# Landscape Fragmentation in Europe

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## Problem

Landscape fragmentation caused by transportation infrastructure has a number of detrimental effects like reduction in size and persistence of wildlife populations, changes of local climate, and increases in pollution and noise from traffic. Therefore, data on the degree of landscape fragmentation are needed for assessing the sustainability of human land uses. In addition, quantitative objectives for the future degree of landscape fragmentation (as an environmental quality objective) are still missing in current environmental politics. In order to compare different regions, their degree of fragmentation needs to be interpreted in terms of socio-economic measures such as population density and GDP.

## Project Objectives

1. Quantitative analysis of landscape fragmentation in Europe at three spatial scales for two points in time (2002 and 2008)
2. Determination of the relative importance of socio-economic factors as drivers of landscape fragmentation

Fig. 1: Transportation infrastructure act as barriers to the movement of many animals. Amphibians are among the species that are strongly affected by traffic mortality.

Fig. 2: Landscape fragmentation caused by roads and settlements. The fragmenting elements (shown in red) act as barriers and as sources of disturbance (left). At the right, the corresponding effective mesh size is shown as a regular network (from Jaeger et al. 2007). The effective mesh size corresponds with the size of the rectangles.

## Methods: Effective Mesh Size $m_{eff}$ and statistical analysis

The currently available data on the road and railroad network in Europe are a reliable basis for defining a fragmentation geometry that is comparable among the different European countries.

We are using the effective mesh size $m_{eff}$ which is proportional to the probability of two points chosen randomly in a region being connected. This probability is then converted into the size of a patch – the effective mesh size $m_{eff}$ – by multiplying it by the total size of the region investigated. The unit of $m_{eff}$ is that of area (e.g., km$^2$). This area corresponds to the size of the »meshes« of a regular network that has the same degree of fragmentation, and it can be compared with the values of $m_{eff}$ from other regions (Fig. 2):

$$m_{\text{eff}} = \frac{1}{A_{\text{total}}}\left(A_1^2 + A_2^2 + A_3^2 + \cdots + A_n^2\right)$$

where $n$ is the number of patches, $A_i$ is the size of patch $i$ (with $i$ = 1, ..., $n$) and $A_{total}$ is the total area of the region investigated which has been fragmented into $n$ patches (Jaeger 2000). The smaller the effective mesh size, the more fragmented the landscape. The degree of fragmentation can also be expressed as the effective mesh density $s$ (i.e., the effective number of patches per 100 km$^2$).

The statistical analysis applies general linear modeling (GLM).

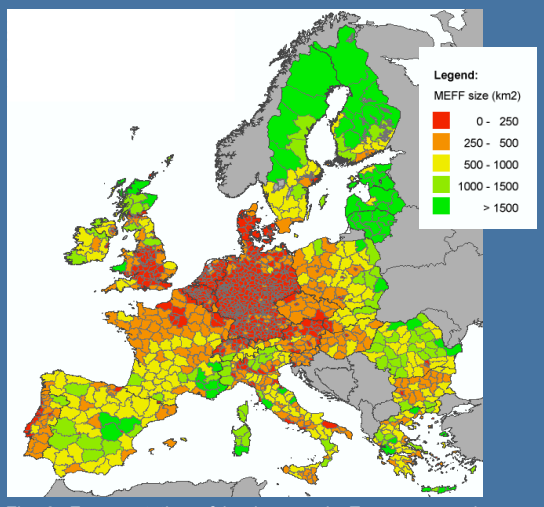


Fig. 3: Fragmentation of landscapes in Europe caused by transportation infrastructure and urban areas at the NUTS3 level (preliminary results by ETC-LUSI).

## Benefits of the project

- World-wide first analysis of landscape fragmentation of an entire continent
- Assessing the degree of landscape fragmentation based on socio-economic and physical factors
- Estimate of the current rate of fragmentation increase in Europe

### Funding and Organization of the project

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