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Research Article

**HIERARCHICAL STRUCTURE OF PATHOGENIC POLYPORE FUNGI COMMUNITY ON PEDUNCULATE OAK IN THE OAK FORESTS OF THE SOUTHWEST OF THE CENTRAL RUSSIAN UPLAND****Alexandr V. Dunaev, Valeriy K. Tokhtar, Elena N. Dunaeva\*, Yelena V. Dumacheva**  
Belgorod State University Pobedy St., 85, Belgorod, 308015, Russia**Abstract:**

*The article deals with the possibilities of typological classification and hierarchical subordination of the communities of pathogenic polypore fungi Polyporaceae s. l., associated with Pedunculate oak Quercus robur L. They allow to propose a schematic-model of the hierarchical structure of the regional community of pathogenic polypore fungi on Pedunculate oak (communities of pathogenic polypore fungi on Pedunculate oak) in the oak forests of the southwest of the Central Russian Upland. Based on studies, conducted in the oak forests of the Belgorod, Shebekinsky, Korochansky, Borisovsky administrative districts of the Belgorod region of the Russian Federation and the territory of Belgorod, 6 types of elementary P<sub>Q</sub>-mycopathocenosis were distinguished: four types of full-membered and two types of semicomplete. Two groups of types of elementary P<sub>Q</sub>-mycopathocenosis have been identified. Four-level scheme-model of the hierarchical structure of the regional community of pathogenic polypore fungi was proposed. It allowed not only to systematize information about this community of wood-destroying fungi, taking an active part in modern succession processes, occurring in the oak forests of the forest-steppe, but also to create prognostic models for their formation under different conditions.*

**Keywords:** hierarchical structure, community, cenosis, Pathogenic Polypore Fungi on Pedunculate oak, PPF on oak, PPF, P<sub>Q</sub>-mycopathocenosis, type of P<sub>Q</sub>-mycopathocenosis, subordination level.

**Corresponding author:****Elena N. Dunaeva**

Belgorod State University Pobedy St., 85,

Belgorod, 308015, Russia

Email id: Dunaev\_A@bsu.edu.ru

QR code



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**INTRODUCTION:**

Forest mycocenology – is a knowledge unit, recently isolated from the section of forest biogeocenology, concerning the fungal cenosis in the composition of biogeocoenosis [1]. One of the such cenosis is a community of pathogenic polypore fungi on Pedunculate oak (PPF on oak) with the level of elementary mycopathocenosis [2, 3], considered by us as set of cenopopulations of pathogenic species of wood-destroying macromycetes, similar in ecobiomorphological and trophotopic aspects, within a part of biotope, occupied by individual forest phytocenosis. Depending on the context, we use the concept of "community" to denote the subordinated unit of any rank. The structure of the regional community of PPF on oak is in the research stage, and its syntaxonomic classification is not developed. The latter circumstance is the driving force behind the present study.

**MATERIAL AND METHODS:**

The object of the research – is the regional community of pathogenic polypore fungi on Pedunculate oak in the oak forests of the south-west of the Central Russian Upland (Belgorod, Shebekinsky, Korochansky, Borisovsky administrative districts of the Belgorod region of the Russian Federation and the territory of Belgorod). The research was carried out during 2010-2015, in oak stands of mountain and ravine oak forests of the region. The research covered 24 oak stands in the composition of 12 mountain oak forests and 19 oak stands in the composition of 8 ravine oak forests of the region.

Oak stands, studied at different times as part of the same oak forests, were the different forest areas in those oak forests. Mainly coppice oak forests with a predominance or complete supremacy of Pedunculate oak, premature and mature, of medium density and medium yield class, were studied. In addition, oak stands of seed and mixed (seed-coppice) origin, mature and overmature, were examined. The subject of investigation is the structure of the regional community of PPF on oak.

The aim of the research is to create a schematic-model of the hierarchical structure of the regional community of PPF on oak. Methods of the research are the following:

1. Field methods (mycocenological, phytopathological) [4, 5],
2. Cameral methods (ordination, comparison and classification) [6-8].

The dominant-determinant approach was used in the process of mycopathocenosis classification [8]. The indices of dominance (by quantity) of individual pathogenic polypore fungi species on oak were calculated in accordance with the scale of E.N. Lubarskiy [9].

The principle of creation a hierarchical system of levels of the PPF regional community consisted in the sequential allocation of generalized higher-order structural unit-types, on the basis of comparative analysis and generalization of specific lower-order unit-images, by abstracting from secondary variable characteristics. The criteria for generalization were chosen in accordance with the specifics of the object and within the framework of the dominant-determinant approach [8].

**Experimental**

Individual community of pathogenic polypore fungi, directly associated with individual oak stands, in the composition of relatively homogeneous oak forest phytocenosis, is an elementary, indivisible unit of the regional PPF community. We call such a community as elementary PPF community or elementary  $P_Q$  - mycopathocenosis ( $P_Q$  – is short for *Polyporaceae in Quercus robur*). This complex of cenopopulations species of pathogenic wood-destroying fungi, associated with an oak, actually existing in the composition of mycocenosis (fungi biota) of the oak forest or its part, is distinguished from the mycocenotic structure of the oak forest or its part, on the basis of morphophysiological similarity (belonging to *Polyporaceae* s.l.) and trophotopic community (association with *Q. robur*, the ability to parasitize, wood-destroying activity, mainly the core localization of the caused dote).

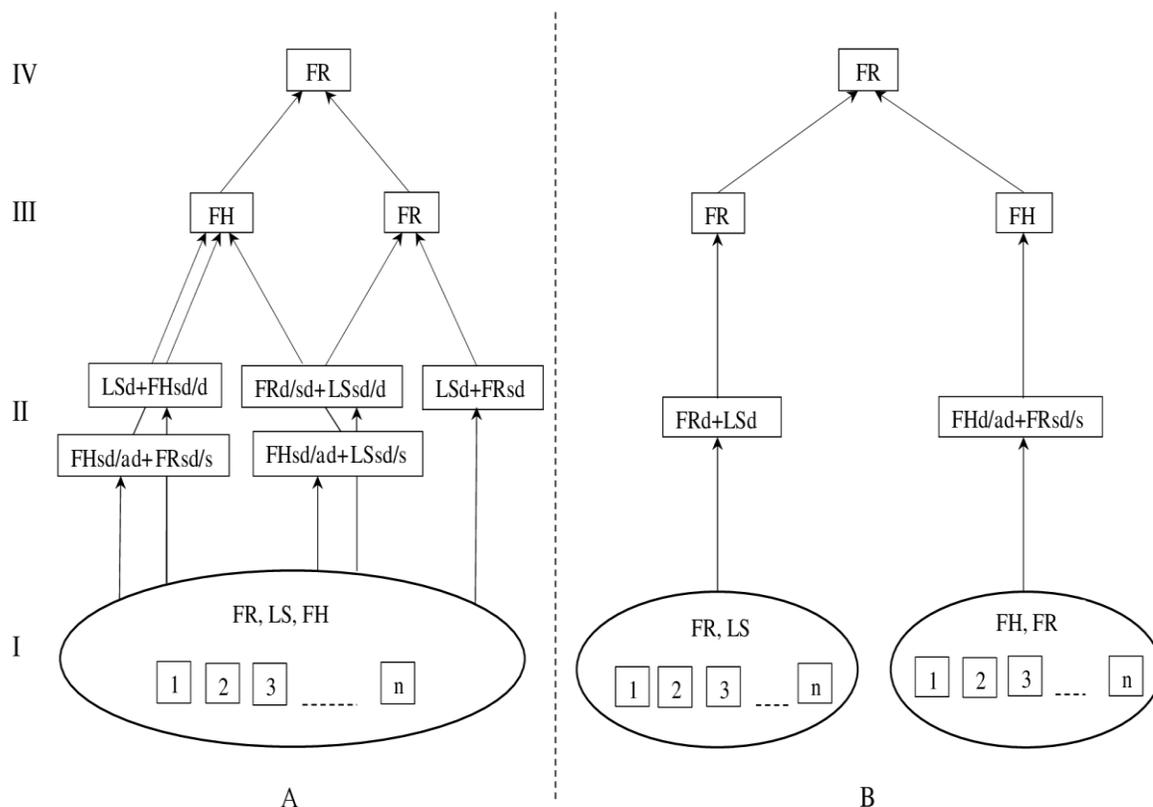
In the process of field investigations, the experimental material was collected, including information about a possible species composition and structure of the specific elementary  $P_Q$  - mycopathocenosis, about the possible nature of their association with oak stands of different status and origin and different site conditions. It was found, that the composition of elementary  $P_Q$  - mycopathocenosis usually consists of 10-11 species of PPF [2, 5]. Not all these species are always found in any of the  $P_Q$  - mycopathocenosis. Most elementary  $P_Q$  - mycopathocenosis has 4-6 species [2, 3], the main of which are 2-3. Based on the results of preliminary cameral analysis, the distinctive types of  $P_Q$  - mycopathocenosis in coppice oak stands of varying degrees of anthropogenic transformation [2], seed and mixed oak forest stands [3] were

determined. Further analysis allowed to state the following considerations.

Species core of the full-membered elementary  $P_Q$  - mycopathocenosis usually consists of three species (Figure: I, A): false oak polypore *Fomitiporia robusta* (P. Karst.) Fiasson & Niemelä, sulphur polypore *Laetiporus sulphureus* (Bull.) Murrill, beefsteak fungus *Fistulina hepatica* (Schaeff.) With. (Latin names of species are given according to [10, 11]). The species core of semi-complete  $P_Q$  - mycopathocenosis consists of two species: *F. robusta* (abbreviated - FR) and *L. sulphureus* (LS) or *F. hepatica* (FH) and *F. robusta* (FR) (Figure: I, B.). These species can act as absolute dominants (abbreviated - ad), dominants (d), subdominants (sd), or even secondary species (s).

As a result of the study of the structure of the  $P_Q$  - mycopathocenosis species core, the association of  $P_Q$

- mycopathocenosis with oak stands of different status and origin, and in certain forest-growing conditions, the groups of elementary  $P_Q$  - mycopathocenosis, similar in terms of two species dominance, whose participation in the species composition is the highest, were determined (identified). Each of these groups is a separate type of elementary  $P_Q$  - mycopathocenosis, similar in configuration of the species core structure and associated with forest stands of similar status and origin and similar forest growing conditions. The name of each individual type can be produced by the names of the types of dominants and subdominants, whose presence and participation in this type of elementary  $P_Q$  - mycopathocenosis distinguishes it from others and determines its features. We have identified the following types of  $P_Q$  - mycopathocenosis (see Figure 1).



**Fig 1: Scheme-model of hierarchical structure of regional PPF community on oak:**

**I-IV - subordination levels: I - level of elementary  $P_Q$  - mycopathocenosis; II - level of elementary types of  $P_Q$  - mycopathocenosis; III - level of groups of elementary types of  $P_Q$  - mycopathocenosis; IV - level of regional community of PPF (regional-formatinal); A - full-membered communities, B – semi-complete communities.**

Among the full-membered  $P_Q$  - mycopathocenosis (see Figure: II, A): (FHsd/ad + FRsd/s)-type (index sd/ad - indicates the range of dominance status of FH species: from subdominant to absolute dominant, index sd/s - indicates the range of dominance status of FR species: from the subdominant to the secondary species); (FHsd/ad + LSsd/s)-type, (LSd + FHsd/d)-type (index d - indicates the dominance status of LS species, index sd/d - indicates the range of dominance status of FH species: from the subdominant to the dominant species, co-dominating LS species); (FRd/sd + LSsd/d)-type (index d/sd - indicates the range of dominance status of FR species: from the dominant to the subdominant, index sd/d - indicates the range of dominance status of LS species: from subdominant to dominant), (LSd + FRsd)-type (LS - is the dominant species, FR - is the subdominant species).

Among the semi-complete  $P_Q$  - mycopathocenosis (see Figure: II, B): (FRd + LSd)-type (FR - is the dominant, LS - is the co-dominating dominant), (FHd/ad + FRsd/s) -type (FH - is the dominant to absolute dominant, FR - is the subdominant to a secondary species).

The revealed types of elementary  $P_Q$  - mycopathocenosis can be used as a basis for constructing a syntaxonomic system of both regional and zonal (forest-steppe) communities of PPF.

More complex unit of the regional PPF community is the group of types (see Figure: III, A, B) - the combination of types of elementary  $P_Q$  - mycopathocenosis, which is distinguished on the basis of types similarity of elementary  $P_Q$  - mycopathocenosis, by the dominance of species-determinants (i.e. dominant species depending on environmental conditions). We have identified the following groups of types of elementary  $P_Q$  - mycopathocenosis (see Figure: III; A, B): FH - is a group of types and FR - is a group of types of elementary  $P_Q$  - mycopathocenosis. FH-group combines the types of elementary  $P_Q$  - mycopathocenosis, formed in coppice oak stands of unsatisfactory sanitary condition in anthropogenically transformed oak forests or in seed old-aged oak stands in oak forests with limited economic activity. FR group combines the types of elementary  $P_Q$  - mycopathocenosis, formed in coppice oak stands of oak trees of satisfactory sanitary condition in anthropogenically transformed oak forests or in seed mature and overmature oak stands in oak forests with limited economic activities.

The community of the highest level, combining all considered communities, is the regional PPF community, which can be considered as a regional-formational one (see Figure: IV; A, B). This is FR-community, since it is *F. robusta*, who claims the role of species-founder of PPF communities: it is widespread, it has a stable and high representation in the PPF community at all hierarchical levels, with a higher representation in the stands, less affected by anthropogenic activities. And, importantly, this species, according to our observations, is the first among the species of community for digesting of new environment - it locates on middle-aged and older trees of oak with seed origin, in oak plantations of artificial origin (for example, in forest belts).

### RESULTS AND DISCUSSION:

On the basis of studies, conducted in the oak forests of the southwest of the Central Russian Upland, six types of elementary  $P_Q$  - mycopathocenosis were distinguished: four types of full-membered and two types of semi-complete.

Two groups of types of elementary  $P_Q$  - mycopathocenosis, associated with oak stands, in mountain and ravine oak forests of the southwest of the Central Russian Upland were identified: FH group (primary dominant - *F. hepatica*) and FR group (primary dominant - *F. robusta*).

FH-group combines the types of elementary  $P_Q$  - mycopathocenosis, formed in coppice oak stands of **unsatisfactory sanitary condition** in anthropogenically transformed oak forests or in seed old-aged oak stands in oak forests with limited economic activity.

FR group combines the types of elementary  $P_Q$  - mycopathocenosis, formed in coppice oak stands of oak trees of **satisfactory sanitary condition** in anthropogenically transformed oak forests or in seed mature and overmature oak stands in oak forests with limited economic activities.

Four-level scheme-model of the hierarchical structure of the regional PPF community was proposed. It allows not only to systematize information about this community of wood-destroying fungi, taking an active part in modern succession processes, occurring in the oak forests of the forest-steppe, but also to create prognostic models for their formation under different conditions.

**CONCLUSIONS:**

Polypores *Polyporaceae* is a group of basidium fungi known as wood destroyer, includes two group FH (primary dominant - *F. hepatica*) and FR (primary dominant - *F. robusta*). groups of elementary  $P_Q$  – mycopathocenosis associated with elementary  $P_Q$  – mycopathocenosis.

Present study not only highlighted the hierarchical structure of polypore fungi but also help research community to find out changes occurring in the oak forests in a time decade.

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