

*Full Length Research Paper*

# Wood-destroying Coleopteran species in the historical buildings in Kastamonu, in Turkey

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The aim of this study is to identify the harmful insects causing damage in the historical wooden buildings of Kastamonu. Accordingly, 15 of those historical wooden buildings situated in the city were periodically controlled between the years 2002 and 2005. During those periodic controls, damages caused by insects were detected and additionally, dead and alive insects were collected from the damaged materials. As a result of this study, 7 species from 4 families were identified; these species are *Anobium punctatum* De Geer, *Xestobium rufovillosum* De Geer, *Ernobius mollis* (L.), *Ptilinus pectinicornis* (L.) (Anobiidae), *Lyctus brunneus* (Steph.) (Lyctidae), *Hylotrupes bajulus* (L.) (Cerambycidae) and *Rhizophora* sp. (Bostriichidae). Except *A. punctatum* and *H. bajulus*, the rest are considered as the first records gathered in Kastamonu region.

**Key words:** Kastamonu, wood-damaging insects, historical wooden buildings.

## INTRODUCTION

Wood is an important material that is made out of trees. Wood as a material source has been commonly used in the service of human beings by means of supplying firewood, armament and settlement since the beginning of history. Furthermore, in accordance with the rapid developments in technology, the use of wood as a raw material for various purposes has increased. It has been known recently that wood as a raw material is used in around 10,000 different areas such as building construction, furniture design and decoration, parquetry, production of musical instruments, wire poles, Palladian wood materials, timber cladding panels, plywood panels, wood wafers, wood fibreboards and production of paper and carton (Colak et al., 2006).

The characteristic of wood under suitable operating activities, as the only renewable raw material of mankind, its high durability against various expositions despite its lightness, the ease of processing; the fact of consuming less energy during its processing, its feature of possess-

ing variety of patterns and colours, its low audio, thermal and electrical conductivity, its flexibility, the opportunity of reprocessing and of containing acoustic features required, the feature of being less affected by chemicals, its attractiveness which increases after surface processing like colouring and lacquering, and its colour getting dark with a fine appearance after use can all be listed as some of the reasons for preferring wooden materials for several works and furniture making (Colak et al., 2006). Thus, the fact that wood had been preferred and used as a construction and building material in historical buildings and mansions in Kastamonu has depended on the inexhaustible reasons just mentioned. Kastamonu is in the Western Blacksea region and is one of the cities of Turkey. The facades of the 534 registered old houses in the city center all exhibit different architectural features. These structures, the majority of which belong to the Ottoman period, have been purchased by the office of the governor and restored for use either by organizations of civil society and charitable foundations or as museums (Anonymus, 2007).

Wood has got many biological enemies among these, insects seems to loom large. One of the most effective ways of passing on wooden buildings, which are mainly

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our historical inheritances and cultural resources, to the next generation is to avoid possible damages and challenge all kinds of defects to which these heritages are exposed. In those buildings observed, dried wood had been used for roofing, beams, columns, stairs, doors and frames and for furniture and other wooden constructions. The detection of wood-damaging insect pests, the improvement of wood protecting methods by means of preventing the damage and decay caused by these insects and the application and refinement of possible management strategies for controlling continuous insect-induced damage play a great role in the preservation and restoration of wooden constructions.

Despite the apparent lack of national literature regarding wood-damaging insects, the first book published "Wood-Damaging Insects in Turkey" (Erdem and Canakcioğlu, 1977) investigated the biological definitions and identification of wood-damaging pests with their characteristics, wood types defect and protection methods against their decay. Later on, wood-damaging insects were also studied and discussed in many books and articles on wood or wood processing (Bozkurt et al., 1993; Canakcioglu and Mol, 1998; Gunay, 2002; Ors and Keskin, 2001; Ozer 1957 - 1962; Toker, 1967). A preliminary study, in which wood-damaging insect species causing decay in wooden materials used for the construction of culturally precious old houses in Bartın was completed in 1996 (Ozkazanc et al., 1996). Toper Kaygin (2007) compiled the studies on wood-damaging animals, particularly on insects, and published a book titled "Industrial Wood Pests". Having economically significance, four Coleoptera species *Anobium punctatum* (De Geer), *Xestobium rufovillosum* (De Geer), *Lyctus brunneus* (Steph.) and *Hylotrupes bajulus* (L.) were detected in wooden materials used in Duzce region (Akbulut et al., 2008). The damage density and the extent of temporal dispersion regarding the defect of *A. punctatum* in historical wooden buildings in the Western Black Sea region were analyzed by Toper Kaygin and her group in 2007 (T. Kaygin et al., 2008).

The purpose of this study is to detect wood-damaging Coleopteran species in old wooden buildings constructed throughout the Ottoman Empire era in Kastamonu and thus, to form a sound and fundamental basis for upcoming studies in respect of determination of insect induce damage in wooden buildings and materials.

## MATERIALS AND METHODS

### Materials

Wooden materials used in historical wooden houses and mansions and wood damaging insect species were studied between 2002 and 2005, in historical wooden buildings situated in Kastamonu. The samples obtained from the old buildings were delivered to a laboratory and examined.

### Selection of sample constructions

Those buildings having been restored and protected under Act 2863 and by the Tourism Office in Kastamonu or those ones which have not yet been restored, as well as old buildings and mansions of private property having historical and cultural value were selected. The careful selection of these buildings dependant on the authentic regional style of architecture. The samples of wooden materials obtained from the old buildings were delivered and examined in Vedat Tek Restoration Center which has been being officially committed to the regional governor's office (Ozcan, 2005).

### Collection, preparation, protection and examination of samples

Wood-boring insect traps were set in the selected buildings and checked regularly, approximately within a week period. The defected materials with frass or sawdust in insect tunnels were delivered to the laboratory and cultured in wooden-glass constricted cages of size 60 cm × 50 cm × 50 cm.

Collection, preparation and identification of samples were done according Çanakcioğlu (1993). The taxonomic status and synonyms of the species were compared to recent updates of web pages (Anonymus, 2009a, b, c).

During the investigations, adult insects observed on randomly selected samples in the buildings and mansions were killed with ether and afterwards the dead adult samples were delivered to the laboratory for preparation in special envelopes packed with cotton. The larvae, observed alive, were collected with the defected materials. By shaving some of them and culturing the rest in the wooden-glass constricted cages, the production of adult insects was attempted.

In order to identify the insects collected, the identification keys of species belonging to Bostrychidae, Lyctidae, Cerambycidae and Anobiidae families were taken into consideration and consulted for the differentiating process.

## RESULTS AND DISCUSSION

The wood materials used for the construction of old buildings in Kastamonu were mostly attained from *Pinus nigra*, *Pinus sylvestris*, *Abies bornmulleriana*, *Quercus* sp., *Castanea* sp. and *Cedrus* sp. It was observed that since *P. nigra* and *P. sylvestris* were much more commonly preferred, insect-induced damage was detected mostly on them. The species of host plant are listed in Table 1 and harmful insect species are listed in Table 2. Among these, *H. bajulus* and *A. punctatum* seemed to be the most harmful and defecting ones. *A. punctatum* was detected in built-in cupboards, carvings, furniture, door and window joints made of black pine and Scots pine while *H. bajulus* was mostly observed in beams, columns and specifically in materials that had not been put through the impregnation process. Furthermore, wooden materials being used during restoration studies in time periods have become a nutrition source for wood-damaging insects. Due to the lack of impregnation, the renewed materials containing wood used for shelves and in built-in bathrooms specifically in mansions, paved the way for wood-damaging insects.

**Table 1.** The families and subfamilies of wood-damaging insects in Kastamonu.

Family	Cerambycidae	Anobiidae			Bostrychidae	
Subfamily	Cerambycinae	Anobiinae	Ernobiinae	Ptilininae	Dinoderinae	Lyctinae
Species	<i>Hylotrupes bajulus</i> (L.)	<i>Anobium punctatum</i> (De Geer)	<i>Ernobius mollis</i> (L.) <i>Xestobium rufovillosum</i> (De Geer)	<i>Ptilinus pectinicornis</i> (L.)	<i>Rhizopertha</i> sp.	<i>Lyctus brunneus</i> (Steph.)

**Table 2.** The data of identified insect species (host plants, their location, biological period and date).

Insect species	Host plant	Location	Date	Biological Period
<b><i>A. punctatum</i> (De Geer)</b>	<i>Juglans</i> sp., <i>Pinus sylvestris</i>	75. Years Cumhuriyet House	12.05.2003	Adult
	<i>Pinus sylvestris</i> , <i>Cedrus</i> sp.	Tahir Efendi Mansion House	27.05.2003	Larva, Adult
	<i>Pinus sylvestris</i> , <i>Quercus</i> sp.	Toprakcilar House	05.07.2003	Larva
	<i>Quercus</i> sp., <i>Pinus nigra</i>	Kirkodali	14.08.2003	Adult
	<i>Quercus</i> sp., <i>Pinus nigra</i>	Kasaba Village Mahmut Bey Mosque	06.06.2004	Adult
	<i>Pinus sylvestris</i>	Ellezler Mansion House	22.06.2004	Adult
	<i>Pinus sylvestris</i> , <i>Quercus</i> sp.	Vedat Tek Restoration Centre	24.06.2004	Larva, Pupa, Adult,
<b><i>Xestobium rufovillosum</i> (De Geer)</b>	<i>Pinus sylvestris</i>	Vedat Tek Restoration Centre	27.04.2003	Adult
<b><i>Ptilinus pectinicornis</i> (L.)</b>	<i>Quercus</i> sp.	Vedat Tek Restoration Centre	23.05.2004	Adult
<b><i>Ernobius mollis</i> (L.)</b>	<i>Pinus sylvestris</i>	Toprakcilar House	18.07.2004	Adult
<b><i>Lyctus brunneus</i> (Step.)</b>	<i>Quercus</i> sp., <i>Castanea</i> sp.	Vedat Tek Restoration Centre	12.07.2004	Adult
<b><i>Hylotrupes bajulus</i> (L.)</b>	<i>Pinus sylvestris</i>	75. Years Cumhuriyet House	12.05.2003	Adult
	<i>Pinus sylvestris</i>	Tahir Efendi Mansion House	27.05.2003	Larva, Adult
	<i>Pinus nigra</i> , <i>Quercus</i> sp.	Toprakcilar House	05.07.2003	Larva, Adult
	<i>Pinus nigra</i> , <i>Quercus</i> sp.	Kirkodali Mansion House	14.08.2003	Adult
	<i>Pinus nigra</i> , <i>Quercus</i> sp.	Kasaba Village Mahmut Bey Mosque	06.06.2004	Adult
	<i>Pinus sylvestris</i>	Ellezler Mansion House	22.06.2004	Adult
	<i>Pinus sylvestris</i>	Sepetcioğlu Mansion House	24.06.2004	Adult
	<i>Pinus sylvestris</i>	Sirkeli Mansion House	28.06.2004	Adult
	<i>Pinus sylvestris</i>	Eflanili Mansion House	10.08.2004	Adult
<b><i>Rhizopertha</i> sp.</b>	<i>Pinus sylvestris</i>	Pursaklar Mosque	10.03.2003	Adult
	<i>Pinus sylvestris</i>	Pursaklar Mosque	29.03.2004	Adult

**Table 3.** Host plant prefers of some wood destroying beetles.

Insect species	Host plants
<i>A. punctatum</i>	Softwood and hardwood
<i>X. rufovillosum</i>	Hardwood and softwood
<i>E. mollis</i>	Softwood
<i>P. pectinicornis</i>	Hardwood
<i>L. brunneus</i>	Hardwood
<i>H. bajulus</i>	Softwood and hardwood
<i>Rhizopertha</i> sp.	Hardwood

**Figure 1.** Small pile of dust accumulates near exit holes of *A. punctatum* in the wood.

The damage caused by *A. punctatum* was detected on materials mostly used in the basements, bathrooms and kitchens of mansions. *H. bajulus* defected the sound and solid part of wooden materials used in regularly heated buildings. Implying the departure of the insects, oval shaped holes and tunnels on the surface of the woods showed that the validity of wood was wasted.

#### Family: Anobiidae

Anobiidae species tend to infest soft woods (such as conifers) but also hard woods (oak, poplar, walnut, beech e.t.c.) in general (Table 2 and 3).

#### ***Anobium punctatum* (De Geer, 1774) (Furniture Beetle):**

Synonyms: *Anobium pertinax* Fabricius, 1775; *A.*

*domesticum* (Geoffroy, 1785) and *A. striatum* Olivier, 1790. This damaging insect was detected in various parts of entrances and rooms of buildings and mainly located in carved boards, in-built bathrooms and wooden ornaments, stair carvings, shelves in kitchens, windows and frames (Table 2). An adult one was noted on the feet of a handmade piano made of walnut tree, at 75, Cumhuriyet House. In addition to this, 78 entry and exit tunnels were observed on a 10 cm × 10 cm piece of shelf obtained from the Mansion of Haci Tahir Efendi. It was observed that a yellow-like frass or powdered wood poured out of exit holes in which some dead adults with their heads turned upside were found near the edges. The damage caused by this insect was the building of parallel short tunnels near the surface of the wood, filled with yellow-like frass or powdered wood. The diameter of exit tunnels ranged from 1 - 1.2 mm (Figure 1).

#### ***Xestobium rufovillosum* (De Geer, 1774) (Death-watch beetle, Knock beetle):**

Synonyms: *Xestobium faber* (Thunberg, 1784), *X. pulsator* Schaller, 1783; *X. tessellatum* (Villers, 1789). The popular name of the "Death-watch beetle" is derived from the tapping noise produced by it and most frequently heard during the pairing season (Gahan and Laing, 1946).

After shaving of samples taken from Vedat Tek Restoration Centre, adult insects were observed to be dead. The circular shaped fly-through-tunnels were 3.5 - 4 mm in diameter. Their oval like shaped nutrition tunnels were quite craggy and excavated and ranged between 3.5 - 4 mm.

#### ***Ptilinus pectinicornis* (Linnaeus, 1758), Fan-bearing Wood-borer:**

Synonyms: *Ptilinus aspericollis* Menetries, 1832; *P. pectinatus* (Laicharting, 1781); *P. serraticornis* (Marsham, 1802). After shaving of frames taken from Vedat Tek Restoration Centre, adult insects were observed to be dead. The circular shaped exit holes ranged between 3.5 to 4 mm. Due to the paucity of these insects, the havoc they caused could not be overly determined.

#### ***Ernobius mollis* (Linnaeus, 1758), Pine Bark Anobiid:**

Synonyms: *Ernobius consimilis* Mulsant and Rey, 1863; *E. sybaris* (Kugelann, 1792); *Ernobius tarsatus* Kraatz, 1881. After shaving of samples obtained from Toprakcilar Evi, adult insects were observed to be alive. As there were barks at the edges of the samples, it was determined that the sample logs had not been whip-



**Figure 2.** Damage of *L. brunneus* (Steph.).

sawed but shaped with hand tools. The insects were discovered under the shells. The circular sectioned fly-through-tunnels were 1.8 - 2 mm in diameter. They randomly excavated tunnels towards the cambium. The larvae were harmful for the sound and solid parts of the wood. Due to the paucity of these insects, the havoc they caused could not be overly determined.

#### **Family: Lyctidae**

#### ***Lyctus brunneus* (Stephens, 1830), Powderpost Beetle:**

Synonyms: *Lyctus disputans* Walker, 1701; *L. costatus* Blackburn, 1888 -*Xylotrogus brunneus* Stephens, 1830. This insect was detected in the exit tunnels of a wooden log in Vedat Tek Restoration Centre during daytime. A pile of tiny dark yellowish frass or sawdust poured out of the circular shaped exit tunnels that was 1.2 to 1.8 cm in diameter. The surface of the sample log was untouched, yet the part under the surface was covered with long, parallel and connected holes that seemed to be the remnants of rat damage (Figure 2). They feed primarily on hardwoods (Table 3).

#### **Family: Cerambycidae**

#### ***Hylotrupes bajulus* (Linnaeus, 1758), House longhorn beetle, Old house borer:**

Synonyms: *Hylotrupes caudata* (De Geer, 1775); *H. similis* (Marsham, 1802). Amongst all, this species was the most damaging and caused most havoc observed in the historical buildings in Kastamonu. It was mostly seen

in wooden beams, floorings and roofs. The sound and solid parts of the wood affected were completely spoiled. When examined outside, the entry holes could be seen whereas insect damage was not apparent. The exit holes were similar to the ones of *L. brunneus* and the excavated tunnels which were oval shaped, short and interrelated led to the deeps of the logs (Figures 3, 4 and 5).

Generally, these beetles infest softwoods such as pine. Besides they damage hardwoods such as poplar, alder, oak, e.t.c. (Özbek, 1978; T. Kaygin 2007; Tozlu, 2001a, b; Yildiz, 1981; Unger et al., 2001) (Table 3).

#### **Family: Bostrychidae**

#### ***Rhizopertha* sp.:**

These beetles feed on most stored grains and have been known to damage books and wood (Anonymous, 2009d).

In Kastamonu-Merkez Pursaklar Mosque, this insect identified as an adult was detected next to the windows and walls and similarly, under the sermon box. It was thought that the adults, observed alive yet motionless, came out because of the home heating panels. The exit holes of *Rhizopertha* sp. with sawdust pouring out of them were noticed on the wainscoted panels of 1 m height, boarded on the interior walls of the mosque.

Table 3 lists which woods are generally or preferentially attacked by insect pests in this research.

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**Figure 3.** Damages of *H. bajulus* (L.).



**Figure 4.** Adults of *H. bajulus* (L.).



**Figure 5.** Larva of *H. bajulus* (L.).

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