## Chapter 12 Forest Fragmentation: Causes, Ecological Impacts and Implications for Landscape Management

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## Abstract

In order to enable the development of appropriate landscape management plans, the causes and impacts of fragmentation should be fully understood. A new definition, incorporating the key aspects cited in landscape ecological literature since the 1980s, is proposed in order to shed light on the matter of fragmentation. By means of two case studies in the Democratic Republic of the Congo (Oriental Province) and in North Benin, the key role of anthropogenic activities in landscape fragmentation is evidenced: the spatial dispersion of forest vegetation is linked to population density and land use change. The potential impact of fragmentation on biodiversity is shown by an analysis of forest diversity in Ivory Coast (Tanda region), and by a study of edge effects on two rodent species in the Democratic Republic of the Congo (Kisangani). The chapter is concluded by an study on how planned corridors, assuming a spatial regrouping of existing teak plantations, could contribute to the conservation and management of remaining natural forest patches in the Atlantic Department in Benin.

## Keywords

Corridor, edge effect, forest degradation, fragmentation, land cover change, landscape connectivity, landscape metric, population density, transition matrix.

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## 12.1 Fragmentation: A plenitude of definitions

The process of forest fragmentation due to human activities such as logging or conversion of forests into agricultural areas and suburbanization (Forman 1995) has been identified as the most important factor contributing to the decline and loss of species diversity worldwide (Noss and Cooperrider 1994). Forest fragmentation occurs when a large region of forest is broken down, or fragmented, into a collection of smaller patches of forest habitat (Wilcove et al. 1986; Collingham and Huntley 2000; Fahrig 2003). The outcome of fragmentation can be considered as a 'binary landscape' in the sense that the resulting landscape is assumed to be composed of spatially dispersed forest fragments with a non-forest matrix between them (Franklin et al. 2002).

Defining fragmentation is crucial in evaluating its effects on species in the forest ecosystem and at the landscape level (Bogaert 2003; Lafortezza et al. 2008). A spectrum of definitions has been cited in landscape ecological literature since the 1980s, of which a representative sample is listed below:

Fragmentation ...

- ... is the process whereby a large, continuous area of habitat is reduced in area and divided into two or more fragments (Wilcove et al. 1986);
- ... is an alteration of the spatial configuration of habitats that involves external disturbance that alters the large patch so as to create isolated or tenuously connected patches of the original habitat (Wiens 1989);
- ... is an event that creates a greater number of habitat patches that are smaller in size than the original contiguous tract(s) of habitat (Bender et al. 1998);
- ... is habitat loss and isolation (Collinge 1996);
- ... refers to the patchiness of a landscape (De Santo and Smith 1993);
- ... produces a series of remnant vegetation patches surrounded by a matrix of different vegetation and/or land use (Saunders et al. 1991);
- ... is the process of breaking up continuous habitats, resulting in reduced area, increased edge, reduced interior area, increased isolation of patches and possibly increased number of patches and decreased average patch size (Davidson 1998); an increase in the total boundary length is also observed (Forman 1995);
- ... is the breaking up of a habitat, ecosystem or land use type into smaller parcels (Krebs 1994; Forman 1995); it is considered as a spatial process of land transformation (Forman 1995; Bogaert et al. 2004);
- ... is heterogeneity in its simplest form: the mixture of habitat and non-habitat (Franklin et al. 2002);
- ... refers to an increase of the number of patches in a landscape (Goodwin and Fahrig 2002);
- ... is the breaking up of extensive landscape features into disjunct, isolated or semi-isolated patches as a result of land use changes (Heywood and Watson 1995);