THE EVOLUTION OF THE SPATIAL STRUCTURE OF CANCER ATTACKS PRODUCED BY FUNGI OF THE *NECTRIA* SP. IN SUCEAVA PLATEAU

EVOLUŢIA STRUCTURII SPAŢIALE A ATACURILOR DE CANCER PRODUSE DE CIUPERCILE GENULUI *NECTRIA* SP. DIN PODIŞUL SUCEVEI

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Abstract. *The research was made in a virgin beech forest in Suceava Plateau (Old growth beech forest of Humosu), based on two successive inventories. The first one was made in 2006 and the second one in 2011. The purpose of this paper is to capture the spatial structure evolution of cancer produced by fungal attacks of the Nectria genus. To carry out this object were made three punctual processes composed from healthy trees (H), medium affected trees (M) and severely affected trees (S).*
Key words: spatial dynamics, beech cancer, *Fagus sylvatica*

Rezumat. *Cercetarea a fost realizată într-un arboret virgin de fag din Podişul Sucevei (Făgetul Secular Humosu), pe baza a două inventarieri succesive, una realizată în anul 2006, iar cea de a doua in 2011. Obiectul prezentului articol este de a surprinde evoluţia structurii spaţiale a cancerului produs de atacul ciupercilor din genul Nectria. Pentru îndeplinirea acestui scop s-au realizat trei procese punctuale constituite din arbori sănătoşi (H), arbori mediu afectaţi (M) şi arbori sever afectaţi (S).*
Cuvinte cheie*:* dinamică spaţială, cancerul fagului*, Fagus sylvatica*

INTODUCTION

In Suceava Plateau, *Fagus sylvatica* is the main species, covering an area of 20,598.1 ha and offering a volume of 3,464,715 m3. From pest category we have taken into analysis *Nectria ditissima* Tul. F.C. with *Cylindrocarpon willkommii* (lind.) Wr form, that produces beech cancer.

This study aims to explain the evolution of spatial structure of the cancer attacks produced by fungi of the *Nectria* genus in a natural beech stand in Suceava Plateau.

MATERIAL AND METHOD

,,*Old growth beech forest of Humosu*", the object of study of this paper, is located in Hârlău Forest District of Iasi Forest Administration., stand having the status of natural reserve, with an area of 73.3 ha, plots 62 and 64 (fig. 1).

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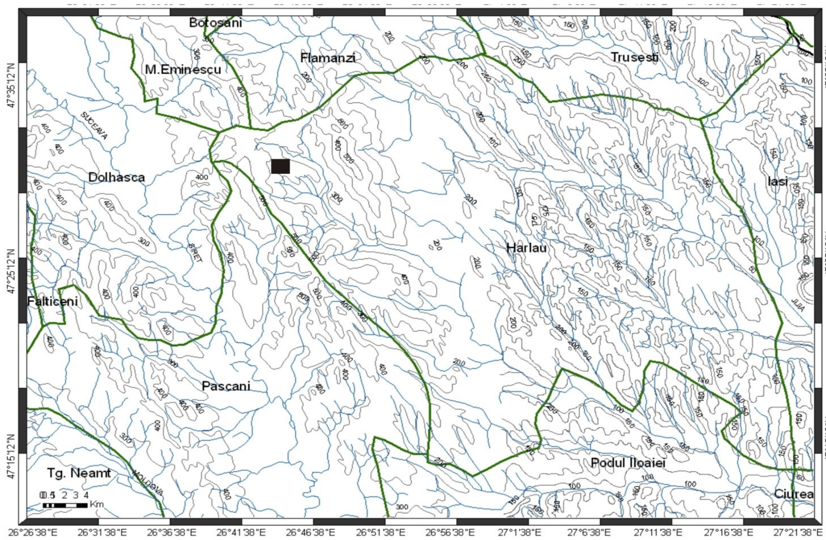

Fig.1 - Location of sample plot

Method of study is based on observation and experiment. In order to surprise spatial structure was used simulation, as a modern method of analysis To fulfill purposed objectives was adopted experimental method based on biometric successive measurements, in a natural beech stand.

The practical part of this study consist from a general recognition of land. Also, inside of stand was chosen and, at random, an evidence experimental permanent area, rectangular area of 1.0 ha, in 2006.

In 2011 the same area was re-invetoried with the aim of study the spatial evolution of cancer attacks produced by *Nectria* fungus. Location, demarcation, inventory and re-inventory of trees in the experimental area was installed in accordance with established methodology for studying the structure of forest ecosystems through structural profiles (Giurgiu, 1979; Cenuşă, 1986; Roibu, 2010).

At successive inventory of stands were registered some characteristics:

- species; diameter of 1.30 (cm) - were measured two perpendicular diameters; increasing samples (2006); total height (m); prune height (m); positional class (lower floor, middle, upper); quality class (grades I-IV);

- crown shape (broom, bucket, flag); diameter crown (m); presence of cancer in the crown (6 classes, percentage of trunk surface): K0: 0 (no cancer) :1-20% K1, K2: 21-40%; K3: 41-60% :60-85% K4, K5:> 85%; branch angle insertion (degrees) (0-90^{o}); rhytidom presence (4 classes, percentage of trunk surface): R1: <25%, R2 :26-50% :51-75% R3, R4:> 76%; cartesian coordinates (x, y) for each tree.

Among the methods used in achieving objectives were applied four punctual processes, Ripley K. In spatial analysis techniques, Ripley K function showed us if we have aggregate, random or regular structure (Ripley, 1976*).*

Ripley K function is a tool for analyzing and quantifying the intensity of second order punctual process completely positioned that is known the position in space to all events. Confidence interval for the theoretical process is obtained by Monte Carlo simulation of a number of 100 punctual processes to a probability of 95% coverage (Hardisty, 1999).

RESULTS AND DISCUSSION

Successive inventories performed can give valuable information on the dynamics of cancer attacks, concentrating attacks, the manner of spreading spores, establishing a united front of tree mortality and possibilities of restoring the stand. Having regard that research has been performed in a natural stand, constituted as a nature reserve, we have the certainty that the results are not distorted by human intervention with direct effects on stand structure.

In these conditions were realized three punctual processes composed by: healthy trees (H), medium affected trees (M) and severely affected trees (S) (fig. 2).

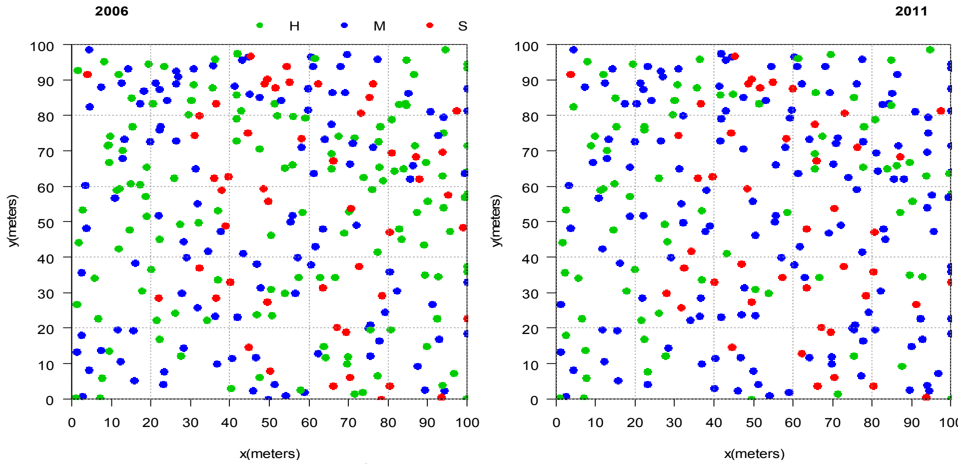

Fig. 2 - Dynamic of the cancer attack during the study period

In the period elapsing between the two inventories was emphasized around the nucleus severe in 2006 a significant increase in intermediate-infected trees proceeds predominantly among healthy trees. The consent of the previously stated, the average distance between two neighboring trees with strong infection provides important information to establish front attack (tab. 1).

Table 1

Distance between attacked trees

Inventory year	**Distance between trees with different degrees of intensity of attack (m)**		
	H	**M**	**S**
2006	4.82	5.34	7.69
2011	6.34	4.67	8.32

We observe that the distances between healthy trees have increased from the first stage of the count from 4.82 m to 6.34 m (2011). This modification indicates, primarily a reduction in the number of healthy trees, and secondly a weakening of the core consists of resistance forms. Instead, the distance between trees with intermediate attacks diminished as a result of enrollment of new trees in this category, proceeds from among the healthy. If trees with severe infections, the average distance to nearest neighbor increased. At trees with severe infections case, the average distance to nearest neighbor increased. This change can be attributed to natural removal of trees reached the limit of physiological longevity. Although the disappearance of severely attacked trees has led to increasing distance of closest neighbors, should not be considered as a reduction of the infestation. On the contrary, eliminated trees (standing dead, felled or broken by wind or snow trees) is a source of spreading the fungus spores.

Another explanation for the reduction of distance between trees with moderate infections can be attributed to wolly scale attack woolly (*Cryptococcus fagisuga*). We meet it on bark of beech branches and stems. Scale insects suck sap and cause dryness and bark falling associated with fungus attack *N. coccinea* / *N. ditissima (*Nechwatal et al., 2011, Way et al., 2012*)*.

These scales are transported by wind or birds settling new trees in the vicinity of the infected, creating favorable conditions for the installation of wood decay fungi, front infections being increasingly more virulent.

If in the first case of stand spatial organization judged only after the relative position of trees, quantifying spatial structure needs a higher requiering (Roibu and Popa, 2007). Achieving this objective involves the use of specific mathematical models. Ripley K function is a tool for analyzing and quantifying the intensity of second order point process completely positioned, or position in space is known to all events (Ripley, 1977, cited by Roibu, 2010).

In the spatial analysis techniques Ripley function showed us if we have aggregate, random or regular structure (Ripley, 1976).

First punctually process, consisting of healthy trees, has a random structure over the entire distance. In 2006 the spatial pattern was more stable, as confirmed by the confidence interval (much lower). Instead, at the second inventory (2011) stability of spatial model is reduced significantly, mainly due to reduction of healthy trees studied (fig. 3).

Spatial organization of the medium affected trees follows a typical pattern for a uniform distance of 4 m. After this value, the point is randomly distributed. In a period of five years, the trends of average uniformity of infested trees disappear, the whole distance being randomized. Emphasizing a regular structure is considered quite rare in special literature *(*Pielou, 1960; Boşcaiu and Lungu, 1982) and specific to a large stand of trees between which establish strong viable relationships in competition for space (Pielou, 1960). Greig-Smith (1952) believes that all wood species indicate trends for regular distributions, even if they remain vague.

The process of space includes all trees with severe infections presents a very interesting spatial structure. In 2006, the pattern is predominantly random, with some short intervals of aggregation. However, during the second inventory, the major pattern observed is aggregate. This has highlighted the rapidity changes the spatial organization of outbreaks, front spread spores becoming increasingly virulent. Thus it was highlighted celerity of changes in spatial organization of the outbreaks, front spread spores becoming increasingly virulent.

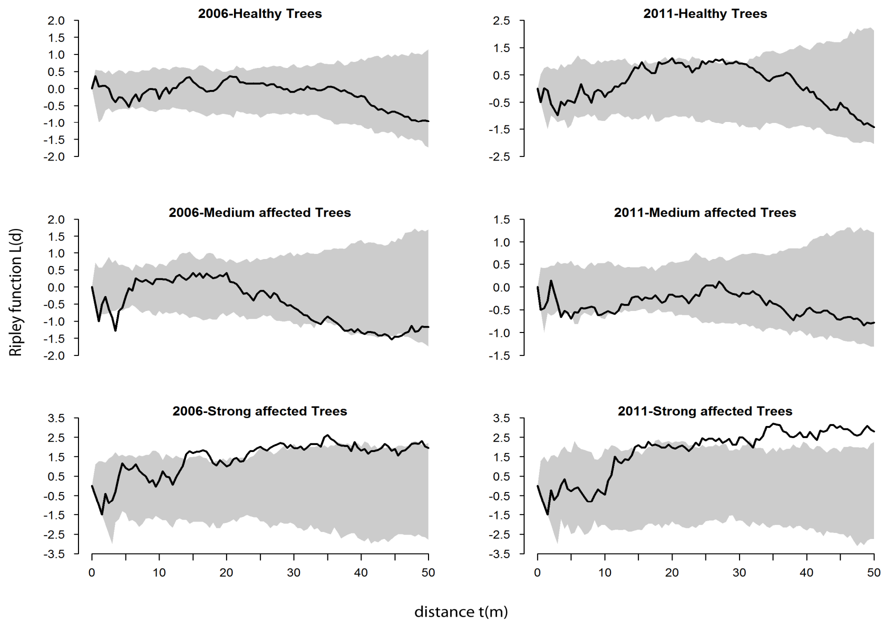

Fig. 3 - Ripley function

CONCLUSIONS

1. Successive inventories performed can provide valuable information on cancer attacks dynamics, focus attacks, the manner of spreading spores, establishing a united front of tree mortality and possibilities of restoring the stand.

2. Were made up three processes off healthy trees (H), medium affected trees (M) and severely affected trees (S). The first major aspect that was noted in the study refers to the resistance nucleus of cancer attack - causing fungus, consisting of healthy trees reduced gradually being replaced by medium intensity forms of the attack.

3. Average distance between neighboring trees with infections help to explain the dynamics of cancer attacks caused by fungus and provides important information to establish the front attack.

4. Quantifying the spatial structure involved using specific mathematical models, such as Ripley K function, which indicated us the structure type: aggregate, random or regular.

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