A beauty of a beetle, a beast for trees

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Two species of longhorn beetles, *Anoplophora glabripennis* and *A. chinensis* (Coleoptera: Cerambicidae), both with origin eastern Asia, have been introduced into areas in northern America and Europe. Both species are very damaging to a series of deciduous tree species due to tunnelling of the larvae. Heavily attacked trees often die in the course of a few years. Since these two species are declared 'quarantine organisms' by the EU, they are considered pest species, and countries are obliged to prevent entry of these beetles, or, if already present, to eradicate/control them. Details about the biology, damage, and eradication strategies are discussed in detail.

Keywords: Anoplophora, longhorn beetles, damage, contingency plan

ANOPLOPHORA: BIOLOGY AND HOST PREFERENCE

The life cycle of *A. glabripennis* and *A. chinensis* is very similar. A female beetle will lay single eggs just underneath the bark of a host tree in a so-called 'oviposition-slit'. In total, up to a few hundred eggs per female are laid (Adachi 1988, Keena 2002, Mitomi *et al.* 1990). Oviposition sites can be recognized as bark scars, often in the form of the letter 'T' or an upside-down 'L'. From these oviposition sites, resin bleeds are common. After about two weeks, the eggs hatch and the larvae feed in the cambial layer of the bark in the branches and trunk. Later, they enter the woody tissue. Larvae tunnel through the wood, and since these larvae can be relatively large (up to 1 cm thick), they can severely damage their host tree. Affected trees that were chopped up into sections revealed the existence of enormous galleries of up to 3 cm in diameter. Larvae of *A. glabripennis* occur mostly in the trunk (above 30 cm from the ground), branches, and crown of the tree. Larvae of *A. chinensis* are only found in the roots and lower parts of the trunk (up to about 60 cm above ground level). At high population densities, they may also occur higher in the tree (M. Maspero, pers. comm.). Infested trees will almost always succumb to the infestation, although it may take several years.

Larvae have 11 stages and are up to 5 cm in length. The larvae have a white, creamy colour with a chitinized brown mark on the prothorax, and dark mouthparts. Development of larvae takes 1-2 years, after which the larva enters the pupal stage. This last developmental stage occurs in a pupal chamber, located just underneath the bark. At the location of these pupal chambers, the bark is often cracked, from which 'frass' (wood shavings/woodpulp) protrudes and falls to the ground. The adults emerge from circular holes, so-called 'exit holes', about 10 mm across. For *A. glabripennis* these exit holes are located at the higher parts of the trunk, and at branches and crown of trees. Exit holes of *A. chinensis* are usually only located at the superficial roots and lowest parts of the trunk. The beetles are typically cerambid in shape, about 25-35 mm long (EPPO 2006) (Fig. 1). The beetle is black with irregular white spots on the elytra. The antennae have 11 segments, each with a bluish-white base. Beetles live for about a month. They generally do not fly far, especially when host trees are nearby (Komazaki *et al.* 1989). For more details on the biology of *Anoplophora*, the authors refer to the 'revision of *Anoplophora*' (Lingafelter & Hoebeke 2002).

HOST TREES

Favourite host trees for *A. glabripennis* are from the genera *Acer* (maple), *Salix* (willow), *Ulmus* (elm), *Salix* (willow), *Aesculus* (horsechestnut), *Betula* (birch),

Figure 1. Anoplophora glabripennis (Coleoptera: Cerambicidae). Photo: Cech, Krehan, Perny, Tomiczek; Forstliche Bundesversuchsanstalt, Austria.

Platanus (London plane tree), and *Populus* (poplar), but species from the genera *Albizia* (mimosa) and *Sorbus* (European mountain ash) may also be attacked. Several tree species are questionable hosts. In some tree species, for example from the genera *Fraxinus* and *Tilia*, egg deposition has been recorded but no full development of the larvae seems to occur. In Austria, *Fagus sylvatica* (beech) has also been attacked but it is yet unknown it the life cycle can be completed on beech under natural conditions (http://bfw.ac.at.rz/bfwcms.web_print?dok=4242). Where *A. glabripennis* is oligophagus, *A. chinensis* is extremely polyphagus. Its host range possibly covers all deciduous trees. In Asia, they are the most important cerambicid pests in citrus orchards (EPPO 2006).

DISTRIBUTION AND DISPERSAL

Anoplophora glabripennis is indigenous to China, Korea, and possibly Japan. Its prevalence and range has increased as a result of the widespread planting of susceptible poplar hybrids, one of its host plants. It has been introduced into parts of northern America and Europe. This passive dispersal occurs by transporting infected plants (mostly bonsais), or by international transport of wood packaging material in which larvae or pupae are present. Over the last few years, *Anoplopha* findings in wood packaging material have declined, due to treatments of this material before export.

In the USA (New York, Chicago, and New Jersey), infestations were discovered in 1996, 1998, and 2002 respectively. In Canada (Toronto/Vaughan, Ontario) an infestation was discovered in 2003. In Europe signs of the species's presence were first discovered in Austria (Braunau) in 2000, although it had probably been present since 1997 or 1998. France has two infestations; discovered at Gien in 2003, and at St Anne/Brivet in 2004. Also Germany has two infestations, one at Neurkirchen in Bayern (discovered in 2004) and the other at Bornheim, near Bonn (discovered in 2005). In 2004, a single beetle was found in Poland. In the Netherlands, only one specimen (dead) has been found, in wood packing material, in 2002.

Anoplophora chinensis originates also from eastern Asia. Its original distribution is China, Japan, Korea, Taiwan, Hong Kong, Myanmar, and Vietnam. Passive dispersal of *A. chinensis* is the same as for *A. glabripennis*: through international transport of infested plants and through wood packaging material. One of the differences with *A. glabripennis* is its potential distribution. Mathematical models on species distribution, based on meteorological data and a larval development period of 1.5-2 years, show that *A. glabripennis* may establish in the Netherlands (MacLeod *et al.* 2002, De Boer 2004). However, compared to *A. glabripennis*, *A. chinensis* is less able to get established in areas where the summers are relatively cold, and an average Dutch summer is probably too cold for *A. chinensis* to complete its life cycle within 2 years (De Boer 2004). However, summers appear to become warmer and the possibility that *A. chinensis* can complete

its life cycle in 2.5 or 3 years under Dutch climatological conditions should not be excluded.

Anoplophora chinensis has been intercepted in several countries, among which the USA (1950's) and the Netherlands (1980's and '90's). In Europe, two countries have experienced *A. chinensis* infestations. France had a small infestation at Soyon (southern France) in 2003 (Coquempot *et al.* 2003). Italy discovered an infestation of CLB at Parabiago (Lombardy) in 2000, although the infestation had probably been present since the mid '90's or even earlier (Maspero *et al.* 2005). Currently, the population in Italy has affected an area of approximately 400 km^2 (Caremi and Maspero, pers. comm.). In the Netherlands, *A. chinensis* has been intercepted about 30 times since 1980, mostly from bonsai *Acer*. Also, single adult beetles have been found in private gardens. In the Netherlands, one specimen was found at Julianadorp and one at Zwanewater, both in 2002. In 2003 one specimen on *Acer japonica* was found at Zwijndrecht, and in 2004 in Lemmer one beetle was found that probably originated from a *Acer palmatum* tree, bought at a garden center. There has been an unconfirmed finding of a beetle near Brussels, Belgium in 2006.

DAMAGE AND ECONOMIC IMPACT

Both species can cause serious damage to healthy host trees. *A. chinensis* is considered an important pest for fruit trees, especially for citrus orchards. Trees are weakened by larval attack and are more readily susceptible to diseases and wind damage. Eventually, most infested trees will die, although this may take a few years. Damage to small, young trees is most serious. Until now, especially trees in semi-urban and urban areas are infested, although some infestations have been found at the edges of forests as well (C. Tomiczek, pers. comm.). Due to its devastating capacities both *A. glabripennis* and *A. chinensis* have the EPPO quarantaine status IAI (no's. 296 and 187 respectively), and are in the EU subject to emergency measures under Commission Decision 1999/355.

CONTINGENCY PLAN

Eradication of a pest that can attack various trees in public and private areas is complex. Findings of single beetles of *A. chinensis* in the Netherlands and recent outbreaks of *A. glabripennis* in European countries show a serious risk of introduction of *Anoplophora* into the Netherlands. Therefore, the Dutch Plant Protection Service is preparing a contingency plan. An international workshop was organized about *Anoplophora* to obtain practical information and exchange ideas about the pest organism and how to handle an outbreak. This workshop was held from 22-24 November 2006 at Wageningen, with representatives of countries that had recently dealt with a *Anoplophora* outbreak: France, Austria Germany, Italy, and Canada. The different control strategies in the countries were discussed.

In Canada, all host trees are removed in a radius of 400 m around trees with one or more exit holes while in the European countries only the visibly infested trees have been removed in most occasions so far. This number of 400 meter was derived from a field study in the USA that showed that 99% did not fly further than 400 m. (Komazaki *et al.* 1989, Sacco 2004). The reason to remove all host trees within a certain area was that even with an intensive monitoting strategy not all infested trees will be observed. In the best situation using tree climbers and bucket trees, only 60% of all infested trees were observed during winter time when trees have dropped leaves (B. Gasman, pers. comm.). During summer time this percentage is even much less due to the presence leafs. In the area around the central zone (400 m radius), a secondary zone (400-800 m) was created to intensively monitor all host trees for signs of infestation. In 2004, Canada had removed approximately 15,000 trees in their central zone. Apparently this method has been successful because after a sharp decline of findings in 2005, no new infections were found in 2006. (B. Gasman, pers. comm.; CFIA 2006). In the infested areas in Europe, the status of *A. glabripennis* is considered as 'under control'. This implies that the population is becoming smaller and the beetle does not spread to other areas, but that it has not been eradicated (yet). This is not the case for the population of *A. chinensis* in Italy, where over the last few years an increase in the number of infested trees has been observed (Maspero *et al.* 2005). All participants of the workshop agreed that for an effective eradication not only the visibly infested trees should be removed but all host trees around the infested trees with a certain radius. This radius might be less than 400 m since preliminary analysis of the data from Canada indicate that the vast majority of the beetles will not fly more than 200 m (B. Gasman, pers. comm.). The radius may also depend on the host plant density in the infested area.

Since *Anoplophora* infestations occur mostly in urban areas, and necessary phytosanitary actions to eradicate the pest take place in those areas, it is essential that, upon an outbreak, all stakeholders are duly informed. These include in the first place the habitants of the areas and local authorities, but also *e.g.* the general public and the press.

During the workshop the importance of 'eyes and ears in the field' was emphasized. The reason for this was that all cases of *Anoplophora* infestations were discovered by the public. Articles, accompanied by pictures of *Anoplophora* should inform the general public. This can be achieved through press releases, providing info at elementary schools, and on the internet, with the message to keep an eye out for this beetle: A beauty, but a killer for trees.

Acknowledgements The authors wish to thank the Dutch Ministry of Agriculture, Nature and Food Quality, and all participants of the workshop '*Anoplophora*' of 22-24 Nov. 2006: Chris Tomiczek, Peter Tiede-Arlt, Ben Gasman, Naima Ait Oumejjout, Thomas Schröder, Matteo Maspero, Gualtiero Caremi, Franck Hérard, Marta Valentini, Maarten Steeghs, Joris Voeten, Maarten Steeghs, Jan Schans, Gerard Prinsen, Manon

Leenders, Alwin de Haas, Peter Mocking, Susanne Driessen, and the invited stakeholders.

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