Spatial analysis of bark-stripping damage by red deer in irregular hardwood forest

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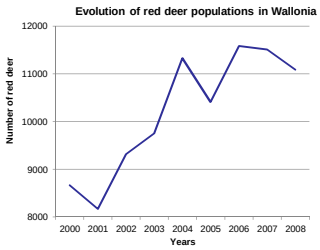
CONTEXT

Over the past years, the population size of red deer (*Cervus elaphus L.*) is following an upward trend in Wallonia. This has led to an increased pressure on vegetation as well as to forest damages of greater frequency and intensity. Among these damages, bark-stripping can be especially harmful to the timber quality due to the development of rot.



The impact of these populations may thus lead to a reduction in forest productivity and to economic losses. Nevertheless, these damages doesn't depend only on the density of red deer but also on the environmental characteristics of their habitats.

OBJECTIVES

The main objective of this study is to perform a spatial analysis of the occurrence of bark stripping in order to identify the environmental factor that affect the occurrence of the damages in hardwood forests. The bark-stripping damages in coniferous stands are well-known due to the fact that they are relatively frequent. Such information is however unavailable for hardwood stands.

MATERIAL

The study site (6500 hectares) is located in the Ardennes in Southern Belgium (Wallonia) and is mainly composed of beech stands.

We used data of inventory campaigns that were carried out for management purposes. In each sampling unit (total of 321 units), we measured different stand characteristics and, during a second phase, the bark-stripping damages. These latter measurements concerned the presence or absence of bark-stripping on each recorded stem and damage age (presence or not of a healing roll). Only trees with dbh greater than 5 cm were taken into account. All the data were collected in hardwood stands.

To perform the spatial analysis, a set of environmental variables, including landscape (distances to the natural or artificial feeding points, to watering-place, to the different types of road and to the forest paths, to refuge areas for deer and to forest edges, etc.) and tree dimension variables, have been collected. The estimated red deer density was also took into account. All these variables have been included in a fixed linear model using stepwise regression.

An angular transformation was applied in order to guarantee appropriate conditions of application of the linear regressions.

RESULTS

Over one hundred variables were tested but only six of them have a significant impact on the bark-stripping rate. The results of the stepwise regression is presented in the table below as well as the contribution of each variables to the model. This model explains only 10,2% of the bark-stripping rate.

Variables	Estimate	P value	Contribution (%)
Intercept	0,1847	0,007535	
Distance to the small forests roads	-0,0001098	4,33e-07	21,1
Number of very small coniferous trees per hectare	-0,0002542	0,04302	3,3
Number of small coniferous trees per hectare	0,001359	0,015096	4,7
Proportion of middle trees	0,003072	0,006351	5,9
Mean circumference of others deciduous species than beech and oak	-0,001684	0,000102	12,3
Proportion of trees having a circumference between 15 and 100 cm	0,006264	8,15e-15	52,7

DISCUSSION

Tree dimension variables explain most of the bark-stripping rate. Thus, forest structure has an important impact on the bark-stripping probability.

The roads and the human activities in general can have an impact on the bark-stripping rate. These activities can disturb the red deer feeding periods during the day and lead to important bark-stripping damages.

We expected to observe other variables contributing to the model such as red deer density and altitude. The absence of effect of altitude can be explained by the fact that bark-stripping of beech trees occurs mainly in summer. The scale of the study can explain the absence of red deer density.

PERSPECTIVES

- Establishment of acceptable levels of bark-stripping damages depending on the forest structure.
- Elaboration of a model at the tree scale, that could allow us to identify whether a local effect of bark-stripping exists.