INSIDE THE WOOD:
Biological control of *Anobium punctatum* with *Spathius exarator*

Exclusive distributor of *Spathius exarator*

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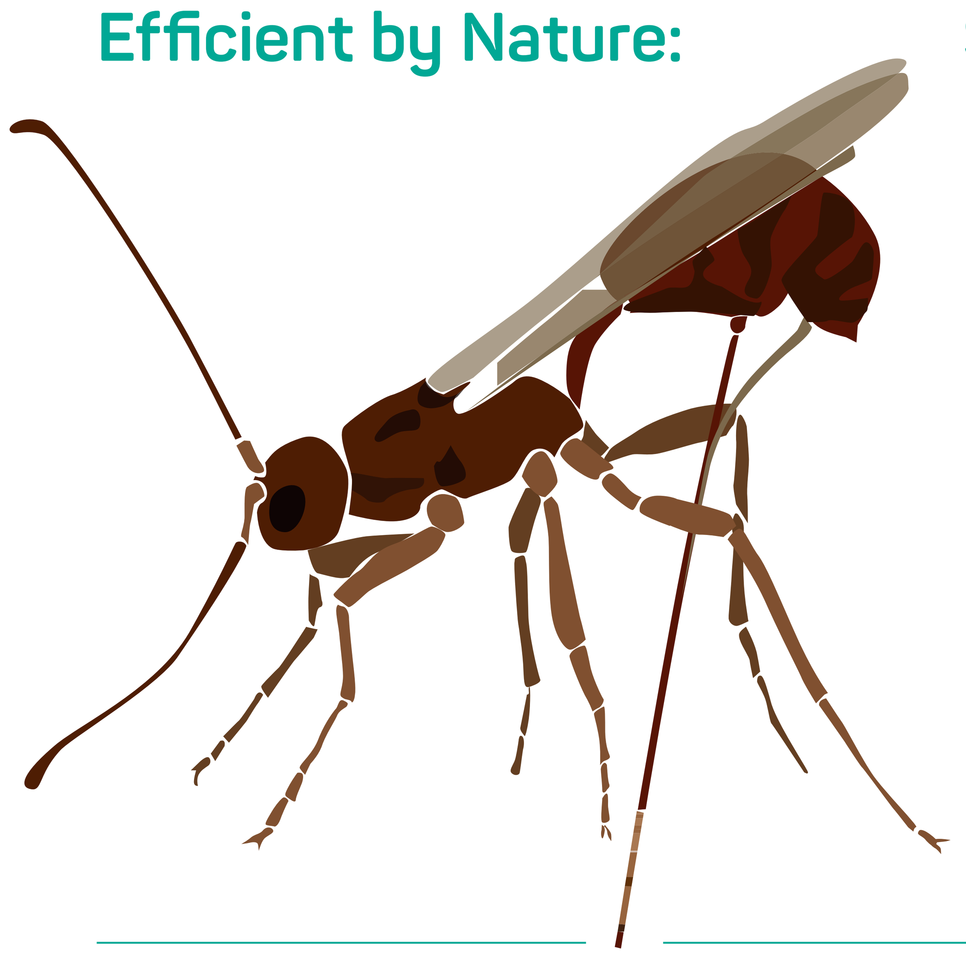
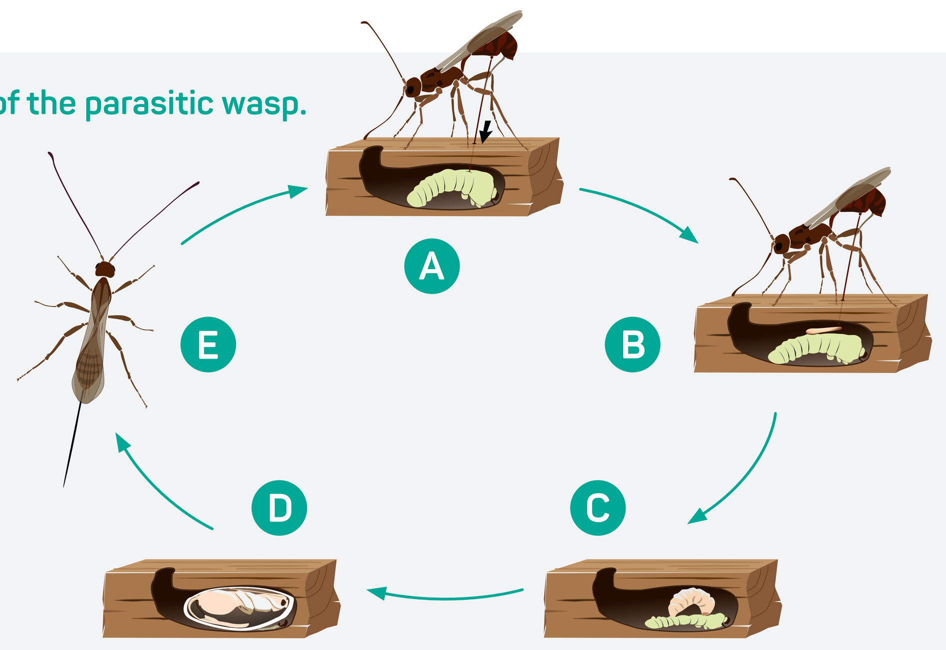
Efficient by Nature:



Spathius exarator versus Anobiidae

Biological control using beneficial organisms is getting more and more important in Integrated Pest Management (IPM). An effective strategy in fighting the furniture beetle *Anobium punctatum* (Coleoptrea, Anobiidae), one of the most common timber pest species, is based on its most frequent antagonist, the parasitoid wasp species *Spathius exarator* (Hymenoptera, Braconidae). The 5 to 9 mm large female braconid wasp parasitizes its host species by piercing the ovipositor directly through the wood surface followed by paralysation of the beetle larva and oviposition. After feeding on its host and killing it, the wasp pupates and hatches as adult wasp through a tiny 0.5 mm self-gnawed wood hole, which can be easily distinguished from the 2 mm wide holes caused by *A. punctatum*.

Life cycle of the parasitic wasp.
(Figure 1)



- A Female parasitic wasp detects furniture beetle larva, pierces its ovipositor into the timber and paralyzes the larva.
- B Oviposition onto paralyzed furniture beetle larva.
- C Eclosion of a parasitic wasp larva, which feeds on furniture beetle larva.
- D Death of furniture beetle larva, pupation of the wasp larva, eclosion and flying out.
- E Adult parasitic wasp.

Commercial use and monitoring procedure

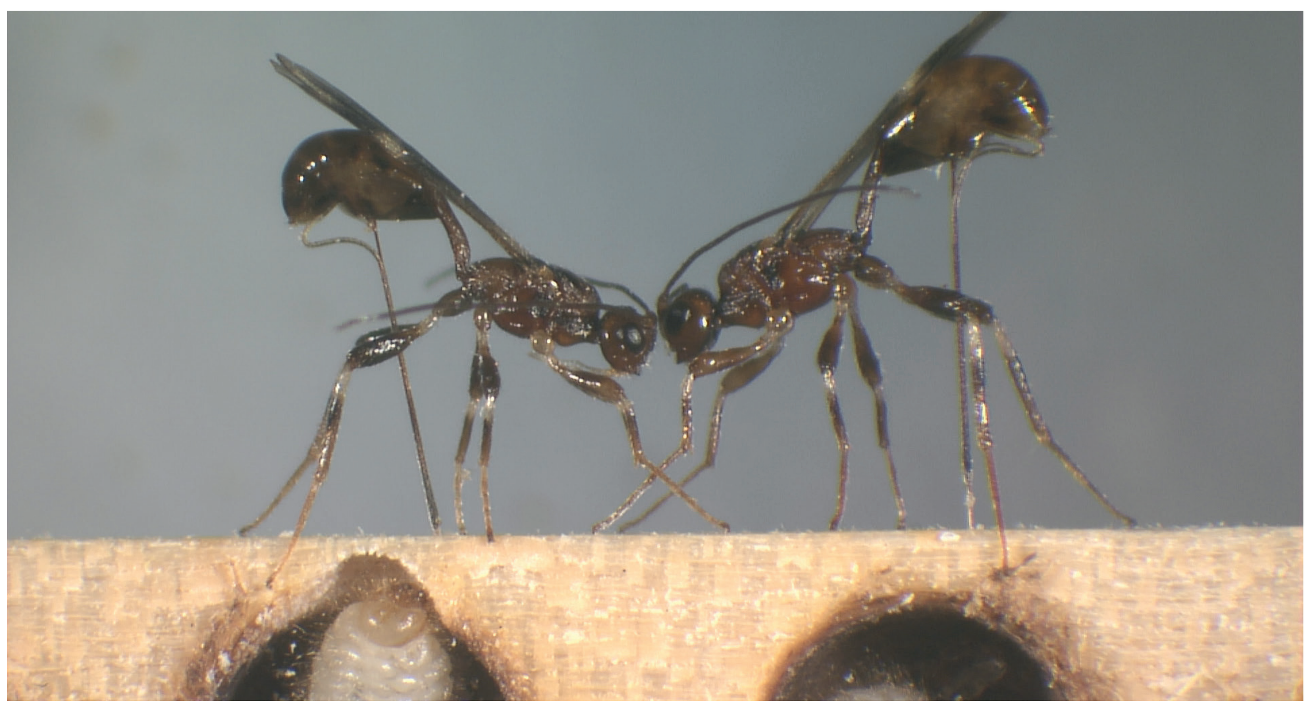
Since summer 2012, the wasps were successfully released into more than 120 different *A. punctatum* infested buildings. At least twelve treatments over a period of three years (> 15° C room temperature) were performed.

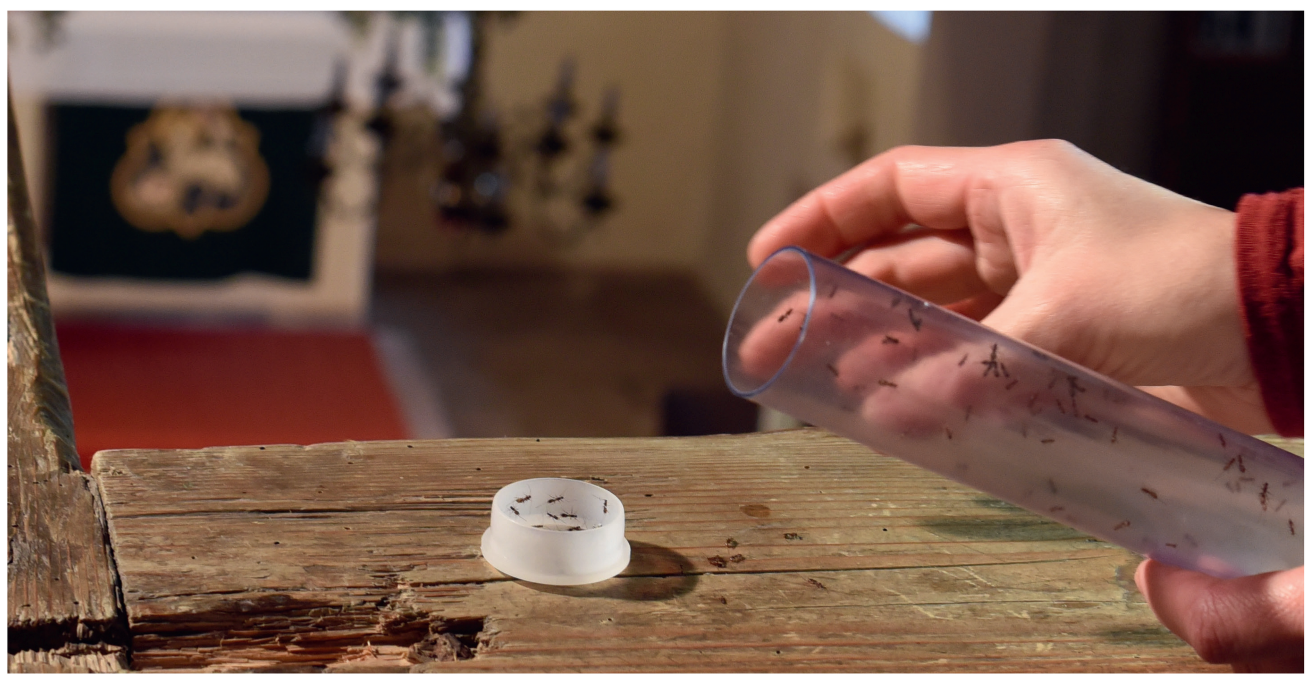
Concomitant to the treatments a monitoring of success, based on the intensity of infestation and the effectiveness of the parasitoids, was performed. Already existing exit holes of *A. punctatum* and *S. exarator* were counted on exactly defined areas before the first treatment started and a cumulative basic parasitization rate was calculated as the proportion of parasitized *A. punctatum*:

$$\textit{parasitation rate} = \frac{\text{no. of } \textit{S. exarator} \text{ exit holes}}{\text{no. of } \textit{S. exarator} \text{ exit holes} + \text{no. of } \textit{A. punctatum} \text{ exit holes}}$$

After each treatment year, the cumulative parasitation rate was recalculated. Each new exit hole of *A. punctatum* represents a surviving and each new exit hole of *S. exarator* represents a killed beetle. With these monitoring data, the number of annual treatments could be specifically adapted to the actual infestation level.

Here we present data of *A. punctatum* infested buildings (n = 52), successfully treated with *S. exarator*, by comparing the cumulative basic parasitation rate before the first treatment with the cumulative parasitization rate found during the last monitoring (Fig. 2). Moreover, the continous increase of the cumulative parasitation rate of three A. puncatum infested objects, treated and monitored over a period of seven years is shown (Fig. 3). In addition we compared the annual parasitation rate of *A. punctatum* infested untreated objects[1] with differing *A. punctatum* infested objects after several years of treatment with *S. exarator* (Fig. 4).





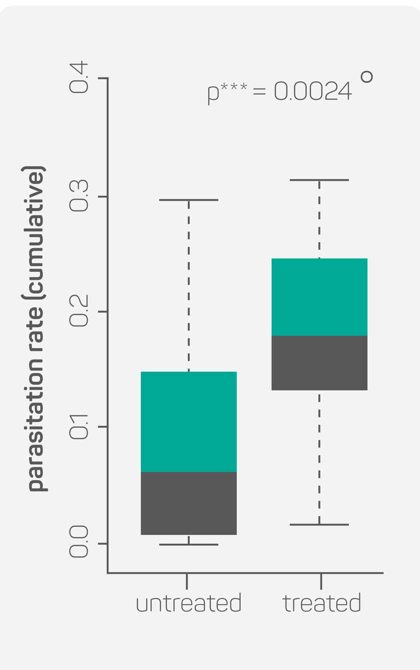


Figure 2

Cumulative parasitation rates of 52 *A. punctatum* infested objects before the first treatment (untreated) and during the last monitoring (treated). circle: outlier; asterisks indicate significant differences between the parasitation rates ($p \leq 0.001$; Wilcoxon-test).

Figure 3

Cumulative parasitation rates of three *A. punctatum* infested objects before the first treatment (untreated) and after each treatment year. The mean numbers of treatments per year were 6.7, 6.7, 2.7, 0.7, 1.7, 1 and 1.7 for treatment years 1 to 7, respectively.

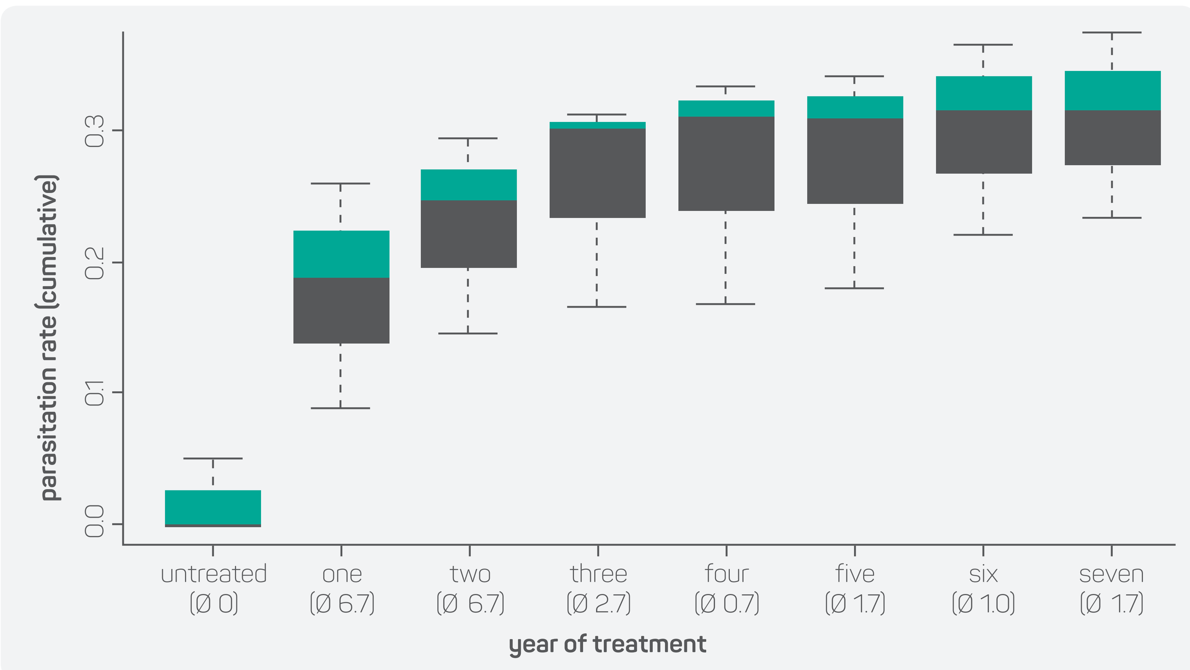
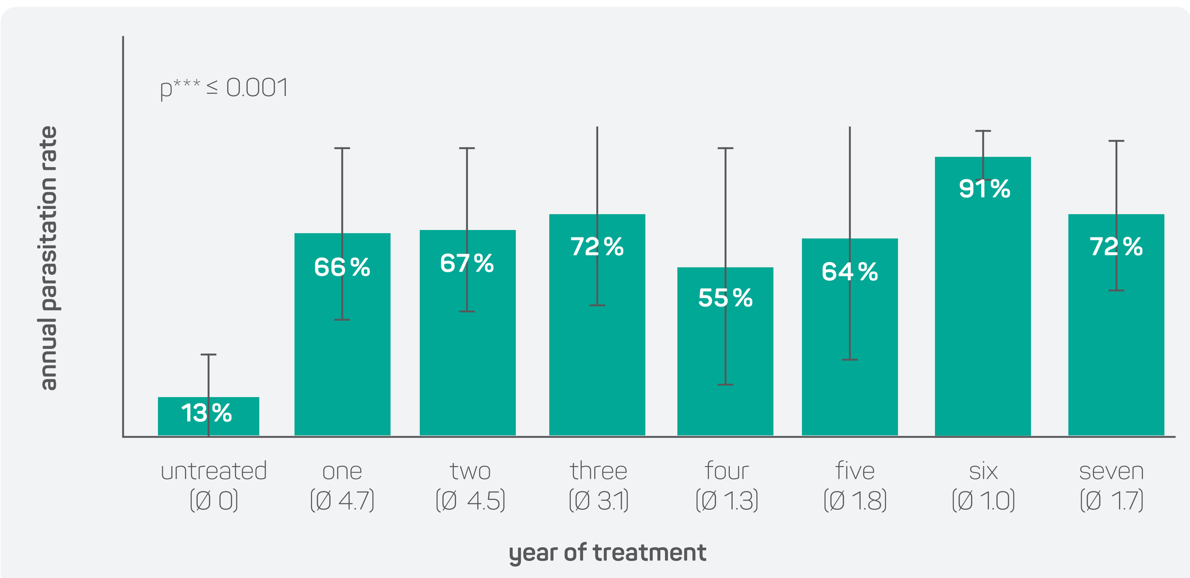


Figure 4

Annual parasitation rates of untreated *A. punctatum* infested objects (n=25; data collected over a period of two years1) and differing objects treated and monitored over a period of up to seven years. The mean numbers of treatments per year were 4.7, 4.5, 3.1, 1.3, 1.8, 1 and 1.7 and the number of treated objects were 54, 47, 24, 11, 9, 3 and 3 for treatment years 1 to 7, respectively. Differences between the untreated objects and the objects after one/two/three years of treatment were highly significant ($p \leq 0.001$; Mann-Whitney-U-test).



References:

[1] Zur Diagnose und integrierten Bekämpfung Holz zerstörender Insekten unter besonderer Berücksichtigung der Buntkäfer (Coleoptera, Cleridae) als deren natürliche Gegenspieler in historischen Gebäuden" Thilo Haustein, Fraunhofer IRB Verlag, 2010)

Results from seven years of practical application

The monitoring of success in *S. exarator* treated objects reveals *S. exarator* as an efficient and sustainable biological control method against the furniture beetle. Cumulative parasitation rates in treated objects are significantly higher compared to untreated objects (Fig. 2). Following the monitoring data of up to seven years of treatment, a stable cumulative parasitation rate is manifested with single annual treatments after the intensive treatment period (Fig. 3). The natural annual parasitation rate in untreated objects averages 13 %. After the first treatment year the parasitation rate increased up to 66 % and remained stable the following years up to now (Fig. 4).

The data demonstrate a higly significant rapid increase of the parasitation rate and consequently a strong decrease of *A. punctatum* activity after treatment with *S. exarator*. However, the respective conditions in the treated objects, like the type of wood, the strength of infestation, paintings or prior insecticide treatments might influence the parasitization success of *S. exarator*. Therefore a continuous monitoring-program after the period of intensive treatment with single extra treatments is recommended.

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