Fragmentation of large forest complexes by major roads

Background

The fragmentation of large continuous complexes of forest by roads is an important subject when considering sustainability of forests or impacts of transport networks on forest ecosystems. Large forests are a very important factor for the conservation of species and habitat diversity, especially for species demanding large undisturbed territories.

The application shown here should be seen as an example of the various type of analysis. In the future the definitions of forest complexes and of the road information used should be more refined.

Methodology

Scientific references

None.

Concept

There is no European definition of a "large forest". Therefore a definition of a large forest was required.
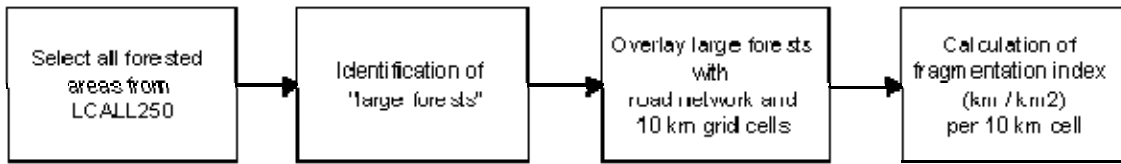
The first step towards a definition of a large forest was the creation of area statistics of forests from CORINE land cover. A modal distribution (frequency distribution) of forest areas was calculated. The size which marked the top 25 % of the largest forest areas was chosen as threshold. All forests bigger than this threshold were considered a large forest for this analysis.

The fragmentation index (km/km^2) represents the length of a road network per forested area in a grid cell of 10 x 10 km. The calculation was performed by overlaying CORINE land cover level 2 . forests. (class 3.1) with the GISCO road network.

Data input

The LCALL250 data set was used as basis for the calculations of the forested area. The GISCO road database (existing roads, all categories in the database) was used to identify the road network.

Actions

Select all forested areas from LCALL250 → Identification of "large forests" → Overlay large forests with road network and 10 km grid cells → Calculation of fragmentation index (km / km2) per 10 km cell

Step 1:

In LCALL250 select all forest classes (CLC 3.1) and create a new data set which contains only forest area.

Step 2:

Identify all forest areas (grid cells) which form one contiguous forest complex. Connected grid cells are grouped to regions with the same value.

For the connectivity analysis all eight neighbour of a grid cell are considered. The consideration of all neighbours ensures that no directional preference is given in the analysis.
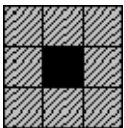

Figure 4: Neighbouring cells considered in connectivity analysis for large forests.

Step 3:

Determine the size of all forest complexes. Creation of a frequency distribution of all forest sizes. Identify the area value (km^2) which marks the top 25% of the occurring forest sizes.

Assuming there are 100 forest complexes, these are grouped by size. Then the size (ha) for forest number 75 (100 - 25(%) = 75) is determined and used as threshold for the definition of a large forest.

Step 4:

Use the threshold value to select only the largest forests (top 25%) from all forested area.

Step 5:

Create a data set of 10 x 10 km cells (vector data) for all countries in which CORINE land cover is existing.

Step 6:

Convert large forests from raster to vector data.

Step 7:

Select from GISCO road database all existing roads, drop planned roads of TEN network.

Step 8:

Overlay large forests with 10 x 10 km grid to obtain the amount of forest per 10 km cell.

Step 9:

Overlay result of step 8 with road network to obtain road length in forest per 10 km cell.

Step 10:

Calculate for each 10 km cell the road length per forest surface. The index is presented as km of road per square kilometre forest surface.

The fragmentation index is calculated with the following formula:

$$\text{fragmentation index} = (\text{road length} / \text{forest area}) / 10$$

forest area is indicated in hectare

road length is provided in meters

In order to convert meters per hectare (m / ha) to kilometres per square kilometre the result needs to be divided by 10.

The fragmentation index is presented on the map by the following classes:

no roads in forest

less than 0.1 km road per km^2 of forest

0.1 to 0.5 km road per km^2 of forest

0.5 to 1.0 km road per km^2 of forest

1.0 to 5.0 km road per km^2 of forest

over 5.0 km road per km^2 of forest

The index is calculated for the amount of forest in a 10 x 10 km grid cell. If the cell is not totally covered by forest, the index represents a value for the area covered by forest in the cell.

Step 11:

Creation of a file which contains only those 10 km grid cells which contain forest. The attribute . index. is used for the map production.

Created data sets:

⊦ coverage with 10 x 10 km cells.

⊦ large forests with roads per 10 km cell

⊦ statistics file with fragmentation index (km/km^2) and grid cell identifier.