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***ASPECTS REGARDING THE PRESERVATION OF SOME WOODEN CHURCHES FROM
SUCEAVA COUNTY AGAINST THE ATTACK OF HARMFUL INSECTS***

ABSTRACT OF THE DOCTORAL THESIS

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Introduction

Cultural heritage is an important component of the national wealth, occupying a special place in the social and economic life. Through its value, number and composition, it envisages the national cultural peculiarity, while its stage of preservation indicates the level of civilization of the contemporary society and the way in which cultural heritage is treated.

The wood, in its various forms, was for men one of the most useful construction materials. Generally, wood degradations occur due to the action of a complex of etiopathogenic, abiotic and biotic factors.

Insects have their well-defined role in the natural biodegradation of material, but when they act against spiritual and material values of men, it is of common sense to intervene in order to preserve those values.

Usually, the management of harmful insects is more often approached through chemical means. However, the scientific research in this domain aims at establishing efficient, ecologic methods that have no collateral effect on the objects, in order to prevent and manage the harmful insects' attack of the heritage assets.

“Aspects regarding the conservation of several wooden churches from Suceava County against the attack of harmful insects” is a doctoral thesis that presents important data regarding the species of insects that are harmful to the art work pieces from the morphologic, biologic, ecologic and ethologic points of view, as well as the measures of prevention and control of the attack.

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Harmful insects have always been part of the human beings life, which determined the need to study them as detailed as possible (morphologically, biologically and/or etiologically), in order to find the most efficient ways to manage them, all this due to the damages that they generate. In **the first chapter – The history of the research**, some of the most important researches, from our country and from abroad, regarding the systematic study of insects is presented, as well as the publications that deal with the preservation issues of heritage assets.

In order to elaborate this study new materials and methods were necessary, these being presented in the **second chapter**, namely: the scientific study of insects that are harmful to the heritage assets. This chapter systemizes all the specialty data related to the morphology, biology, ecology and management, the fundamental literature including specialty works from our country as well as from around the world; the biologic material, in this case insects that are harmful to the heritage assets, as well as their predators and parasitoids, was sampled from 14 wooden churches from Suceava county; in order to make it available for the study (macro- and microscopic), the scientific preparation of the collected material was made through dry and wet conservation methods; the growth of two xilophagous coleoptera, *Callidium violaceum* L. (Coleoptera: Cerambycidae) and *Ptilinus pectinicornis* L., (Coleoptera: Anobiidae), was achieved; the provision of iconography was made through photographic (macro- and microphotography) and video recordings of the sampled biologic material and of the degradations produced by insects; for the statistic processing of the data the analytic parameters of *frequency* (F) and *constancy* (C) were used, and the biocide quality of the essential oil of cinnamon (*cinnamomum casia*) was tested in the laboratory.

In **chapter III** general information and geoclimatic considerations regarding Suceava county are presented, along with the fourteen investigated stationaries – wooden churches from Northern Moldova that are subjected to the attack of harmful insects.

The **forth chapter** presents species of previously identified xilophagous coleoptera that are harmful to the wooden cultural heritage from Romania, as well as specie of harmful insects identified by us at the wooden churches from Suceava county (2007-2012), namely species from the following families: Anobiidae - **1. *Anobium punctatum* De Geer**, **2. *Priobium carpini* Herbst**, **3. *Stegobium paniceum* L.**, **4. *Ernobius mollis* L.**, **5. *Xestobium rufovillosum* De Geer**, **6. *Ptilinus pectinicornis* L.**, Ptinidae - **7. *Ptinus fur* L.**, **8. *Ptinus raptor* Strum**, Dermestidae – **9. *Anthrenus scrophularie* L.**, **10. *Anthrenus museorum* L.**, **11. *Anthrenus polonicus* Mroczkowski**, **12. *Anthrenus verbasci* L.**, **13. *Attagenus piceus* Oliver**, **14. *Dermestes lardarius* L.**, **15. *Megatoma undata* L.**, Cerambycidae - **16. *Callidium violceum* L.**, **17. *Hylotrupes bajulus* L.**, **18. *Arhopalus rusticus* L.** și Curculionidae - **19. *Hexarthrum exiguum* Boh.**, and **20. *Stereocoryncoes truncorum* Germ.**.

Furthermore, this chapter comprises the compendium of the identified species of harmful insects, along with information regarding the synonymy, geographical distribution, morphology, biology, ecology and the references made within our research. The photographic illustration, made with the help of the optical and electronic microscopes caught some novel aspects regarding the morphology of adults, eggs, larvae and pupas.

Thus, the species of xilophagous coleoptera, that have a greater impact in the degradation of the studied wooden churches, were treated more detailed.

Chapter V comprises biological data of some insects that are harmful to the wood, with specific references on the growth of xilophagous coleoptera: the embryonary development, the post-embryonary development, the sexual dimorphism, the sex ratio, the longevity of adults and the length of the biological cycle, personal data such as the longevity of adults from the *Callidium violaceum* L. (Coleoptera: Cerambycidae) and *Ptilinus pectinicornis* L. (Coleoptera: Anobiidae) species being also presented, along with the biological cycle of the two species.

Chapter VI is entitled *Ecological data upon some harmful insect species pertained to some wooden churches from Suceava*. The colonization and settlement of any biological community on the organic and inorganic material is influenced by the composition and preservation state of the

substratum or by the environmental factors (temperature, humidity, light). The life cycle, spread, activity and reproduction of the insects are also influenced by these ecological factors. The variations of the ecologic factors lead to a differentiated accommodation on the part of xilophagous insects, depending also on their interaction with the other factors.

Aspects regarding the influence of abiotic factors (temperature, humidity, light, nutritive support) on the development of harmful insect species that have been identified during our research had been marked out, general data on the biological cycle of the *Ptilinus pectinicornis* L. specie – aprox. 10 months at 20°C temperature and 65% RH – being presented, as well as original aspects regarding the preferences of the harmful species for a certain nutritive substratum (depending on the wood essence, age and level of decay due to fungi), and in order to support the specialists involved in the domain of conservation and restoration of cultural heritage in recognizing the species, the structural and color characteristics of the fecal matters of the *Anobium punctatum*, *Ptilinus pectinicornis*, *Xestobium rufovilosum* anobidae species, as well as of the *Callidium violaceum* cerambicidae specie and of the *Hexarthrum exiguum* specie, from the Curculionidae family are being presented.

Regarding the influence of the biotic factors on the xilophagous coleoptera, a series of inter-reciprocity and interdependency relations (symbiosis, sinoecia, parasitism and predation) are being presented.

The natural enemies, organisms that live on the account of insects that are harmful to the heritage assets, impeding their reproduction, growth and even inducing their death, are of certain interest from the point of view of the biological control. In the present study two species of hymenoptera, new genera and species for the Romanian fauna, are being identified: *Rhysipolis decorator* Hal. (Braconidae: Rhysipolinae), and *Pandelus flavipes* Föster, (Pteromalidae: Chalcidoidea). Species of parasitoids and predators identified in the studied stationaries are also indicated:

- parasitoids: from the Hymenoptera order, Ichneumoidea superfamily, Braconidae family: **1.** - *Spathius exarator* L. (Doryctinae Subfamily), **2.** - *Hecabolus sulcatus* Curt. (Doryctinae Subfamily), **3.** - *Rhysipolis decorator* Hal. (Rhysipolinae Subfamily); from the Ichneumonidae family **4.** - *Perithous scurra* Panzer (Pimplinae Subfamily); and from the Pteromalidae family **5.** - *Pandelus flavipes* Föster specie (Chalcidoidea: Pteromalidae);
- predators: from the Psocoptera order, Liposcelididae family: **6.** - *Liposcelis sp.*, (Psocoptera: Liposcelidae), and from Coleoptera order, Cleridae family, **7.** – the *Korynetes caeruleus* De Geer specie, and **8.** – the *Tillus elongatus* L. specie, while from Malachiidae family, we identified 5 species, from which only two are determined up to the specie level: **9.** - *Malachius bipustulatus* L. and **10.** - *Anthocomus fasciatus* L..

Through the laboratory experiment, namely by taking from a natural environment a wood piece infested with the *Ptilinus pectinicornis* L. xilophagous coleoptera, we obtained, in the following years, predators and parasitoids of the above mentioned pests. Thus, observations regarding the role of the parasitoid complex and the contribution of parasitoid species to the limitation of the *Ptilinus pectinicornis* L. population could be made (Suceava, 2011 – 2012).

Chapter VII, Ethologic data on some insects harmful to the wood, comprises observations regarding acoustical communication, mating behavior, thanatosis, the egg laying behavior and the behavior during the larvae stage of the insects harmful to the wood. Thus, several original aspects pertaining to the ethology of some insect species are presented:

- the mating behavior of the *Callidium violaceum* and *Ptilinus pectinicornis* species;
- the thanatosis phenomenon of the *Ptilinus pectinicornis* specie;

- the egg laying behavior of the *Callidium violaceum* and *Ptilinus pectinicornis* species;
- the behavior and attack method of the larvae of *Hylotrupes bajulus* L., *Callidium violaceum* L. and *Ptilinus pectinicornis* L.

In the **last chapter**, *Measures concerning the preservation of some wooden churches from Suceava County against harmful insects' attack*, aspects regarding the identification and the methods of managing the attack of insects that are damaging the wooden heritage assets are presented. The identification of the xilophagous insects in the studied wooden churches was made by studying several aspects: the form and dimensions of the degradations of the wooden substratum (exit holes, galleries and types of boring dust), the adult insects, the larvae, the presence of predators and parasitoids (a fact that mainly indicates the active character of the attack), thus, numerous aspects that underline the degradations due to these insects are being presented within a photographic documentation.

In order to support the specialists involved in the conservation of heritage assets, several characteristics of the attack of the most encountered harmful insects' species are being presented within a synoptic table, thus enabling their identification according to these characteristics. Similarly, novel data acquired following the overtaken researches regarding the predilection of insect species for a certain category of construction elements or ecclesiastic heritage objects is presented. Concerning the frequency of the harmful insects' attack within the 14 wooden churches, the first place is occupied by the anobiidae, the most frequent being the *Anobium punctatum* specie.

Regarding the control measures of the harmful insects that lead to the degradation of heritage assets, physical, chemical, biological, as well as some references to integrated management methods are being presented. Moreover, aspects concerning personal applications of harmful insects' management are being presented:

- among physical methods, we chose candescent electrical traps and those with adhesive;
- among chemical methods, the effect of some biocides on harmful insects was monitored;
- a special experiment was carried out in order to observe the effect of cinnamaldehyde on the larvae of the *Hylotrupes bajulus* L. specie, within the laboratories of the *Institutului de Valorificare a Lemnului și a Speciilor Arboricole (Istituto per la Valorizzazione del Legno e delle Specie Arboree, IVALSA)* in Florence, Italy; the results of the experiment prove that the cinnamaldehyde in the used concentration, has only a repellent character on the larvae, still this fact encourages further studies in order to determine the method and minimal concentrations that could make it lethal for insects that produce degradations to the wooden heritage.
- a larger number of adults of some parasitoid species have been obtained in laboratory conditions (2010 – 2012), *Hecabolus sulcatus* Curt. (Hymenoptera: Braconidae) and *Pandelus flavipes* Föster (Hymenoptera: Pteromalidae) for the xilophagous *Ptilinus pectinicornis* (Coleoptera: Anobiidae); this fact encourages the considerations regarding the growth of these species in laboratory conditions in order to be used in the biological management of harmful insects.

Conclusions:

The study elaborated on the 14 wooden churches from Suceava County, led to the conclusion that this type of heritage presents degradations that are part of a larger category of problems pertaining to the heritage assets from our country. All the studied monuments have preservation problems, the biodegradation provoked by xilophagous insects being one of outmost importance. The church of *The Feast of the Ascension*, Vama, from the Bucovina Village Museum was subjected to conservation-restoration interventions, the attention drawn by the problem regarding the harmful insects having however a permanent aspect, because the permanent improvement of the protection

and insect management measures is still open. This case can be considered one of the “happy” ones, at the opposite side being some wooden churches that have never been part of conservation-restoration projects, being at the most subjected to some empiric interventions that in most of the cases led to a more accentuated decay (no matter how good the intention was), their existence being shortened, up to some irredeemable losses.

In this case, the ignorance or the lack of financial means on the part of the beneficiaries of historic and artistic assets, the lack of an efficient national protection system, the faulty application of the Heritage Legislature, led to a major situation concerning the wooden architectural heritage.

The doctoral thesis presents briefly the situation regarding the state of preservation of some churches, wooden architectural monuments, with their pertaining heritage, that are not in the attention of the habilitated institutions due to their classification in the category of monuments of local importance within the National Heritage List; it is a fact however that this kind of situation is characteristic for the whole country.

Local or central authorities within the Minister of Culture consider the responsibility for the heritage assets to belong first of all to the beneficiaries, invoking the Heritage Law according to which the owners are responsible with the preservation and restoration of the assets belonging to them, but the latter, once having the necessary financial means, may be “discouraged” by the difficult procedures for the procurement of the necessary notifications.

The difficult situation involving the economic issues, the lack of efficient laws and measures meant to protect the heritage, as well as the lack of proper qualification in the preservation domain among monument beneficiaries, make it almost impossible the insurance of minimal preservation interventions, such as current attendance and monitoring of degradations.

This study represents also an alarm signal for the rescue of the National Heritage assets, along with other studies elaborated under the guidance of thy profesors Maria and Gheorghe Mustață, by my colleagues acting in the domain of heritage preservation (Giorgiana Gămălie, Mina Moșneagu, Bogdan Ungurean).

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