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*Bulletin OEPP/EPPO Bulletin* (2018) **48** (2), 277–280 ISSN 0250-8052. DOI: 10.1111/epp.12468

# First record of *Xylotrechus chinensis* (Coleoptera, Cerambycidae) in Greece and in the EPPO region

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*Xylotrechus chinensis* belongs to the entomofauna of China, Japan, the Korean Peninsula and Taiwan. Prior to this paper it has been intercepted twice outside its native range, once in Philadelphia (USA) and once in Germany (Europe). In spring 2017, it was detected for the first time in Greece, in Heraklion city (Island of Crete) infesting the trunk of trees of *Morus* species planted near the harbour of the city. It can thus be hypothesized that *X. chinensis* was transported from its native range with commodities that are handled in the harbour. Eradication efforts are being taken in order to prevent its further spread, which could threaten several other tree species because *X. chinensis* attacks a wide range of hosts. This is the first record of this pest from the EPPO region.

## Introduction

The cerambycid genus *Xylotrechus* (Coleoptera) has a Holarctic distribution, with the majority of species occurring in Southeast Asia and North America (Cherepanov, 1990). At least 180 *Xylotrechus* species have been recorded worldwide (Ohbayashi & Niisato, 2007). Given the richness of the genus in concert with the different environments the species inhabit, larval feeding preferences of *Xylotrechus* species vary greatly, including oaks (*Quercus* sp.), pines (*Pinus* sp.) and willows (*Salix* sp.) among many others (Linsely, 1964). About 85 *Xylotrechus* species are found in the Palearctic region (Sama & Löbl, 2010). Prior to this study only seven of these *Xylotrechus* species had been recorded in Europe. In Greece, four species from the genus have been reported, namely *Xylotrechus arvicola*, *Xylotrechus stebbingi*, *Xylotrechus rusticus* and *Xylotrechus antilope* (Fauna Europaea, 2018). These four species have drawn little attention so far, probably due to the fact that they have not caused extensive damage. In the spring of 2017, mulberry trees near the harbour of Heraklion (Crete) were found to be heavily infested by a cerambycid species (Figure 1) that bore no resemblance to other species of the endemic entomofauna. In order to accurately identify the species, samples were sent to the Natural History Museum of Crete for morphological identification, and molecular analysis was conducted in the Laboratory of Forest Entomology (Forest Research Institute, Thessaloniki).

## Biology and morphology of *Xylotrechus chinensis*

*Xylotrechus chinensis* mainly infests old mulberry trees (*Morus* sp.) but can also feed on Rosaceae (*Malus* spp. and *Pyrus* spp.) and Vitaceae (*Vitis vinifera*) (Han & Lyu, 2010). Immediately after the hatching, larvae make galleries under the bark of the tree and gradually enter the wood tissues of the lower parts of the trunk and roots (in August–September). *Xylotrechus chinensis* overwinters in the wood of the infested tree, where it pupates. Adults emerge in late spring (May–June) through circular exit holes and then move to the top of the tree to feed on shoots and leaves of the tree and become sexually mature. Infested trees exhibit multiple exit holes, most of which are located mainly on the south-eastern parts of the tree. Symptoms of infestation include droppings and frass on the surface of the trunk. A direct consequence of the infestation is a gradual weakening of the tree that can result in its death.

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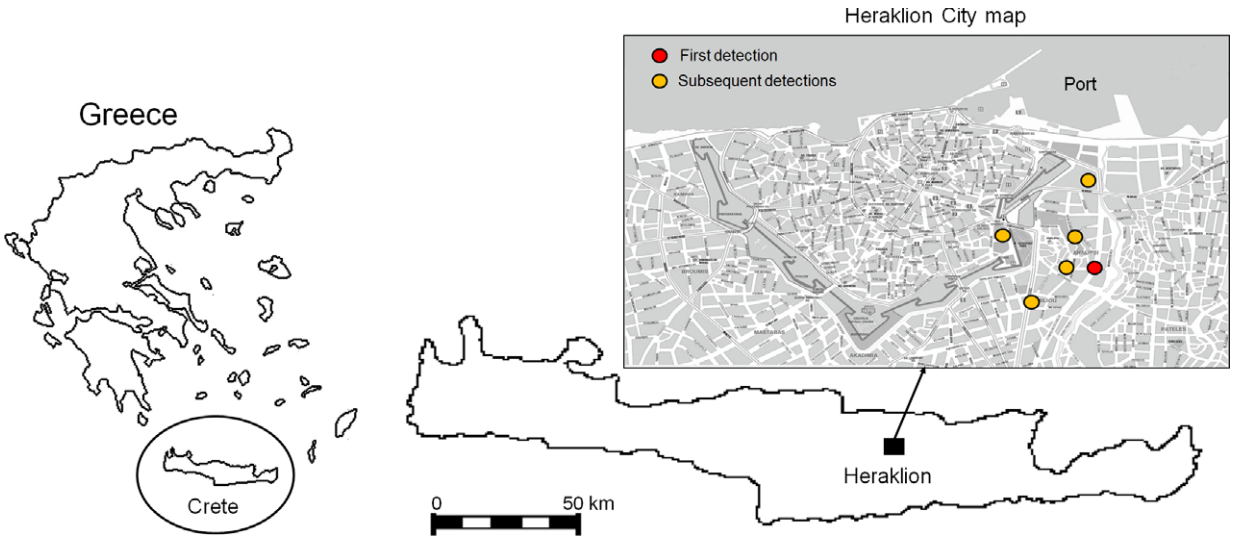


**Fig. 1** Map showing the locations where *Xylotrechus chinensis* was found in Greece for the first time. [Colour figure can be viewed at wileyonlinelibrary.com]

## Identification of *X. chinensis*

### Morphological identification

Morphological identification was carried out by the fourth author based on the detailed description presented by Han & Lyu (2010).

### Molecular identification

DNA was extracted from four adult individuals using a GenElute Kit (Sigma) following the manufacturer's protocol. Amplification of an approximately 700 bp locus from the mitochondrial cytochrome oxidase I (*Cox1*) gene was carried out with primers LCO2198 (5′-ggtc aac aaa tca taa aga tat tgg-3′) and HCOI1490 (5′-taa act tca ggg tga cca aaa aat-3′) (Folmer *et al.,* 1994). Each reaction of 25 μL in volume contained 0.2 μL of MyTaqTM (BioLine, GmBH, Germany), 5 μL of the provided 5× MyTaqTM Red Reaction Buffer (BioLine, GmBH, Germany), 0.75 μL of each primer (20 μM), 8 μL of DNA extract and finally double-distilled $H_2O$ to make up the volume to 25 μL. The PCR conditions included an initial denaturation step at 94°C for 3 min, followed by 40 cycles at 94°C for 30 s, 48°C for 30 s and 72°C for 90s with a final extension step that lasted 7 min at 72°C. The PCR products were then purified with PureLink™ PCR Purification Kit (Invitrogen) and sent for sequencing with both primers at a commercially available service (Cemia SA, Larissa, Greece). The obtained sequences were initially visualized by ChromasLite® (Technelysium Pty Ltd) and then aligned manually by eye. The sequence retrieved was compared with others already deposited in the NCBI GenBank using CLUSTALX (Thompson *et al.,*1997) and was then submitted to NCBI GenBank with the accession number (MH191402).

Both molecular approaches and the morphological study indicated that the species found is *X. chinensis* (Figure 2), a wood-boring beetle that is endemic in China, Japan, the Republic of Korea and Taiwan (Han & Lyu, 2010). In Europe, this longhorn beetle was intercepted for the first time in wood packaging material imported to Germany (Benker, 2008), while it has also been detected in Philadelphia (USA) in non-compliant wood spools that held steel wire rope shipped from China in 2011 (CBP, 2011).

Given the fact that all specimens found were located in close proximity to the harbour of Heraklion and in concert with other interceptions of this species (Benker, 2008), it is highly probable that *X. chinensis* was transported with commodities that were handled in the port of the city. Even though *X. chinensis* exhibits a rather low interception frequency rate based on interception records from the USDA and New Zealand Forest Research Institute (Brockerhoff *et al*., 2014), its potential as an invasive pest should not be overlooked, in particular because of its broad host range. The isolation of its sex pheromones (Iwabuchi *et al.,* 1987; Kuwahara *et al.,* 1987), which can be used in traps, provides an additional tool for a prompt detection before *X. chinensis* becomes established.

## Current pest status/distribution in Heraklion city

*Xylotrechus chinensis* was detected for the first time in the Heraklion city area in spring 2017 on the trunk of a tree belonging to the genus *Morus*, as shown in Figure 1. The infested tree was found less than 1 km from the port of Heraklion. Further surveys in summer 2017 indicated additional infestations near to the initial detection point (<700 m from) and all close to the port area, indicating that the initial infestation leading to the establishment of the pest was most probably located among the spots detected in



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**Fig. 2** Adult *Xylotrechus chinensis* detected in the region of Heraklion. [Colour figure can be viewed at wileyonlinelibrary.com]

this study (Figure 1). Thus far, around 200 trees have been recorded as being infested by *X. chinensis*. Of these trees, about 15% exhibited complete desiccation while the rest exhibited typical symptoms of *X. chinensis* infestation such as the characteristic adult exit holes on the tree trunk (Figure 3). From the small size of the infestation area and taking into account the annual life cycle of the pest the date of introduction of *X. chinensis* to the Heraklion area was estimated to be 2014–15.

## Conclusions

Given the current limited occurrence of *X. chinensis* in Heraklion city, the need for eradication measures becomes important. Following similar cases of measures taken against other invasive cerambycid species (e.g. *Anoplophora chinensis*, *Anoplophora glabripennis*), the success of eradication efforts mainly depends on the accurate and timely detection of infested trees (Meng *et al.,* 2015). To achieve that, numerous approaches have been employed over recent years; these mainly include ground and tree-climbing surveys (Meng *et al.,* 2015). However, the only means to effectively control further spread is the cutting down and destruction of infested trees before the emergence of adults (Hérard *et al.,* 2006), and this has worked well in some cases (Haack *et al.,* 2006). For that reason, similar approaches are currently being employed in the region of Heraklion in an endeavour to reduce drastically the population of the beetle. However, at the same time, and taking into account the ability of the species to attack a wider range of hosts, the authors would recommend adding *X. chinensis* to the EPPO Alert List, in order to protect other countries in the region from this wood-boring beetle.

## Premier signalement de *Xylotrechus chinensis* (Coleoptera, Cerambycidae) en Grèce et dans la région OEPP

*Xylotrechus chinensis* belongs to the entomofauna of China, Japan, Korea and Taiwan. Prior to this paper it has been

**Fig. 3** Exit holes of adult *Xylotrechus chinensis* on mulberry trunks near the harbour of Heraklion. [Colour figure can be viewed at wileyonlinelibrary.com]

intercepted twice outside its native range, once in Philadelphia (USA) and once in Germany (Europe). In spring 2017, it was detected for the first time in Heraklion city (Crete, Greece) infesting the trunk of *Morus* sp. trees planted near the harbour of the city. It can thus be hypothesized that *X. chinensis* was transported from its native range with commodities that are handled in the harbour. Since then, eradication efforts are being taken in order to prevent its further spread, which could threaten several other tree species, as *X. chinensis* attacks a wide range of hosts. This is the first record of this pest from the EPPO region.

## Первое сообщение о *Xylotrechus chinensis* (Coleoptera, Cerambycidae) в Греции и в регионе ЕОКЗР

*Xylotrechus chinensis* относится к энтомофауне Китая, Японии, Кореи и Тайваня. К моменту выхода этой статьи, он был дважды выявлен в грузах за пределами своего естественного ареала, один раз в Филадельфии (США) и один раз в Германии (Европа). Весной 2017 года, он впервые был обнаружен в городе Ираклион (Крит, Греция). Заражены были стволы деревьев *Morus* sp., посаженные возле городской гавани. Таким образом, предположительно, *X. chinensis* был завезен из своего



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естественного ареала вместе с товарами, прибывшими в гавань. С тех пор предпринимаются усилия по его ликвидация, с целью предотвращения его дальнейшего распространения, которое может представлять угрозу для нескольких других видов деревьев, т.к *X. chinensis* заражает широкий круг хозяев. Это первое сообщение о присутствии этого вредного организма в регионе ЕОКЗР.

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