and are a good foundation for future actions, co-operation and solutions.

IENE (Infra Eco Network Europe), founded in 1995, is the European network where COST 341 was born and bred, and where the results of COST 341 will be further developed and disseminated after formal completion of the Action. In the last few years, the IENE network has promoted a sharp growth in co-operation between experts across Europe as well as further afield, *e.g.* through collaboration with the American ICOET network (International Conference on Ecology and Transportation). Let us hope that this international network will act as a model for the conservation and restoration of fragmented habitats and lead to better integration of infrastructure into the landscape.

Hans Bekker
Chairman COST 341

Habitat Fragmentation: What is the Problem?

Transport Infrastructure in Europe is Growing...

Between 1970 and 1996, the length of the Trans-European Transport Network almost doubled, to cover 1.2% of the total land area. Today, this network is made up of *ca.* 75,000 km of roads and *ca.* 79,000 km of conventional and high-speed railway lines. Most regions in Europe are highly fragmented by transportation infrastructure. The length of roads and railways planned for construction across Europe is considerable: *i.e.* more than 20,500 km and 23,000 km respectively by 2010¹.

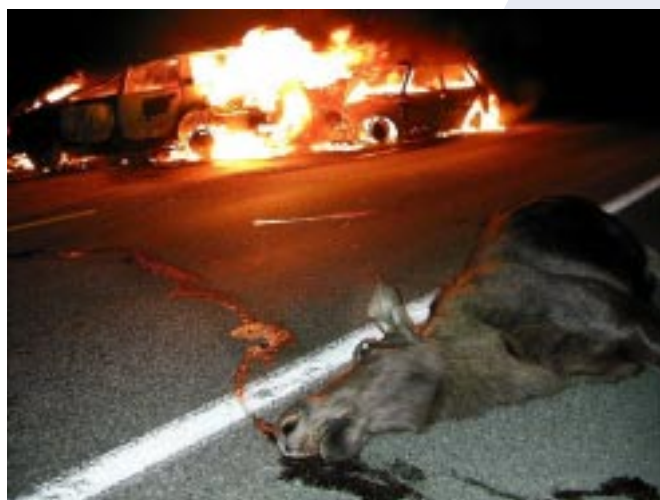
...Biodiversity is Declining

With the increasing spatial demands of transportation infrastructure and predicted continued growth in traffic flows, conflicts between infrastructure and the natural environment are inevitably set to increase in the future.

One of the major impacts of transportation infrastructure on nature is habitat fragmentation. It has been recognised as one of the most significant factors contributing to the decline of biodiversity in Europe. Habitat fragmentation can be described as the splitting of natural habitats and ecosystems into smaller, more isolated patches. The process of fragmentation is connected to many different factors, of which the direct loss and isolation of natural habitat are the most important. Transportation, agriculture and urbanisation are three main causes of fragmentation.

The ecological effects of transportation include disturbance in terms of noise and visual nuisance and pollution, which act to reduce the suitability of adjacent areas for wildlife. The infrastructure itself contributes significantly towards habitat fragmentation by creating barriers to animal movement. This may result in the isolation and extinction of vulnerable species. The steady increase in the number of animal casualties associated with roads, railways and, to a lesser extent with drowned animals in waterways, provides a further indication of the fragmentation effect. Fauna mortality, in particular, has helped raise the public perception of the problem, due to the inherent link to traffic safety. Finally, devaluation of the landscape and nature for human recreation can make an important negative economic factor.

¹ EEA, 1998, EEA, 2000





The Challenge

The challenge for European countries is to adapt the existing and future transportation infrastructure to produce an ecologically sustainable transportation system. In practice, solutions must be found to current fragmentation problems. A strategy must be put in place for extending future infrastructure without further intensifying fragmentation. During the implementation of COST 341, the differences in experiences between different countries and organisations have been clearly highlighted. Throughout Europe, the process of addressing the impact of habitat fragmentation

due to transportation infrastructure is still in its infancy and will require more concentrated effort and detailed work in the future. Nevertheless, it is also clear that efforts to tackle the negative effects of fragmentation have already led to a marked improvement in the situation. In many cases, fragmentation is being taken into account in the choice of routes and mitigation measures for new roads and railways. In addition, in some countries, existing bottlenecks where ecological networks and transport infrastructure cross are being retrofitted with fauna passages.

Valuable lessons for mitigation and compensation can be learnt from densely populated and intensively developed countries in Western Europe, where the problem of habitat fragmentation has long been recognised. From less populated countries in the Nordic area we can learn what undisturbed areas can be. Many other European countries have already developed national research programmes into the effects of infrastructure on biodiversity, the findings of which will be used to inform the planning and design of new infrastructure.

However, the critical questions still remain: How can the *European transportation infrastructure* be managed, upgraded and extended without significantly increasing fragmentation effects? How should fragmentation problems associated with the existing network be addressed? How can policies and directives be helpful in this matter?

What are the solutions?

General Principles to consider

- The fragmentation of natural habitats by transportation infrastructure is a problem, which can only be solved through acceptance of the issue at a policy level. Only an interdisciplinary approach involving planners, economists, engineers, ecologists and landscape architects etc., can provide the necessary tools for successfully addressing fragmentation. Public involvement is also essential to ensure the success of the chosen solutions.
- Habitat connectivity is a vital property of landscapes and is especially important for sustaining animal movement across the landscape. The preservation of habitat connectivity should be a strategic goal in the environmental policy of the transport sector.
- Avoiding and mitigation should be applied from the start of the planning process.

Avoidance or Prevention of Habitat Fragmentation

Best practice dictates that project planning and design should aim to avoid ecological damage, especially to protected or sensitive habitats and/or species. The avoidance of fragmentation should be considered before resorting to mitigation measures.

The sensitivity of habitats and wildlife populations to fragmentation and disturbance, the mobility of animals and the size of their home ranges are all ecological factors that should be considered when evaluating alternative alignments for proposed new infrastructure.

Route alignment should be adapted to avoid the bisection of vulnerable habitats. Landtake and disturbance of adjacent habitats should be minimised. Seeking an optimal alignment of the road in the landscape can minimise conflicts and the need for mitigation measures such as fauna passages.

The basic approach should be that prevention is better than cure. Fragmentation should be minimised when planning new or upgrading existing infrastructure. Although the focus is mainly on new infrastructure, these principles should also be applied equally to existing infrastructure where repair and maintenance are being undertaken.

Mitigating Fragmentation

As some degree of fragmentation is inevitable when building infrastructure, mitigation measures must be implemented to ensure connectivity of dispersal corridors and priority habitat areas and to minimize disturbance.

During the planning, construction or upgrading of transportation infrastructure, all possible efforts must be made to maintain or restore ecological structures and connect habitats and populations. Particular attention should be paid to rivers, streams, riparian forests, wooded corridors, networks of hedges and dikes etc., which provide ecological corridors for growth, expansion of range and/or migration of wildlife populations and can often be the last refuge for many species in an intensively man-used landscape.

Mitigation measures are more likely to be effective if integrated at an early stage of the planning process as well as being cheaper than measures built retrospectively i.e. after infrastructure development. This requires the involvement of ecological expertise at an early stage and throughout the process.



Different methods and techniques for minimizing and reducing habitat fragmentation are described in the COST 341 European Handbook 'Wildlife and Traffic' in relation to the different phases of the planning process.

Mitigation measures such as fauna crossings (underpasses and overpasses) have a proven record of success. However, mitigation should not just focus on the more prestigious passages for large animals. Much can also be done, at relatively low cost, to increase the permeability of the existing and future transportation infrastructure by adapting the design of engineering structures to wildlife. Many existing wildlife barriers could be lifted by adapting local road and rail overpasses and underpasses to allow for infrequent use by animals. Ecological expertise is necessary from the early beginning of each plan for infrastructure project. Engineering structure design processes and standards should be reviewed by ecologists to assess these possibilities.



Mitigation is also important for existing infrastructure, much of which was built at a time when the effects of habitat fragmentation were not yet understood. It is often possible to mitigate existing impacts with appropriate retrofit measures.





Compensation or Construction, Restoration or Enhancement of Habitats

In situations where infrastructure dissects especially vulnerable areas or where mitigation measures are inadequate or impossible to construct, compensation measures may be necessary.

Ecological compensation may be defined as creating, restoring or enhancing ecosystems in order to counter-balance ecological damage caused by infrastructure development. For example, specified natural habitats and their ecological functions, such as wetlands or old-growth forests, should be developed elsewhere to compensate for the negative effects of a project. When compensation is implemented, the measures should balance the ecological damage, aiming for a 'no-net-loss' situation, that benefits both habitats and their associated species.

Ecological compensation is a 'last resort' solution - it should be used only when planning and mitigation measures have not been able to prevent damage. However, it should be noted that the biological value of newly engineered habitats is often not as high as old and established natural and semi-natural habitats, for example, in terms of biodiversity.

Legal and Political Support

The fragmentation of natural habitats by transportation infrastructure is a problem that cannot be solved without an acknowledgement of the topic at policy level and without specific strategies and plans.

The principles of avoidance, mitigation and compensation are embedded in European and in some national administrative policies and legal frameworks. Currently, the most important instruments at the European level are:

- the EC Directive on Environmental Impact Assessment (EIA) ;
- the EC Strategic Environmental Assessment (SEA) Directive;
- the Habitats and Birds Directives (which together designate the Natura 2000 ecological network);
- the Convention on Environmental Impact Assessment in a Transboundary Context and the Pan-European Biological and Landscape Diversity Strategy (PEBLDS); and
- White Paper on European Transport Policy.

Carrying out SEAs and EIAs ensures that environmental issues including fragmentation are considered at an early stage of programme, plan, or project development. Another aim of the SEA and EIA is to ensure public consultation at the early stage. Before a programme, plan or project is adopted and before any construction work is initiated, all relevant authorities, stakeholders, NGO's and members of the general public should be involved in a public inquiry to inform the final decision on whether the development should proceed.



The Pan-European Biological and Landscape Diversity Strategy (PEBLDS) promotes the concept of 'ecological networks' (i.e. connections between habitats via ecological corridors). This has been specifically identified as an effective strategy for addressing habitat fragmentation as it promotes the integration of biodiversity conservation into land use planning procedures. Consideration of these 'ecological networks' in the planning of roads, railways and waterways may help to avoid critical bottlenecks in habitat connectivity and identify where mitigation measures are required.



The EC White Paper on European Transport Policy for 2010 highlights the importance of sustainable development principles within the transport sector and strives to make the transport more environmentally friendly. It gives priority to air quality, climate change and noise pollution problems, however, it is useful to mention biodiversity or habitat fragmentation as issues of concern. In some European countries, nevertheless, the problem has been recognised at such a level that it receives a special mention in their national transport policies.

What further action is required?

The key to success is the adoption of an approach that allows the whole range of ecological factors operating across the landscape to be integrated within the planning process. The problem of fragmentation is universal and its solutions are relevant to the local situation, therefore joint research and combined international efforts are required. To develop adequate tools for assessing, preventing and mitigating the negative ecological impact of infrastructure requires interdisciplinary work. A significant challenge to ecologists, infrastructure planners and civil engineers and other actors is the establishment of an ecologically adapted, safe and sustainable transportation infrastructure system and, of course, the involvement of users of the infrastructure in the process.

The political support is the foundation of the success in combating the problem of habitat fragmentation due to transportation infrastructure.

COST 341 identified the following needs for the future:

- An ongoing exchange of knowledge through Europe is vital, because of the complexity and widespread nature of the problem. A systematic and uniform approach to collect information on mitigation techniques and measures is necessary.
- The disturbance effect created by infrastructure needs to be more widely studied and mitigated in order to minimise habitat degradation adjacent to infrastructure.
- Monitoring programmes to establish the effectiveness of mitigation measures are essential and need to be standardised. The cost of monitoring programmes should be included in the overall budget for infrastructure schemes.

There is still a long way to go before ecological tools are fully developed and implemented in transportation planning and management. It is hoped that the COST 341 products (described in the next chapter), will assist in raising awareness of the problem and promote best practice within the planning and transport sectors.





Products of COST 341

Representatives from 20 European countries in the Infra Eco Network Europe (IENE) have underlined the need for co-operation and exchange of information in the field of habitat fragmentation caused by transport infrastructure at a European level. IENE also recognised the need for support at a European governmental level. This led to the development of COST 341 'Habitat fragmentation due to transportation infrastructure', which started in 1998.

Over the 5 years of the COST 341 action, the following countries and organisations have officially participated:

Austria, Belgium, Cyprus, Czech Republic, Denmark, France, Hungary, The Republic of Ireland, The Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, United Kingdom and the European Centre for Nature Conservation (ECNC).

Several countries and organisations outside the official membership have also contributed to COST 341. Recognition should be given to contributors from Estonia and Italy.

COST 341 has delivered seven different products:

1. COST 341 - Habitat Fragmentation due to Transportation Infrastructure: The European Review. This report provides an overview of the scale and significance of the problem of fragmentation of natural habitats by roads, railways and waterways in Europe and examines solutions that are currently applied.
2. National State-of-the-Art Reports on Habitat Fragmentation due to Transportation Infrastructure from 13 European countries: Belgium, Czech Republic, Denmark, France, Hungary, The Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom. Each national report describes existing practice regarding methods, indicators, technical design and procedures for avoidance, mitigation and compensation of adverse effects on nature in that country. These reports created the basis for the European Review.

Most of the National Reports are also published separately in the countries and can be downloaded from the IENE website www.iene.info

3. Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions is a solution-orientated handbook, based upon the accumulated knowledge of a broad range of experts from participating countries and from numerous international contacts. It gives practical guidance for those involved in the different phases of the planning, construction and maintenance of transportation infrastructure. The main

aim of this handbook is to assist planners and engineers to minimise ecological barriers and fragmentation effects of transportation infrastructure such as roads, railways and waterways.

The handbook takes the reader chapter-by-chapter through all the different phases, from the first steps of strategic planning, through the integration of roads in the landscape, the use of mitigation measures such as over- and underpasses for different animals, the lesser known field of compensatory measures, and finally to consider the monitoring and evaluation of the chosen solutions.

4. Online database on Habitat Fragmentation due to Transportation infrastructure, which contains information on existing international and national literature related to habitat fragmentation. The database gives references to reports that are difficult to trace via other referencing systems. An access to the database is possible through the IENE website: www.iene.info.
5. COST 341 - Habitat Fragmentation due to Transportation Infrastructure: The Final Report, which describes the problem and provides a summary of possible solutions and ways forward.
6. CD-ROM on Habitat Fragmentation due to Transportation Infrastructure, which contains an electronic version of all the COST 341 products outlined above.
7. European Conference on Habitat Fragmentation due to Transport Infrastructure & Presentation to the COST 341 action, Brussels 13-15 November 2003
The conference provides experts, decision makers, ecologists, scientists, engineers and professionals with the opportunity to exchange ideas, present projects and work, share experiences for a better collaboration and communication.

Citations:

1: Trocmé, M.; Cahill, S.; de Vries, J.G.; Farrall, H.; Folkeson, L.G.; Hichks, C. and Peymen, J. (eds), 2003. COST 341 - Habitat Fragmentation due to Transportation Infrastructure: The European Review. Office for official publications of the European Communities, Luxembourg.

3: Iuell, B. (ed.), 2003. Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions. Office for official publications of the European Communities, Luxembourg.

5: Damarad, T. and Bekker, G.J., 2003. COST 341 - Habitat Fragmentation due to Transportation Infrastructure: The Final Report. Office for official publications of the European Communities, Luxembourg





COST – Co-operation in the field of Scientific and Technical Research

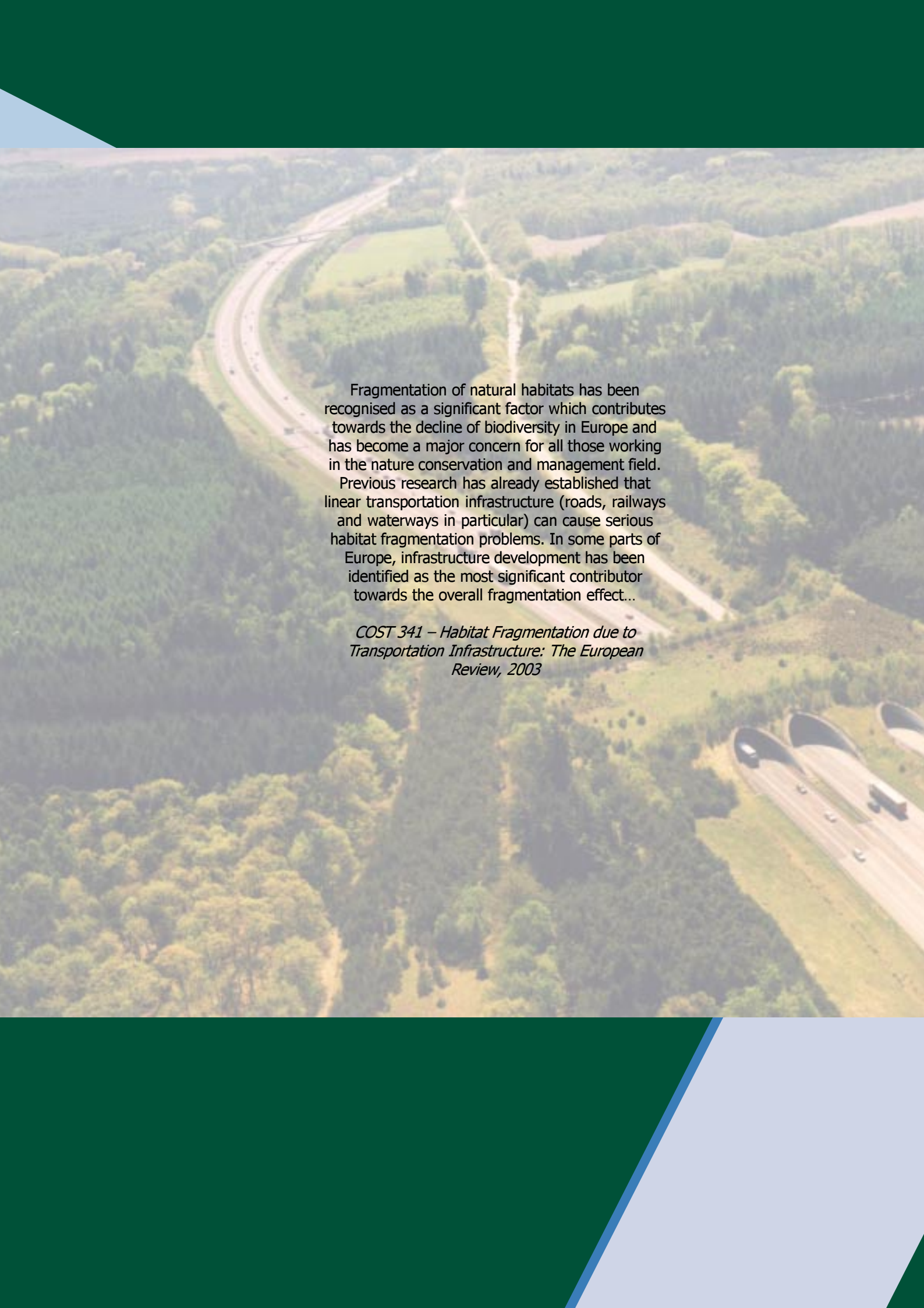
Founded in 1971, COST is an inter-governmental framework for European Co-operation in the field of Scientific and Technical Research, allowing the co-ordination of *nationally funded* research on a European level. COST Actions cover basic and pre-competitive research as well as activities of public utility.

COST 341 "Habitat Fragmentation due to Transportation Infrastructure" is the Action that aims at promoting a safe and sustainable pan-European transportation infrastructure through recommending measures and planning procedures that conserve biodiversity and reduce vehicular accidents and fauna casualties.

16 countries (Austria, Belgium, Cyprus, Czech Republic, Denmark, France, Hungary, The Republic of Ireland, The Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom) and one international organisation (European Centre for Nature Conservation) were members of COST 341.

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An aerial photograph showing a multi-lane highway curving through a dense, green forested area. The highway is a prominent linear feature that divides the natural habitat. In the background, a river flows through the landscape. The overall scene illustrates the impact of transportation infrastructure on natural environments.

Fragmentation of natural habitats has been recognised as a significant factor which contributes towards the decline of biodiversity in Europe and has become a major concern for all those working in the nature conservation and management field. Previous research has already established that linear transportation infrastructure (roads, railways and waterways in particular) can cause serious habitat fragmentation problems. In some parts of Europe, infrastructure development has been identified as the most significant contributor towards the overall fragmentation effect...

COST 341 – Habitat Fragmentation due to Transportation Infrastructure: The European Review, 2003