Pest Risk Analysis

Anoplophora chinensis

European and Mediterranean Plant Protection Organisation
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Guidelines on Pest Risk Analysis
Lignes directrices pour l'analyse du risque phytosanitaire

Pest Risk Analysis record format for PM5/3 (2) *Decision-support scheme for quarantine pests* (version 2006-09)

PEST RISK ANALYSIS FOR *Anoplophora chinensis*			
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Stage 1: Initiation			
1 What is the reason for performing the PRA?			This PRA was initiated following the finding of *Anoplophora chinensis* (an EU IAI listed pest) in growing plants in the Netherlands in December 2007. In addition, in August 2005 *A. chinensis* had been detected in the UK emerging from *Acer palmatum* that had been imported from China (Ningbo) in March 2005. The ongoing occurrence of *A. chinensis* in Italy also threatens the Plant Health Status of the EU and so for these reasons an EU wide PRA is warranted. <u>Details of NL outbreak</u> In December 2007, one *Acer campestre* shrub and one *Acer platanoides* tree growing in public area and a private garden, respectively, were found infested with *Anoplophora chinensis* in the Netherlands The *Acer* shrub had one exit hole. No larvae were found inside the shrub but the remaining exuvium of a larva showed that the exit hole had been made by *A. chinensis*. The

Acer tree had 7 exit holes and inside the trunk 18 larvae of *A. chinensis* were found. The *Acer* shrub and tree had not been imported but were growing 20 - 30 m away from a nursery which stocked *Acer palmatum* trees imported from China. Close to the infested tree and shrub 4 other *Acer* trees and shrubs and one *Corylus avellanae* shrub in public area ands private gardens were found infested (Table 1). Neither of these plants had been (recently) imported and at least several of the infested trees and shrubs had been planted before 2002.

Table 1. Number of exit holes and larvae of *Anoplophora chinensis* found in trees and shrubs growing in the Netherlands

No.	Plant species	Diameter infested stem or branch (cm)	Number of larvae	Number of exit holes
1	*Acer campestre*, shrub	4	0	1
2	*Acer campestre*, shrub	6	1	0
3	*Acer platanoides*, tree	25	18 larvae	7
4	*Acer platanoides,* tree	16	1 larva, 5 larval tunnels	4
5	*Acer pseudoplatanus*, tree	22	2 larvae, 3 larval tunnels	2
6	*Acer pseudoplatanus*, shrub	5	1	0
7	*Corylus avellanae*, shrub	3	0, 3 larval tunnels	2

At the Dutch nursery, *Acer palmatum* trees had been regularly imported from China since 2002. In December 2007, about 2,000 *Acer palmatum* trees were present at the nursery, a random sample of 400 of these showed that approximately 25% were infested with *A. chinensis*. Because of this finding The PPS performed intensive surveys at all nurseries/locations with *Acer* spp. imported from China and Japan and also at garden centres. Surveys were also performed in the surroundings of nurseries on which infested consignments were found and also in the surroundings of nurseries that have had plants originating from infested consignments. During these surveys, *A. chinensis* was found in imported consignments at 5 other nurseries, but not in the areas surrounding these nurseries. Infested consignments were destroyed and in cases where more than one exit hole was present that had been formed in the same season, host plants directly adjacent to the infested consignment were also destroyed.

		Between January 1980 and March 2008 *Anoplophora chinensis* has been detected more than 30 times in consignments of *Acer* and other genera imported from China, Japan and Korea but until the above-mentioned finding it was unknown whether *A. chinensis* could establish in the Netherlands. A CLIMEX study indicated that it was unlikely that *A. chinensis* could establish in North Western European countries (De Boer, 2004). A UK-PRA had concluded that it was unlikely that *A. chinensis* could establish in the UK based on a comparison of climate data from one of the warmest parts of the UK and areas where *A. chinensis* is known to be present (Baker & Eyre, 2006). The finding in the Netherlands with summer temperatures comparable to those in the warmest parts of the UK shows that *A. chinensis* can establish in the Netherlands and probably also in the UK.
2 Enter the name of the pest		Scientific name: *Anoplophora chinensis* (Forster). A comprehensive list of synonyms is provided in Lingafelter & Hoebke (2002). The most common synonym encountered in the literature is probably *Anoplophora malasiaca* . Common name: Citrus longhorn beetle
2a Indicate the type of the pest		A longhorn beetle whose larvae bore inside living hosts.
2b Indicate the taxonomic position		Insecta: Coleoptera: Cerambycidae
3 Clearly define the PRA area		EU
4 Does a relevant earlier PRA exist?	Yes, go to 5.	A PRA for the UK from 2006 (Baker & Eyre, 2006).
5 Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?	Partly valid, go to 6.	The PRA area was the UK, not the EU. The UK PRA concluded that *A. chinensis* is unlikely to establish in the UK. However, the outbreak in the Netherlands, indicates that *A. chinensis* can establish in climates with relatively low summer temperatures (like the Netherlands and the UK).
Stage 2A: Pest Risk Assessment - Pest categorization		
Identify the pest (or potential pest)		
6 Does the name you have given for the organism correspond to a single taxonomic entity which can be adequately distinguished from other entities of the same rank?	Yes, go to 8.	However, it is noted that *A. malasiaca* was recognised as a junior synonym of *A. chinensis* by Lingafelter & Hoebke in 2002, hence it can be confusing reading literature predating 2002 that differentiates between *A. chinensis* and *A. malasiaca*.
7 Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms and to be transmissible?		
Determining whether the organism is a pest		
8 Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?	Yes, go to 10.	In Asia, *A. chinensis* is the most important cerambycid pest in citrus orchards (Smith et al., 1997)

9 Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?		
Presence or absence in the PRA area and regulatory status (pest status)		
10 Does the pest occur in the PRA area?	Yes, go to 11.	*A. chinensis* is present in four areas in Lombardy in Italy. The largest area is 100 km^2, the other 3 areas are each about 2 km^2; these infestations are under official control according to the Lombardy Plant Protection Service. *A. chinensis* is transient and under official control (eradication) in the Netherlands. Detection of *A. chinensis* in consignments entering the UK have resulted in destruction of the consignments. *A. chinensis* is not known to occur in the UK.
11 Is the pest widely distributed in the PRA area?	No. Go to 12.	*A. chinensis* is present and under official control in Lombardy (Italy) and transient (under eradication) in the Netherlands.
Potential for establishment and spread in the PRA area		
12 Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?	Yes. Go to 13.	Hosts such as *Acer*, *Corylus, Prunus, Citrus*, *Malus*, *Populus* and *Salix* are widely distributed in the EU.
13 If a vector is the only means by which the pest can spread, is a vector present in the PRA area? (if a vector is not needed or is not the only means by which the pest can spread go to 14)	Not applicable, go to 14.	
14 Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?	Yes. Go to 15.	Climates similar to that of Lombardy can be found elsewhere within the EU, especially within southern Member States.
Potential for economic consequences in PRA area.		
15 With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) ?	Yes. Go to 16.	*Anoplophora chinensis* is the most important cerambycid pest of citrus orchards in Asia (Smith et al., 1997). *Citrus* is a very important crop in the EU. *A. chinensis* is very polyphagous on many deciduous trees: amenity trees and many natural forests in northern and southern Member States are at risk.

Conclusion of pest categorization		
16 This pest could present a risk to the PRA area.	Go to Section 2B	*Anoplophora chinensis* is a major wood boring pest of fruit trees, including *Citrus*, in China, Japan and Korea. There is a history of *A. chinensis* being transported from Asia into the EU via plants for planting. A population of *A. chinensis* is present in the southern EU (Northern Italy) although under official control (source: Lombardy Plant Protection Service, http://www.eppo.org/QUARANTINE/anoplophora_chinensis/chinensis_IT_2007.htm) and there is evidence that *A. chinensis* can establish in northern parts of the EU (Netherlands). Amenity trees and forests of deciduous trees across the EU and *Citrus* trees in the south of the EU are at risk from this pest.
17 The pest does not qualify as a quarantine pest for the PRA area and the assessment for this pest can stop (summarize the main reason for stopping the analysis)		

Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences

1. Probability of introduction **Introduction, as defined by the FAO Glossary of Phytosanitary Terms, is the entry of a pest resulting in its establishment.**		
Probability of entry of a pest		
Identification of pathways Note: If the most important pathway is intentional import, do not consider entry, but go directly to establishment. Spread from the intended habitat to the unintended habitat, which is an important judgement for intentionally imported organisms, is covered by questions 1.33 and 1.35.		
1.1 Consider all relevant pathways and list them		I. Host plants of *A. chinensis* imported from regions outside the European Union where the pest is present: *A. chinensis* is primarily present in China, Korea and Japan, "but a few specimens have been seen from Vietnam, Taiwan, Indonesia, Philippines, and Malaysia" (Lingafelter & Hoebeke, 2002). According to CABI (2007) *A. chinensis* is also present in Hawaii (US) and Myanmar. Table 2 lists *Anoplophora chinensis* host imports into the Netherlands, 2005-2007 from countries where *A. chinensis* is present. (SOURCE: Dutch Plant Protection Service). The total import of host plants is probably higher since the pest is polyphagous attacking plants belonging to more than 70 genera (see the genera listed by Lingafelter & Hoebeke (2002) , plant genera being attacked in Italy (Question 1.16) and genera on which the species has been found or intercepted (Question 1.5).

Table 2. Import of host plants of *A. chinensis* into the Netherlands from countries outside the EU where *A. chinensis* is present. (Database of PPS screened for import data of the following plant species or genera: *Acer, Carpinus, Celastrus, Cydonia, Chaenomelus, Corylus, Malus, Pyrus, Rosa, Sageretia*).

No	Host plant species	Country of origin	Number of plants imported from 2005 – 2007 into the Netherlands
1	*Rosa* spp.	China	25,000,000
2	*Acer* spp.	China	3,800,000
3	*Acer* spp.[1)]	South Korea	1,500,000
4	*Rosa* spp.	Japan	1,400,000
5	*Sageretia* spp.	China	600,000
6	*Rosa* spp.	South Korea	160,000
7	*Acer* spp.	Japan	31,000
8	*Carpinus* spp.	China	15,000
9	*Chaenomeles* spp.	China	6,000
10	*Corylus spp.*	Japan	5,500
11	*Lagerstroemia* spp.	Japan	4,000
12	*Lagerstroemia* spp.	China	2,500
13	*Rosa* spp.	Indonesia	1,800
14	*Carpinus* spp.	South Korea	1,800
15	*Cydonia sinensis*	South Korea	1,300
16	*Malus* spp.	Indonesia	1,200
17	*Rosa* spp.	Vietnam	1,000
18	*Chaenomelus* spp.	South Korea	360
19	*Carpinus* spp.	Malaysia	280
20	*Lagerstroemia* spp.	Indonesia	190
21	*Chaenomeles* spp.	Japan	180
22	*Pyrus* spp.	China	26
23	*Carpinus* spp.	Japan	19
24	*Malus* spp.	China	1
		sum	32,532,155

1) *Acer* spp. from South Korea are (mainly) rootstocks: seedlings with a stem diameter of 4 – 10 mm.

		Import of host plants from China, Japan and Korea into other EU-countries: In France less than 1,000 plants of *Acer* spp. and less than 10,000 plants of other host plant spp. were imported from China, Japan and Korea in 2005 (source: P. Reynaud, French Plant Protection Service). In the Netherlands, 1.6 to 2 million Acer were imported per year during the period 2005 – 2007. Dutch importers and growers estimate the total value of these plants (wholesale price) on about 3 – 6 million euro. They also estimate that 30 – 70 % of all Acer imported into the EU from China, Japan and Korea are imported via the Netherlands. Therefore, we assess the total import of Acer from these countries into the EU on about 4 million plants with a total value of about € 6 –12 million. <u>II) Solid wood imported from China, Korea, Japan</u> Solid wood (including wood products, wood packaging material) is a recognized pathway for the related species *A. glabripennis* (Hérard et al., 2005; Anonymous, 2006). This pathway is probably less important for *A. chinensis*: because *A. chinensis* usually deposits eggs on the main trunk at or just above ground level and 90% of the larvae are found in wood below ground level (Hérard et al., 2005) where wood is not harvested for WPM. Thus, *A. chinensis* is less likely to be present in solid wood material than *A. glabripennis*. However, one interception of *A. chinensis* in wood packaging material has been reported from Germany in June 2007 (Source: Europhyt), showing that it can be present in wood package material. EU requirements in line with ISPM no. 15 stipulate treatment of wood packaging material to prevent introduction of pest. If treatments required by ISPM no. 15 are carried out properly it should prevent introduction of both *Anoplophora glabripennis* as *A. chinensis*. For this reason and because all other known interceptions and findings of A. chinensis are related to the import of plant material with the exception of a few finds of which the origin was unknown, this pathway is not considered any further in this PRA. China, Japan and Korea are large importers of wood and as far as known no tree trunks are imported from these countries into the Netherlands or other EU member states. Relatively low volumes of artificially dried and treated wood (plywood, flooring and furniture) are probably imported from China into the Netherlands (information obtained from the VVNH/NTTA (Netherlands timber trade association). The probability that living specimen of *Anoplophora chinensis* will be associated with these wood products is estimated to be very low and, therefore, this pathway will not be considered any further in this PRA <u>III) Wood chips imported from China, Korea, Japan</u> Infested wood, chipped into pieces larger than 1.5 cm can enable larvae of *Anoplophora* spp. to survive. Chipping infested wood into smaller pieces is an effective way to eliminate *A. glabripennis* (Anonymous, 2007; USDA, 2008). As far as we know wood chips are not imported from areas where *A. chinensis* is present and, therefore, this pathway will not be discussed further in this PRA.
1.2 Estimate the number of relevant pathways, of	Moderate	We estimate there are approximately 50 pathways (plant genus x country of origin).

different commodities, from different origins, to different end uses.	number	
1.3 Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.		The import of host plants from areas where *A. chinensis* is present is considered the most important pathway. Solid wood is a pathway but is much less important than import of host plants as shown by the numerous interceptions/findings related to host plants (see the answer to question 1.5). In the present PRA, we will consider only the pathway "trade of host plants" since this is the most important pathway for the entire EU. All host plants of *A. chinensis* originating from regions where the pest occurs are relevant pathways. *Rosa* spp. are imported from Eastern Asia in large numbers (Table 2) but no interceptions of *A. chinensis* are known in *Rosa* spp. Possibly because *Rosa* spp. are grown in areas in Eastern Asia where *A. chinensis* is not present or only at low prevalence. Another reason could be the fairly small diameter of the stem of the imported plants. Because no interceptions are known, *Rosa* spp. from Eastern Asia are not considered an important pathway in the present PRA. Most known detections in consignments are related to the import of *Acer* spp (2008, EUROPHYT, EU records of interception). Import of *Acer* spp. from areas where the pest is present is, therefore considered the most important pathway. *A. chinensis* has, however, also been intercepted in several of the other host plants mentioned in Table 1 and, therefore, we consider all these host plants as important pathways (see the answer to question 1.5 for data concerning detection in consignments and findings related to imported host plants). In Eastern Asia, *A. chinensis* is primarily present in China, Korea and Japan (Lingafelter & Hoebeke, 2002). For this reason and because no interceptions are known of *A. chinensis* in plants imported from countries other than China, Japan or South Korea, only host plants imported from these countries are considered to be pathways from Eastern Asia. The probability that plants with a very small stem diameter, e.g. less than 1 cm, are infested may be lower than plants with larger stem diameters. However, inspectors of the Dutch Plant Protection Service have found living larvae of *A. chinensis* in *Acer* trees with a diameter of about 1 cm. Therefore, we consider all *Acer* spp. originating from areas where the pest is present as an important pathway independent of the size of the stem diameter. Thus, trade of host plants from infested areas are considered most important in the present PRA and will be discussed further. Import of *Acer* spp. is the most important pathway as shown by the high number of interceptions (see also 1.5).

		I. Host plants imported from China, Japan and South Korea belonging to the following genera: No. / Host plant / Country of origin: 1 – *Acer* spp. – China, Japan, South Korea[1)] 2. – *Carpinus* spp. – China, Japan, South Korea 3. – *Chaenomeles* spp. – China, Japan, South Korea 4. – *Lagerstroemia* spp. – China, Japan 5. – *Sageretia* spp. – China 6. – *Malus* spp. – China 7. – *Pyrus* spp. – China 8. – *Corylus* spp. – Japan 9. – *Cydonia sinensis* – South Korea 1) *Acer* spp. from South Korea are mainly rootstocks: seedlings with a stem diameter of 4 – 10 mm. **Uncertainty**: the minimum stem and root diameter needed to for full development of *A. chinensis*
Pathway n°. 1	Import of host plants from countries where the pest occurs outside the PRA area	
Probability of the pest being associated with the individual pathway at origin.		
1.4 How likely is the pest to be associated with the pathway at origin?	Likely	For host plant from China, Japan and South Korea: *A. chinensis* is widespread in these countries (Lingafelter & Hoebeke, 2002). Many interceptions and findings in imported host plants are known (see the answer on question 1.5).

1.5 Is the concentration of the pest on the pathway at origin likely to be high, taking into account factors like cultivation practices, treatment of consignments	Likely	<u>For all host pathways:</u> There are no effective methods available to control the pest except by spraying insecticides against adult beetles during summer months (Maspero *et al*., 2007). *A. chinensis* has a life cycle of 1-2 years in Eastern Asia and adults only live about 1- 3 months during summer. Adults lay their eggs in the bark (not between bark and wood) and eggs hatch after about 10 days (CABI, 2007; Maspero *et al*., 2007). Larvae are protected inside the stem or roots of plants and cannot be reached by non-systemic insecticides. It is also not possible or very difficult to see if a plant is infested when no exit holes (from which the beetles emerge) are present. Thus *A. chinensis* can only be controlled during a short period of its life cycle. The host plants mentioned under 1.3 are grown under non-protected conditions and the probability that they will become infested is likely to be high. This is confirmed by several interceptions in, and findings related to, imported consignments: **Interception data and findings per pathway since 1980** <u>1. ACER. SPP, ORIGINATING FROM CHINA, JAPAN AND SOUTH KOREA,</u> <u>Data from the Netherlands</u>: *Interceptions and findings during post-entry inspections (1980 – 2006)* From 1980 to 2006, *A. chinensis* has been intercepted/found in the Netherlands: - 6 times in *Acer* consignments from China - 11 times in *Acer* consignments from Japan *A. chinensis* has been intercepted both in naturally or artificially dwarfed plants (bonsai) and in small *Acer* trees with a stem diameter of about 1 cm or more. *Findings in the urban environment (1980 – 2006)* 2003 and 2004: two findings of single beetles in private gardens. Both beetles were found close to an *Acer palmatum* tree with an exit hole. The *Acer* trees originated from the same consignment imported from China. A living larva was found in trees of the same consignment at the nursery that had imported the trees. All trees were destroyed. *Findings since 2007* 2007/2008: During an intensive survey in 2007/2008, the Dutch Plant Protection Survey inspected about 100 locations with stocked *Acer* sp. imported from China or Japan for presence of *A. chinensis*. Infested *Acer* consignments were found at 6 different locations. At one of these locations living larvae were found in two consignments of *Acer* trees of different origin, both from Japan; in three other *Acer* consignments at this location (2 from Japan and one from China) exit holes were found that had probably been formed by *A. chinensis* as indicated by internal and external symptoms in/on these plants. Most of these exit holes had most likely been formed after import as indicated by the age of the exit holes (determined by analysis of the number of year rings formed after the exit hole had been formed). Sixty plants of one of the infested consignments, which did not show any clear external symptom were cut just above the soil and 13

		of them (22%) appeared to be infested as shown by the presence of a larva or a larval tunnel. From January 2008 – March 2008: 45 consignments of *Acer* spp. were imported from China and Japan. *A. chinensis* was intercepted in 2 consignments during import inspections and in 12 consignments during a post-entry inspection. All interceptions and findings were in *Acer palmatum,* except one finding in *Acer buergerianum*. <u>Interceptions/findings in countries other than the Netherlands</u> Several interceptions and findings on *Acer* spp. have been reported by other EU-countries and the USA (Anonymous, 2001; Hérard et al., 2005; Baker & Eyre, 2006; Wermelinger, 2006; Europhyt): Europhyt (interrogated 28 February 2008) contains interceptions of *A. chinensis* or *A. malasiaca* (syn.) on *Acer* spp. by the UK (and the Netherlands): UK: 4 interceptions on plants originating from China, 2 on plants that had been imported via the Netherlands) and 1 on plants (naturally or artificially dwarfed *Acer*) originating from South Korea. Year of interception: 1998 (1x), 2002 (1x), 2005 (1x), 2006 (3x), 2007 (1x). Two interceptions were *Anoplophora* sp. (species not indidated) on *Acer palmatum* and it is assumed in this PRA that the species was *A. chinensis*. UK, 2005: finding in 46,000 *Acer palmatum* trees in a nursery in Hampshire. The *Acer palmatum* originated from China. The outbreak was eradicated (EPPO, 2006) UK: from 1998 – 2007, in total 20 finds in England and Wales: 15x *Acer*, 4 origin unconfirmed, 1 x *Malus sylvestris* from Japan (pers. comm.. A. Macleod, Central Science Laboratory, UK). UK, Geurnsey island, 2008: finding of ten beetles on a batch of 900 *Acer palmatum* plants originating from China and imported via the Netherlands (EPPO Reporting Service, 2008/136 – source NPPO of Guernsey, 2008-07). Switzerland, 2006: finding one beetle originating from *Acer palmatum* imported from Japan via Belgium (Wermelinger, 2006). France: finding of one beetle emerging from a naturally or artificially dwarfed plant (bonsai) in 2002 (Hérard et al., 2005). Germany, 2008: findings of *A. chinensis* on two consignments of *Acer palmatum* originating from China and imported via the Netherlands (EPPO Reporting Service, 2008/115 – source NPPO of Germany, 2008-06) In the Netherlands, no interceptions or findings are known that could be related to *Acer* spp. that had been imported from South Korea. In 1998, the UK intercepted *A. chinensis* in naturally or

		artificially dwarfed plants of *Acer buergerianum* from South Korea (source: Europhyt). <u>2. CARPINUS SPP, ORIGINATING FROM CHINA, JAPAN AND SOUTH KOREA</u> No interception data are known. Three exit holes presumably from *A. chinensis* were found in a *Carpinus laxiflora* tree imported from Japan during a survey in the Netherlands in 2007. No living larvae were found in this tree and therefore the presumed origin of the exit hole could not be confirmed. <u>3. CHAENOMELUS SPP, ORIGINATING FROM CHINA, JAPAN AND SOUTH KOREA</u> *A. chinensis* was intercepted/found on *Chaenomelus sinensis* originating from Japan in 1988 and on *Chaenomelus* sp. from Japan in 1989 in the Netherlands. <u>4. LAGERSTROEMIA SPP, ORIGINATING FROM CHINA AND JAPAN</u> One interception on *Lagerstroemia indica* from China (1999) is known from the USA (Anonymous, 2001). In Italy *Lagerstroemia* spp. is one of most preferred host plants (Maspero et al., 2007). <u>5. SAGERETIA SPP. ORIGINATING FROM CHINA</u> Two interceptions in naturally or artificially dwarfed plants of *Sageretia* sp. in the Netherlands (1987, 1988). <u>6. MALUS SPP. ORIGINATING FROM CHINA</u> Import of Malus spp. from Japan has not been registered in the Netherlands from 2005 - 2007. In the past (1986-1988), *A. chinensis* has been intercepted 5 times on naturally or artificially dwarfed *Malus x micromalus* from Japan. No interceptions are known on *Malus* spp. from China. In the UK *A. chinensis* has been found once on *Malus sylvestris* from Japan between 1997 and 2007 (pers. comm.. A. Macleod, Central Science Laboratory, UK; see also above). <u>7 AND 8. PYRUS AND CORYLUS SPP. ORIGINATING FROM CHINA AND/OR JAPAN</u> No interception data <u>9. CYDONIA SINENSIS</u> Imported into Germany and the Netherlands via China or Japan; date of interception/finding before 1990. (EPPO datasheet on Quarantine pests: *Anoplophora malasiaca* and *Anoplophora chinensis*). In 1988, the pest has also been intercepted on naturally or artificially dwarfed *Celastrus* from Japan. No import records are known in the Netherlands of *Celastrus* spp. during the period 2005-2007. <u>Findings in the Netherlands that could not be related to any of the above mentioned pathways:</u> 2002: Amateur -entomologists reported the finding of single beetles of *A. chinensis* at two different locations in the Netherlands (Anonymous, 2002). The report included pictures of the beetle

1.6 How large is the volume of the movement along the pathway?	Moderate	Table 3. Import of host plants of *A. chinensis* from China, Japan and South Korea into the Netherlands from 2005 – 2007 (source: Dutch Plant Protection Service)

Host plant	Country of origin	No. of consignments	Total number of plants	Mean no. plants per consignment
Acer spp.	China	270	3,800,000	14,074
Acer spp.	South Korea [1)]	167	1,500,000	8,982
Sageretia spp.	China	302	600,000	1,987
Acer spp.	Japan	77	310,000	4,026
Carpinus spp.	China	7	15,000	2,140
Chaenomeles spp.	China	1	6,000	6,000
Corylus spp.	Japan	1	5,500	5,500
Lagerstroemia spp.	Japan	2	4,000	2,000
Lagerstroemia spp.	China	9	2,500	278
Carpinus spp.	South Korea	4	1,800	450
Cydonia sinensis	South Korea	1	130	130
Chaenomeles spp.	South Korea	3	360	120
Chaenomeles spp.	Japan	8	180	23
Pyrus spp.	China	1	26	26
Carpinus spp.	Japan	5	19	4
Malus spp.	China	1	1	1

[1)] mainly seedlings with a diameter of 4-10 mm

1.7 How frequent is the movement along the pathway?	Often	See table 3 for the number of consignments. Most consignments are imported in the period December – May.
Probability of survival during transport or storage		
1.8 How likely is the pest to survive during transport /storage?	Very likely	Plants are stored cool during transport that takes about 4 weeks. Larvae inside plants can survive temperatures around zero for prolonged period of times. *A. chinensis* is present in areas with minimum temperatures during winter far below zero (Baker & Eyre, 2006). The many interceptions and findings (see 1.5) show that *A. chinensis* can survive transport.
1.9 How likely is the pest to multiply/increase in prevalence during transport /storage?	Very unlikely	*A. chinensis* has a life cycle of at least one year and is not active at temperatures below about 10°C (Adachi, 1994)
Probability of the pest surviving existing pest management procedures		
1.10 How likely is the pest to survive or remain undetected during existing phytosanitary	Very likely	Plants are inspected visually. In most cases it is not possible to see if a plant is infested with *A. chinensis* when no exit hole is present. Sometimes, the presence of saw dust can be an indicator

measures?		that larvae are present. The experience of inspectors of the Dutch Plant Protection Service is that *Acer* trees that do not show any clear symptom may harbour a larva of *A. chinensis*. In February 2008, an inspector cut 60 *Acer* trees from a consignment just above soil level and found larvae in 13 of these trees, i.e. 22% infested. None of these 60 trees had any clear symptom on the outer side.
1.11 In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	Very Widely	Host plants mentioned in Table 3 are being distributed to many EU-countries. Dutch growers/importers of *Acer* spp. from China or Japan estimate that 75 – 90% of *Acer* plants imported in the Netherlands are shipped to other European countries, especially to Germany, UK, Belgium, France, Italy and Austria.
1.12 In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	Yes	Plants are stored cool and planted in the spring or summer. Larvae will develop to adults the same season the plants have been planted or in the second or third year depending on summer temperatures and the developmental stage of the larvae inside the trees at time of import. Adult beetles can mate and female beetles can deposit egg on other host plants.
1.13 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	Very likely	The pathway (host plants for planting) means it is not necessary to transfer to another host. Nevertheless, imported plants are very likely to be stored on a tree nursery where they can stay for a few months or more than one year before being sold to garden centres or consumers. Suitable host plants are usually present near the imported trees.
1.14 In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	Very likely	Infestation of host plants for planting ensure that a suitable host is available. See also the answer on question 1.13
<u>Consideration of further pathways</u>		
1.15 Do other pathways need to be considered?	No.	Solid Wood Package Material is a potential pathway but is not considered further due to existing measures that follow ISPM 15 (see 1.1).
<u>Conclusion on the probability of entry</u>		
The overall probability of entry should be described and risks presented by different pathways should be identified.		The probability of entry is very high as shown by the high number of interceptions and the recent findings of infested consignments at Dutch and UK nurseries. Most interceptions/finds of *A. chinensis* could be related to import of *Acer* spp. from Eastern Asia. All known interceptions/finds in the present PRA on host plants other than *Acer* spp. imported from Eastern Asia date back from before 1990 except one on *Malus* spp. (UK) and one on *Lagerstroemia* spp. (USA). In a few cases the origin of a find was unknown. The lack of more recent interceptions/finds related to host plants other than *Acer* spp. imported from Eastern Asia indicates a presently low to medium probability of entry related to this import into the EU. This probability may, however, well be underestimated as the pest can be easily overlooked during inspections. In the EU, intensive inspections on imported host plants other than *Acer* spp. are needed to better estimate the probability of entry related to the import of these host plants.

Probability of Establishment		
Availability of suitable hosts or suitable habitats, alternate hosts and vectors in the PRA area		
1.16 a Specify the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants) present in the PRA area.	Wide range	*A. chinensis* is polyphagous and many host plants are present in each EU-country. *A. chinensis* can attack trees belonging to more than 20 plant families (Lingafelter & Hoebeke, 2002)
1.16 b Estimate the number of host plant species or suitable habitats in the PRA area.	Very many	*A. chinensis* can attack plant species of more than 20 plant families (Lingafelter & Hoebeke, 2002). In Italy, plant species belonging to 22 genera are attacked (Registro Ufficale 0020882-09/11/2007).
1.17 How widespread are the host plants or suitable habitats in the PRA area? (specify)	Very widely	Widespread. Many tree species and shrubs commonly planted in the EU (like *Acer, Platanus, Betula, Fagus, Corylus, Rosa, Malus, Pyrus, Prunus lauroceracus, Populus, Ulmus* and *Salix*) are host plants of *A. chinensis*.
1.18 If an alternate host is needed to complete the life cycle, how widespread are alternate host plants in the PRA area?	N/A	Not applicable
1.19 If the pest requires another species for critical stages in its life cycle such as transmission, (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers), how likely is the pest to become associated with such species?	N/A	Not applicable
Suitability of the environment		
1.19A Specify the area where host plants (for pests directly affecting plants) or suitable habitats (for non parasitic plants) are present (cf. QQ 1.16-1.19). This is the area for which the environment is to be assessed in this section. If this area is much smaller than the PRA area, this fact will be used in defining the endangered area.		Suitable host plants are present across the whole of the EU PRA area.
1.20 How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?	Largely similar (for large parts of the PRA area)	The Dutch Plant Protection Service performed a CLIMEX study in 2004 (DeBoer, 2004). Climate data from the known distribution were compared to those in Europe. The results of that study indicate that large parts of the EU have a climate suitable for establishment for *A. chinensis* and that the northern limit was south of the Netherlands. A climate study made for the UK also indicated that it was unlikely that *A. chinensis* could establish in the UK (Baker & Eyre, 2006). However, recent findings of *A. chinensis* emerging from plants in the Netherlands that had not been imported show that *A. chinensis* can establish in more northern parts of the EU and parameters used in CLIMEX studies should be revised. In central England, an adult *A. chinensis* was detected emerging from an Acer palmatum in August 2008. The plant had been bought locally in 2005, having come from China via the Netherlands. Assuming that the tree was infested in China, which is by far the most likely scenario, development of A. chinensis under UK climatic conditions is clearly possible and is likely

		to take approximately three years.
1.21 How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?	Largely similar	Findings of breeding populations in Italy, France and the Netherlands show that other non-climatic conditions are suitable for establishment in large parts of the EU (Hérard et al., 2005).
1.22 If protected cultivation is important in the PRA area, how often has the pest been recorded on crops in protected cultivation elsewhere?	N/A	Not relevant. *A. chinensis* is a pest of outdoor grown plants.
1.23 How likely is it that establishment will not be prevented by competition from existing species in the PRA area?	Very likely	There is no evidence from Italy that competition from existing species has prevented or inhibited establishment.
1.24 How likely is that establishment will not be prevented by natural enemies already present in the PRA area?	Very likely	It is very likely that establishment will not be prevented by natural enemies as shown by the findings of breeding populations in Italy, France and the Netherlands
<u>Cultural practices and control measures</u>		
1.25 To what extent is the managed environment in the PRA area favourable for establishment?	Highly favourable	*A. chinensis* attacks trees and shrubs in managed urban, agricultural and rural environments.
1.26 How likely is it that existing control or husbandry measures will fail to prevent establishment of the pest?	Very likely	Amenity trees are largely unmanaged so there are few existing measures to inhibit establishment. Establishment in commercial fruit orchards may be affected by measures targeting other pest organisms .
1.27 How likely is it that the pest could survive eradication programmes in the PRA area?	Moderately likely Likely (in case large areas have been infested before the pest was detected)	Small infestations can be eradicated by destruction of visibly infested trees and of hosts around visibly infested trees. Removal of non(-visibly) infested trees around visibly infested trees is needed since trees may be infested without clear symptoms (egg deposits are very difficult to observe and trees without any visible symptom may harbour eggs and/or larvae (see also the answer on question 1.10). In the USA there has been an on-going eradication effort against the related *A. glabripennis* which has had mixed success. For example, *A. glabripennis* was reported as eradicated from in and around Chicago after an eradication campaign lasting 9 years, during which 61 square miles was considered infested and during which almost 1,800 host trees were destroyed (http://www.pestalert.org/oprDetail.cfm?oprID=313). On the other hand there has been a campaign in New York against A. glabripennis since 1997 and whilst numbers have fallen, the pest continues to be found in new areas of the State. APHIS's official Asian Longhorn Beetle eradication plan calls for an investment of $48 million a year in order to eradicate the pest nationwide by 2014, or $30 million a year for eradication by 2020 (http://www.house.gov/weiner/report-asianbeetle-05262006.pdf). However, before eradication can be attempted, an outbreak first has to be detected, and as noted above, detection can be very difficult.
<u>Other characteristics of the pest affecting the probability of establishment</u>		
1.28 How likely is the reproductive strategy of the	Likely	In Italy, *A. chinensis* has a life cycle of 1-2 years and possibly most individuals need 2 years to

pest and the duration of its life cycle to aid establishment?		complete their life cycle (Maspero, 2007). In the Netherlands, *A. chinensis* may have a life cycle of three years. This hypothesis is based on the following observation: an *Acer platanoides* trees with 7 exit holes was investigated in December 2007. The tree contained 18 larvae that were about 5.5 cm long. Because of the size of the larvae, it was assumed that the larvae would develop to beetles in the summer of 2008. Two of the exit holes had probably been formed in 2005 based on the growth of tree rings that had been formed after the exit holes. It was hypothesized that a female beetle that had emerged in 2005 from the tree had deposited her eggs on that same tree. *A. chinensis* has a long life cycle but larvae develop inside the tree and are protected from adverse conditions. Despite its long life cycle of at least one year *A. chinensis* has shown to be able to establish in large parts of the EU (Hérard *et al*., 2005; recent finding in the Netherlands).
1.29 How likely are relatively small populations or populations of low genetic diversity to become established?	Likely	No information is available about the number of female and male beetles that is needed to start a new population. The presence of only one male and one female beetle at the same location and at the same time may be sufficient to start a new population. Findings of trees in France and the Netherlands with exit holes close to a nursery with trees from Eastern Asia suggest that only a few beetles are needed to infest new areas. However, this is very uncertain as information is lacking about the number of beetles that were actually present when eggs were deposited on these trees. **Uncertainty**: the number of male and females beetles needed to start a new population.
1.30 How adaptable is the pest? Adaptability is:	High	*A. chinensis* is highly polyphagous and has shown to be able to complete its life cycle in regions with relatively cool summers like the Netherlands. It can survive cold winters (Baker & Eyre, 2006)
1.31 How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)	Occasionally	Several introductions are known: Italy, detected in 2000 (Maspero *et al*, 2007) France, detected in 2003 and eradicated (Hérard *et al*, 2005, 2006) The Netherlands, detected in 2007 (Information from the Dutch Plant Protection Service) Hawaii (CABI, 2007) Instances are only included where *A. chinensis* had infested trees or shrubs that had not been imported from areas where the pest is present and when the pest had completed its whole life cycle on these plants.
1.32 Even if permanent establishment of the pest is unlikely, how likely are transient populations to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment) ?	N/A	Not applicable
<u>Conclusion on the probability of establishment</u>		
The overall probability of establishment should be described.	Very high	Host plants and suitable habitats are widespread in the EU. Findings of breeding populations in Italy, France and the Netherlands, have shown that *A. chinensis* is able to establish in various climatic regions of the EU.

Probability of spread		
1.33 How likely is the pest to spread rapidly in the PRA area by natural means?	Unlikely	Natural spread from the infested areas in the PRA area *A. chinensis* is present in Lombardy (Italy). Beetles of *A. chinensis* probably behave like beetles of the related species *A. glabripennis* in that they usually do not fly over long distances, usually less than 400 m (Dumouchel, 2004; Anonymous, 2007; Sacco, 2004). Natural spread from the infested area in Italy will, therefore, proceed slowly. Only one study is known to have investigated dispersal of *A. chinensis*. In a mark-recapture study, a few beetles were found at a distance of more than 2 km from the initial point of release (unpublished data referred to in Adachi, 1990; no details were given about this study by the author). More information is available about dispersal distance of the related species *A. glabripennis*. In mark-recapture studies of this beetle, marked beetles were found at distances of more than 1 or 2 km (Smith et al., 2001, 2004). However, most beetles of *A. glabripennis* remained near the tree from which they emerge (Sacco, 2004). In the infested area in Chicago, 99% of trees with egg-deposit sites were within about 400 m (1/4 mile) of the nearest tree with one or more exit holes (http://www.aphis.usda.gov/ppq/ep/alb/control.html). In *A. glabripennis* infested areas in Europe, all infested trees were within an area with a radius of 200 – 500 m at the end of 2004 (Hérard et al., 2005). These observations indicate that beetles did not fly over long distances in these areas. Beetles will possibly fly over longer distances at high population densities or low host plant densities (see also Dumouchel, 2004; Anonymous, 2007). In the US, individual females of *A. glabripennis* may have travelled over more than in 1.6 km in some infested areas possibly due to the presence of large open terrain and lack of host plants in the direct environment (Sawyer, 2007). It is believed that *A. chinensis* like *A. glabripennis* will usually stay near the tree from which it emerged: • In France, two *Acer* trees were infested next to the nursery that had imported infested plants from eastern Asia (Hérard et al., 2005, 2006). • In the Netherlands, *Acer* trees were infested that were within 30 m from the nursery that had imported infested plants. The infested trees were found during the winter of 2007/2008 while the pest had probably been introduced in 2002 already. Thus, *A. chinensis* will probably spread slowly by natural means. At high population densities *A. chinensis* may fly more than 2 km and may spread more rapidly (Adachi, 1990). However, it is likely to take several years for populations to build up to high densities at new outbreak sites in the EU.
1.34 How likely is the pest to spread rapidly in the PRA area by human assistance?	Moderately likely	*A. chinensis* could spread by human assistance in several ways a) By trade of infested trees *A. chinensis* has been introduced into new areas by movement of infested plants over large distances (from Eastern Asia to Europe and the USA). If areas become infested in which plants are grown for trade, *A. chinensis* can be moved over large distances within the PRA area.

		A. chinensis is present in four areas in Lombardy in Italy (1 area of approximately 100 km^2 and 3 areas of 2 km^2 each) where it is under official control, and transient (under eradication) in the Netherlands. Movement of host plant species from Lombardy (Italy) including naturally or artificially dwarfed plants into other regions of the EU is a potential pathway to other EU-areas. Presently, this pathway is considered not relevant by the Plant Protection Service of Lombardy because inside the infested zone only one nursery is present that sell plants to companies/persons outside the infested zone. The plants are naturally or artificially dwarfed plants (bonsais) imported from Asian countries that may only be sold when no symptoms have been observed on these plants during a quarantine period of at least 2 years (Source: Plant Protection Service Lombardy). Several small tree nurseries are located inside the infested zone but according to the Plant Protection Service only sell plants on the local market. *A. chinensis* has been found only in a single nursery and in that nursery all the host plants have been completely destroyed. Large nurseries are present in Lombardy that produce *Acer* spp that are also exported to other EU-countries. These nurseries are, however, located outside the infested areas. Plants of the following genera/species are considered as host plants in Lombardy (decree issued by the *Ministero delle politiche agricole alimentari e forestali*, concerning mandatory actions against Citrus Longhorn Beetle, *Anoplophora chinensis* (Thomson). Registro Ufficale 0020882-09/11/2007): *Acer* spp., *Aesculus hippocastanum*, *Alnus* spp., *Betula* spp., *Carpinus* spp., *Corylus* spp., *Cotoneaster* spp., *Crataegus* spp., *Fagus* spp., *Ficus carica*, *Lagerstroemia* spp., *Malus* spp., *Platanus* spp., *Populus* spp., *Prunus laurocerasus*, *Pyrus* spp., *Rhododendron* spp., *Rosa* spp., *Salix* spp., *Quercus* spp., *Ulmus* spp., *Citrus* spp. *Quercus* spp. is a questionable host plant as only one record is known of a suspected tree but the presumed infestation was never confirmed. For *Rhododendron* spp., *Ficus carica* and *Crataegus* spp. only one infested plant have been found sofar while these plant species are generally occurring in the infested areas. These three plant species/genera are, therefore, considered minor host pants (source: Lombardy Plant Protection Service). Trade in host plants originating in the Netherlands is not considered a relevant pathway, since the recent outbreak has been delimited and relevant host plants have been destroyed in the area. In the Netherlands, only few specimens (larvae) of *A. chinensis* have been locally detected in December 2007 within a distance of 20 –30 m of a location where large quantities of *Acer palmatum* were imported from China. All *Acer* trees and shrubs in a radius of 200 – 300 m from exit holes and of 7 other plant genera in a radius of 100 m have been destroyed. Each tree or shrub was examined for presence of larvae or symptoms of *A. chinensis* before destruction. In total, 6 *Acer* trees and shrubs were found infested and one *Corylus avellana* shrub. All infested trees were found within about 30 m from the nursery. It is believed that the outbreak has been eradicated. Furthermore, no host plants of *A. chinensis* are traded from the area (in a radius of at least 600 m) surrounding the outbreak. Intensive surveys will be performed in the area at least

		until the end of 2011. Because of the finding of this outbreak The Dutch PPS performed intensive surveys at all nurseries/locations with *Acer* spp. imported from China and Japan and also at garden centres. During these survey *A. chinensis* was found in imported consignments at 5 other nurseries but not in the environment of these nurseries. Infested consignments were destroyed and in cases where more than one exit hole was present that had been formed in the same season host plants directly adjacent to the infested consignment were also destroyed. Intensive post-entry inspections are continued at locations with *Acer* spp. imported from China, Japan or South Korea (see also question 1) As an example of Dutch trade in *A. chinensis* hosts with other EU Members States, from July 2005 to June 2006, 1,548 *Acer* spp. were shipped to England & Wales from the Netherlands, and between July 2006 and June 2007, *2,083 Acer* spp. were shipped from the Netherlands to England & Wales (PHSI data) (see also question 1.11). At present, there are no plant passport requirements for most host plants of *A. chinensis* as determined by EU Council Directive 2000/29/EC, as amended. It is therefore difficult to distinguish between host plants originating in pest free areas and host plants originating in areas where *A. chinensis* is known to occur. Moreover, interception of the pest at import or EU internal movement of the commodity is difficult by regular inspection because the pest can reside within the tree for one to three years (depending on the climate) before emergence. b) As a contaminant on transport vehicles *A. chinensis* is present in Lombardy (Italy). Locally, high population densities are present. Observations in Canada with the related species, *A. glabripennis,* suggest that beetles can be moved passively over large distances in/on transport vehicles (Anonymous, 2006). Spread over larger distances as a contaminant on transport vehicles is also thought to be a means of spread in Lombardy. c) By movement of infested wood *A. glabripennis* was probably spread by movement of infested firewood in Austria (Hoyer-Tomiczek et al., 2005). *A. chinensis* could also be spread by movement of infested wood although the probability that that would happen is lower than for *A. glabripennis* since *A. chinensis* is mainly present in the lower 60 cm of the trunk and about 90% of the larvae are present below ground level (Hérard et al, 2005). In several instances, however, *A. chinensis* exit holes were observed higher than 2 m on the trunk. Thus, movement of wood or plants especially by private owners can be an important means of spread.
1.35 How likely is it that the spread of the pest will not be contained within (part of) the PRA	Moderately likely	If detected early enough spread can be prevented as with the campaign against *A. glabripennis* in the USA. However, as noted above detection is crucial.

area?		
Conclusion on the probability of spread		
The overall probability of spread should be described.	Moderate High in Italy	The probability of spread is moderate but will increase with population sizes. The probability of spread will especially increase if areas become infested in which host plants are grown for trade. The probability of spread in Italy is high because of the large extent of the current infested area.
Conclusion on the probability of introduction and spread		
The overall probability of introduction and spread should be described. The probability of introduction and spread may be expressed by comparison with PRAs on other pests.		The probability of introduction is high. *A. chinensis* has been regularly intercepted in consignments from China and Japan. Breeding populations have been detected in Italy, France and the Netherlands since 2000. Once *A. chinensis* has established in the PRA area, it will not spread rapidly but the probability of spread will increase over time as the population grows.
Conclusion regarding endangered areas		
1.36 Based on the answers to questions 1.16 to 1.35 identify the part of the PRA area where presence of host plants or suitable habitats and ecological factors favour the establishment and spread of the pest to define the endangered area.		The endangered area is the whole EU, with the exception of the most northern areas. **Uncertainty**: it is uncertain if the climate in northern EU-countries, like Denmark, Sweden and Finland, is suitable for establishment of *A. chinensis*. A revised CLIMEX study could be undertaken taking new information into account, i.e. (i) reproduction in the Netherlands and France is possible, (ii) 1800 degree days (PDD) may be required for development but if the life cycle extends over 2 or 3 years, and CLIMEX works on an annual basis, then the CLIMEX PDD parameter should be reduced to either 900 (for 2 years) or 600 (for 3 years). The capability of spread of the pest in relation to climatic conditions, population density and host plant density is also uncertain.
2 Assessment of potential economic consequences		
2.0 In any case, providing replies for all hosts (or all habitats) and all situations may be laborious, and it is desirable to focus the assessment as much as possible. The study of a single worst-case may be sufficient. Alternatively, it may be appropriate to consider all hosts/habitats together in answering the questions once. Only in certain circumstances will it be necessary to answer the questions separately for specific hosts/habitats.		

Pest effects An overview of available data and observations on current damage levels and assessment of potential damage levels by *A. chinensis* but especially of the related species *A. glabripennis* has been made in several PRA's (Anonymous, 2001; MacLeod et al, 2002; Dumouchel, 2004; Baker & Eyre, 2006). The conclusion in each of these PRA's was that the potential economic and environmental impact of both *A. chinensis* and *A. glabripennis* is high or massive. *A. glabripennis,* like *A. chinensis,* also attacks living trees and attack by *A. glabripennis* has similar effects on tree health as *A. chinensis*. Because of these recent studies, questions mentioned below about the economic and environmental impact (2.1- 2.9) will only briefly be answered and we will refer to the above-mentioned studies.		
2.1 How great a negative effect does the pest have on crop yield and/or quality to cultivated plants or on control costs within its current area of distribution?	Major-massive	No actual data were found in literature on percentage yield losses but several reports in literature indicate that *A. chinensis* has a great negative effect on crop yield in its current area of distribution. "*A. chinensis* is regarded as one of the most destructive cerambycid pests of fruit trees, especially Citrus in lowland areas of China, where economic losses can be substantial" (CABI, 2007). It is "the most dreaded wood-infesting pest of citrus trees in Japan" (Adachi, 1994). *A. chinensis* can kill trees especially small trees. But also large trees can die when many larvae infest them. Trees that do not die directly from the infestation are weakened and are susceptible to secondary pests. In a survey of Citrus orchards in Japan, 66% of the trees were found with exit holes (CABI, 2007). Lieu (1945) mentions various examples of *Citrus* trees that died or felt down due to attack by *A. chinensis*. Experiences in Italy: *Acer saccharinum* trees are heavily attacked and usually die either due to secondary infections or directly due to the high number of larval tunnels in the wood. Other *Acer* spp. and *Fagus* sp. are also heavily attacked often leading to the death of the tree but only when they have (many) roots surfacing above the ground. Trees without superficial roots are usually infested to a lower extent and attacks do not usually lead to the death of trees or at least not within a few years. *Corylus avellana* shrubs are heavily attacked leading to the death of the shrub or to the death of individual branches. Other host trees and shrubs in Lombardy are generally attacked to a lower extent and usually do not die or at least not within a few years. They may, however, be weakened due to attack of the pest leading to a shorter lifetime expectation. The level of infestation and the probability that a tree will die varies and depends on the individuals situation. For example, on one known occasion *Alnus* spp. were heavily attacked and the trees dies after a certain number of years, whilst in other areas *Alnus* spp. are infested at relatively low levels and have not been killed. More quantitative data are available for the related species *A. glabripennis* (Dumouchel, 2004). For example: attempts to grow North American species of maple (*Acer* spp.) for wood and syrup production in China were stopped since *A. glabripennis* repeatedly killed the trees after planting (V. Mastro, pers. com., quoted by Cavey, 1998 and referred to by Dumouchel, 2004).
2.2 How great a negative effect is the pest likely to have on crop yield and/or quality in the PRA	Major-massive	*Prunus, Malus*, *Pyrus* and *Citrus* spp. are among the host plants of *A. chinensis* (Lingafelter & Hoebeke, 2002). The pest is known to cause much damage in *Citrus* orchards in China and

area?		Japan (see Q 2.1). *Malus* and *Pyrus* spp. are among the main host plants in Lombardia (Maspero et al., 2007). In host plant choice experiments carried out at EBCL, Montpellier, France, various *Prunus* spp. were attacked by *A. chinensis* (oviposition and development of larvae) (F. Hérard, pers. comm.). Thus, *A. chinensis* can have a large negative effect on crop yield in various fruit orchards. *A. chinensis* attacks many deciduous tree species and can also have large negative effects on tree nurseries. It may not have a direct effect on yield only but also indirectly since customers may avoid buying plants that are frequently attacked by *A. chinensis.*
2.3 How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?	Major	*A. chinensis* is very difficult to control. Options to control/reduce damage by *A. chinensis* are: - Placements of sentinel plants around orchards and tree nurseries and replace them regularly. - Using insect-gauze to protect trees (CABI, 2007). This is only feasible for small trees since the whole tree has to be covered by insect-gauze. - Insecticidal sprays (pyrethroids) against adult beetles during summer (CABI, 2007; Maspero, 2007). However, these sprays will interfere with integrated crop protection methods and will make control of other pests more difficult. - Encapsulated pesticides (beads) extending the duration of efficacy of the pesticide. Such pesticides could be sprayed at the base of trees. The pesticide is released when beetles crawl on the beads during their search for some oviposition site or when they emerge and crawl on the trunk towards the crown. The efficacy of this method will first need to be tested (see als 3.18; Smith et al., 2007) . - In the future, biological control agents may become available and could aid to control of the pest. Biological control has been used in Japan and several natural enemies have been indentified in the infested area in Lombardy (CABI, 2007; Maspero et al., 2007). - Bands impregnated with the entomopathogen, *Beauveria brongiartii*, could also be used (Kashio, 1996; Dubois et al. 2004a, 2004b). The measures mentioned above will lead to an increase in control costs. Production costs will especially increase due to yield losses by *A. chinensis* (lower yield per ha).
2.4 How great a reduction in consumer demand is the pest likely to cause in the PRA area?	Moderate	*A. chinensis* can destroy trees in orchards (citrus, apple, pear). Yield losses in orchards will lead to increase in prices of fruits and, thereby, to a reduction in consumer demand. Consumers run the risk of introducing *A. chinensis* when they buy trees or shrubs that are host plants of the pest. This can lead to a reduction in consumer demand especially of host plants that are mostly preferred by *A. chinensis* like *Acer* spp.
2.5 How important is environmental damage caused by the pest within its current area of distribution?	Massive	No specific estimates of damage or losses are available. In Italy, *A.chinensis* attacks many host plant species. Infested trees are destroyed as part of the eradication program but in several cases trees have been found that were heavily infested and dying due to attack by *A. chinensis*. It is believed that most trees that are being attacked will eventually die or weakened because of *A. chinensis*. In the infested area in Lombardy (Italy), € 1.2 million has been spent on surveys, removal of infested trees and research 2004 to 2007; € 10 million has been allocated for surveys, removal and replanting of trees, research and raising public awareness for the period 2008 – 2010 (source: PPS Lombardy).

		Quantitative estimates of the potential impact have been performed for the related species *A. glabripennis* in Germany, USA and Canada. Germany: the total potential loss for the most preferred host plant, *Acer* spp., including costs for replanting was estimated to be about € 96 million for Berlin alone (Balder, 2003). USA: estimates were performed for 9 large cities: *A. glabripennis* could destroy 35% of the tree canopy, with an estimated loss of $ 668 billion. These costs did not include decreased values of properties due to a decreased landscape-value, decreased quality of environment etc. (GAO, 2006) Canada: removal and replacement of one urban tree was estimated at about 1,000 Canadian dollar (Dumouchel, 2004) MacLeod et al (2002) and Dumouchel (2004) have given a more detailed overview of economic costs in China and potential economic costs in the USA and Canada by *A. glabripennis* In Southern Europe, the impact of *A. chinensis* may be higher than that of *A. glabripennis* since *A. chinensis* has a broader host range. However, some tree species seem to be attacked by *A. chinensis* generally at low levels only and this may not harm the tree to a great extent (see 2.1). The climate in Northern Europe is possibly more favourable to *A. glabripennis* than to *A. chinensis* (Macleod et al, 2002) and its impact may, therefore, be higher despite the wider host range of *A. chinensis.*
2.6 How important is the environmental damage likely to be in the PRA area?	Massive	*A. chinensis* is highly polyphagous. Trees that are infested eventually die or can be weakened. Introduction of *A. chinensis* may lead to loss of diversity of tree species (see also: Baker & Eyre, 2006).
2.7 How important is social damage caused by the pest within its current area of distribution?	Major	Social damage in Italy: • *A. chinensis* has an effect on biodiversity since preferred host plant will disappear to a great extent in infested areas • Citizen react emotionally when trees in their neighbourhood have to be removed or when trees die due to attack by *A. chinensis*.. No information is available on social damage in Eastern Asia.
2.8 How important is the social damage likely to be in the PRA area?	Major	*A. chinensis* can kill or weaken many different host tree species. Trees have an emotional value for many people.
2.9 How likely is the presence of the pest in the PRA area to cause losses in export markets?	Likely	Small infestations in non-agricultural areas will probably not lead to loss of export markets. Larger outbreaks that also include agricultural areas will probably lead to loss of export markets. Within Europe, there is a growing concern that *A. chinensis* may be spread by trade of infested trees from the infested area in Italy (Tomiczek & Uhe-Tomiczek, 2007). According to the PPS of Lombardy there is presently no risk that the pest will be spread by trade of host plants from the infested area (see also 1.34)
2.9A As noted in the introduction to section 2, the	Go to 2.16	

evaluation of the following questions may not be necessary if any of the responses to questions 2.2, 2.3, 2.4, 2.6 2.8 or 2.9 is “major or massive” or "very likely” or "certain". You may go directly to point 2.16 unless a detailed study of impacts is required.		
2.10 How easily can the pest be controlled in the PRA area?		
2.11 How likely is it that natural enemies, already present in the PRA area, will not suppress populations of the pest if introduced?		
2.12 How likely are control measures to disrupt existing biological or integrated systems for control of other pests or to have negative effects on the environment?		
2.13 How important would other costs resulting from introduction be?		
2.14 How likely is it that genetic traits can be carried to other species, modifying their genetic nature and making them more serious plant pests?		
2.15. How likely is the pest to act as a vector or host for other pests?		
2.15A Do you wish to consider the questions 2.1 to 2.15 again for further hosts/habitats?		
Conclusion of the assessment of economic consequences		
2.16 Referring back to the conclusion on endangered area (1.36), identify the parts of the PRA area where the pest can establish and which are economically most at risk.	Large	The potential damage in the EU is large (see also Baker & Eyre, 2006).
Degree of uncertainty		
Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the hypothetical situation in the PRA area. It is important to document the areas of uncertainty and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used. This is necessary for transparency and may also be useful for identifying and prioritizing research needs. It		The outbreak in Northern Italy (Lombardy) and findings of breeding populations in France and the Netherlands show that *A. chinensis* can be introduced to the PRA area. The large number of infested trees in Lombardy shows that its potential impact is massive for large parts of the EU. Thus, the degree of uncertainty is low for the assessment of the probability of entry and establishment and for the assessment of the economic impact. The main uncertainties in the present PRA are: The minimum stem and root diameter needed to for full development of *A. chinensis* The number of female and male beetles needed to start a new population. It is assumed that the presence of one male and one female beetle at the same time at the same location is sufficient to

should be noted that the assessment of the probability and consequences of environmental hazards of pests of uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.		start a new population. This is, however, uncertain. Establishment in Northern Europe: it is uncertain if Northern European countries like Sweden and Finland are part of the endangered area. Climate studies that have been performed before indicated that the climate in the Netherlands and the UK and also in the Scandinavian countries would not be suitable for establishment. However, recent findings of breeding population in the Netherlands show that the outcome of such climate studies should be interpreted with care.
Conclusion of the pest risk assessment		
Entry: Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.	Very high	**Import of *Acer* spp. from China and Japan** Several interceptions in the past and recent findings of infested consignments at Dutch and UK nurseries show that the probability of entry is very high. **Import of *Acer* spp. from Korea** One interception is known on Acer (on artificially or naturally dwarfed Acer) in 1998 in the UK) Probability of entry low-medium **Import of host plants other than *Acer* spp. from China, Japan, Korea** 13 interceptions/findings are known of which 11 date back from before 1990. Six out of the 13 interceptions/findings were on *Malus* spp from Japan. Import of *Malus* spp. from Japan has not been registered in the Netherlands during 2005-2007. Probability of entry: very low – medium
Establishment Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.	Very high	*A. chinensis* can establish in large parts of the EU as shown by the outbreak in Italy and finds of breeding populations in France in 2003 and in the Netherlands in 2007.
Economic importance List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.	High	After initial introduction, it may take several decades before the pest will have a large impact because the pest will probably have a life cycle of 2-3 years in large parts of the EU, it will spread slowly by natural means and it will take time before large populations have been built up. It also usually takes 5-10 years before a tree will die due to attack by the pest or due to secondary infections (experiences in the infested area in Lombardy). In Southern Europe, *A. chinensis* has a life cycle of 1-2 years and populations will be built up much faster than in Norther European countries. Hence, the pest may already have a large impact within 10 years of its introduction. In the longer term, the impact on the economy and environment of the EU will likely be high or massive, as also concluded by Baker & Eyre (2006). In a USA-PRA, the pest risk potential was estimated “high” (Anonymous, 2001).

		In summary, establishment of *A. chinensis* will lead in the long term to - loss of trees and shrubs in urban areas, on country sites and possibly also in forests. - loss in biodiversity (tree species that are heavily attacked by *A. chinensis* may disappear in urban areas and landscapes) - crop losses and loss of export markets for tree nurseries - yield losses in fruit orchards (*Citrus, Malus, Pyrus*) due to die back or weakening of trees
Overall conclusion of the pest risk assessment The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the pest risk associated.		*A. chinensis* is a quarantine pest within the EU. The recent finding of infested trees in the Netherlands shows that *A. chinensis* can both establish in Southern Europe as well as in North Western European countries like the Netherlands (it is uncertain if *A. chinensis* could establish in more Northern parts of the EU). This new information suggests that the overall risk presented by *A. chinensis* to the EU is greater than previously thought. The probability of introduction is larger than assessed before since many host plants from areas where the pest is present are imported into North Western European countries (e.g. the Netherlands and UK). Also the potential economic and social effects for the whole EU are larger than assessed before. Because of this high probability of introduction and potential major economic and social impacts, there is a need to consider additional measures to reduce the probability of introduction of *A. chinensis* into the EU. Possible management options and related costs and benefits will be analysed in part 3 of this PRA.
This is the end of the Pest risk assessment		

Stage 3: Pest risk Management		
3.1. Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combination an acceptable risk?	No	
Pathway n°1		Answers given to the questions relate to the most important pathway: import/trade of host plants from areas where *A. chinensis* is present (including import of host plants from third countries as well as trade within the EU since *A. chinensis* is present in Northern Italy).
3.2. Is the pathway that is being considered a commodity of plants and plant products?	Yes, go to 3.10	
3.3 Is the pathway that is being considered the natural spread of the pest? (see answer to question 1.33)		
3.4 Is the pest already entering the PRA area by natural spread or likely to enter in the immediate future? (see answer to question 1.33)		
3.5 Could entry by natural spread be reduced or eliminated by control measures applied in the area of origin?		
3.6 Could the pest be effectively contained or eradicated after entry? (see answer to question 1.27, 1.35)		
3.7 Was the answer "yes" to either question 3.5 or question 3.6?		
3.8 Is the pathway that is being considered the entry with human travellers?		
3.9 Is the pathway being considered contaminated machinery or means of transport?		
Existing phytosanitary measures		

3.10. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest	No	There are no species specific requirements for *Anoplophora chinensis* since the pest is prohibited from entering the EU. However, some host plants are prohibited entry into the EU, for example 2000/29/EC Annex III A 16 prohibits plants of *Citrus* other than fruit and seeds from Third Countries. There are also general requirements for host plants which are not prohibited, the most relevant being 2000/29/EC Annex IV AI 39 which requires trees and shrubs from third countries to be clean (i.e. free from plant debris) and free from flowers and fruits; to have been grown in nurseries; and to have been inspected at appropriate times and prior to export and found free from symptoms of harmful bacteria, viruses and virus-like organisms, and either found free from signs or symptoms of harmful nematodes, insects, mites and fungi, or have been subjected to appropriate treatment to eliminate such organisms. Since existing phytosanitary measures mainly consists of visual inspections of plant material it is not possible, or very difficult, to see if a plant is infested unless exit holes are present (see also the answer to question 1.10). In the future, sound detectors may help to find infested trees (see also 3.12). Since 15 January 2008, the Dutch Plant Protection Service uses a destructive sampling method which means that 1% of trees from a consignment up to a maximum of 200 plants are cut to look for larvae inside the trees. This method will increase the probability to detect infested trees compared to non-destructive sampling. However, the probability to detect the pest when only a low percentage of the trees is infested is still low. From January – May 2008, *A. chinensis* was intercepted in 2 consignments using a destructive sampling method while the pest was found in 12 more consignments during a post-entry inspection when plants had been placed in pots (see also the answer to questions 1.5 and 3.29). Annex 1 shows the likelihood of detecting *A. chinensis* (if evenly distributed) in consignments of 500 to 20,000 plants when destructively sampling 1% up to a maximum of 200 plants per consignment.
Identification of appropriate risk management options		
Options for consignments		
Detection of the pest in consignments by inspection or testing		
3.11. Can the pest be reliably detected by a visual inspection of a consignment at the time of export during transport/storage or at import?	No	See the answer on question 3.10 and Annex 1.
3.12. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)?	No	Research in the UK on an acoustic detection system is underway but further development is necessary before a practical tool is available. Further details are provided in Farr & Chesmore (2007).

3.13. Can the pest be reliably detected during post-entry quarantine?	Yes (if sampling is intensive enough)	The period of the quarantine period should, however, be at least 2 years in southern European countries and at least 3 years in northern European countries based on the duration of the life cycle. During the quarantine period hosts should be kept within physical protection (polytunnels or within screened houses to prevent escape of adults). Regular inspections should take place during the quarantine period and at the end of the quarantine period, trees should be inspected intensively. The consignment should be destroyed when any of the following symptoms are observed: - the presence of frass (saw dust), - signs on twigs that look like adult feeding symptoms - exit holes In case of doubt, a sample of trees should be cut just above and below soil level to look for larval tunnels, and to sample larvae for subsequent DNA analysis and identification.
<u>Removal of the pest from the consignment by treatment or other phytosanitary procedures</u>		
3.14. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?	No Presently not. Maybe for woody plants in a dormant stage but experimental research is needed.	<u>Chemical treatment</u> Treatment with fumigants is probably not effective since the larvae are protected inside woody stems or roots and fumigants will probably not be able to enter the larval tunnels to kill the larvae. Treatment with methyl bromide using in vacuum might kill the larvae inside the woody material (T201-a-2 in USDA Treatment Manual, 1998). Research will be needed to determine the efficacy of this method. This method cannot be recommended from an environmental point of view as the use of methyl bromide should be abandoned in the future due to negative effects of this substance on the ozone layer (Montreal Protocol). <u>Thermal treatment</u> Incubation of woody plants (dormant) in hot water might kill the larvae inside the roots. Larvae are present in the woody stem or roots of the plant and plants need probably stay in a hot water for a relatively long time to achieve lethal temperatures inside the wood that will kill the larvae. It is, therefore, expected that temperatures and exposure time needed to kill the larvae will negatively affect the viability of the plants. Heat treatment is accepted as a Phytosanitary procedure to kill larvae of the related species *A. glabripennis* in wood package material. In that case the internal core of the material should reach a minium of 56°C during 30 min. (Dumouchel, 2004). Such a treatment will likely have negative effects on the viability of the young *Acer* trees and will, therefore, be no good option. <u>Irradiation</u> Insects need an absorbed dosage of 1000 Gy. Effects on plants can be seen on a dosage of more than 1 Gy; 1000 Gy will lead to negative effects on the viability of the plants. Lower dosages may be sufficient to sterilize the larvae inside the plants. Experimental research will be needed to test that hypothesis. When it works, methods will have to be developed to be able to check that the treatment has been properly performed and larvae are innocuous (Hansen & Hara, 1994)

3.15. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants)	No	
3.16. Can infestation of the consignment be reliably prevented by handling and packing methods?	No	
<u>Prevention of establishment by limiting the use of the consignment</u>		
3.17. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?	No	
Options for the prevention or reduction of infestation in the crop		
<u>Prevention of infestation of the commodity</u>		

3.18. Can infestation of the commodity be reliably prevented by treatment of the crop?	Possibly	Stem and soil injection and soil drench with systemic insecticides Soil or stem injection with systemic insecticides (imidacloprid) might prevent infestation. The method is used in the USA to prevent trees from infestation by the related species *A. glabripennis;* tree injection is repeated every year using imidacloprid. (Anonymous, 2007; USDA, 2008). For soil injection, the time of application is especially important since it is stated on the APHIS/USDA website that " Sufficient insecticide residues for ALB control are not achieved until 2 to 3 months post-application" (http://www.aphis.usda.gov/plant_health/plant_pest_info/asian_lhb/control.shtml#chemical; website visited in February 2008). Soil or stem injection can only be used in a preventive way in eradication programmes against *A. glabripennis* since it does not kill most of the larvae in infested trees (Wang, et al, 2001; Poland et al., 2006). Field trials in China, indicated that tree or soil injection killed less than 50% of larvae inside the trees but was especially effective against adults (Poland et al., 2006). The insecticide possibly remains in the outer growth layers and larvae that tunnel deeper in the sapwood and heartwood are probably not exposed to the insecticide (Poland et al., 2006). According to the Pest response guideline of the USDA to control *A. glabripennis*, the insecticide is effective against adults when feeding on small twigs, when depositing eggs and against young larvae (USDA, 2008). Soil or stem injection may be much less effective against *A. chinensis* than against *A. glabripennis* since results from pilot stem injection experiments performed with large trees in Italy were not very promising (Maspero et al., 2007; pers. comm. M.Maspero, Minoprio Foundation, Italy). Imidacloprid applied by stem or soil injection or as a soil drench may, however, be more effective against larvae and beetles in young trees than in older trees. In young trees with a stem diameter of 1-4 cm, larvae may probably be much more exposed to the insecticide than when applied in larger trees. Poland et al (2006) performed field trials with elm, poplar and willow with stem diameters of about 9, 7 and 10 cm, respectively. In Italy stem diameter of injected trees was about 30 cm. Experiments will be needed to determine the efficacy of stem and soil injection/drench in smaller trees. Stem injection with systemic insecticides is not an approved control method in the Netherlands, Italy or the UK. Foliar application with insecticides Foliar application and spraying of the stems with insecticides can reduce infestation: - adults feeding on twigs that has recently been sprayed will be killed (Anonymous, 2007) - the number of oviposition sites will possibly be reduced (Maspero et al, 2007) Foliar and stem application may not be sufficient to prevent infestation since beetles can feed on trees outside the nursery and deposit eggs on stems of trees inside the nursery. Moreover, pesticides break down due to sunlight and intensive spraying regimes will be needed to protect the foliage from feeding during the flight season of the beetles. The use of special formulated insecticides that protect the active ingredient from degrading effects of sun light, like Demand® CS or Scimitar®CS (a.i.: cyhalothrin) might be a solution to this problem. In experiments,

		Demand®CS for example was 100% effective during 90 days after a single application to bands and experiments are going on to see if treatment with these insecticides can prevent attack by *A. glabripennis* in China (Smith et al., 2007). Cyhalothrin and other pyrethroids are non-selective insecticides and large-scale applications of these insecticides will have negative effects on beneficial organisms and could not be recommended from an environmental point of view.
3.19. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants)	No	*A. chinensis* has a very wide host range but appears to prefer certain host plant species especially *Acer* spp. (Maspero et al., 2007). The pest may prefer certain *Acer* spp. more than others. The related species *A. glabripennis* for example is more attracted to *Acer mono* than to *Acer negundo* (Smith et al., 2006). However, *Acer* spp. in general seem to be highly attractive and no information is available on differences in between susceptibility cultivars of the same *Acer* species.
3.20 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened glasshouses, physical isolation, sterilized growing medium, exclusion of running water...)?	Yes	Growing plants under net screens or in screened glasshouses can prevent infestation of plants. The maximum mesh size should be 5 mm and the material should be resistant to the beetle mandibles. In areas with a very high population density of *A. chinensis*, a double door lock may be needed to prevent entry of beetles especially in areas with high populations densities. Regular inspections will be needed during the flight season of the beetles to check for signs of the beetles. For example: three official inspections at the beginning, during and at the end of the flight season of the beetle could be required to check for the presence of the maturation phase of adults as they feed on leaves and twigs.
3.21. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?	No	
3.22. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?	Yes	A certification scheme would be particularly helpful in the country of origin, where the identity of the plants can be recorded, as originating from registered nurseries that are officially free of the pest. Since it is difficult to detect the pest in a crop, without destructive sampling, preservation of the true origin and identity is an important tool for ensuring pest freedom of consignments. Pest freedom of a production place can be achieved by different options: net screens, pest free buffer zone and maybe also by chemical treatment of the crop (see 3.29). Regular inspections will be needed to check if no beetles have entered the production place and/or buffer zone . (see 3.20, 3.27). See also ISPM No 4 (Requirements for the establishment of pest free areas).
<u>Establishment and maintenance of pest freedom of a crop, place of production or area</u>		
3.23. Has the pest a very low capacity for natural spread?	No	
3.24. Has the pest a low to medium capacity for natural spread?	Yes	Pest-free place of production and appropriate buffer zone (details of an appropriate buffer zone are given in the answer to question 3.29) or a pest free area - see ISPM No 4 (Requirements for the establishment of pest free areas).
3.25. Has the pest a medium capacity for natural spread?	No	
3.26. The pest is of medium to high capacity for natural spread	No	

3.27. Can pest freedom of the crop, place of production or an area be reliably guaranteed?	Yes	Pest freedom of the crop is difficult to guarantee since larvae may be present inside plants without any visible symptoms. A single inspection of a crop will, therefore, not be sufficient to guarantee pest freedom. Pest freedom can only reliably guaranteed when the crop is produced in a pest free production place or area. A place can only be guaranteed to be pest free if the pest or symptoms have not been observed at least during 2 years (or 3 years in areas where the pest may have a life cycle of 3 years).
<u>Consideration of other possible measures</u>		
3.28. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts?	Yes (to reduce the probability of establishment)	The probability of establishment is highest near tree nurseries with large numbers of imported trees. Phytosanitary surveillance at these tree nurseries and surroundings up to 200 m distance from the nursery will increase the chance of detecting introduced populations at an early stage when it is still possible to eradicate the pest. Populations could, however, also establish elsewhere (near garden centres or even in private gardens) and it is impossible to perform surveys throughout the whole PRA area. Thus, it is possible that infestations are detected when the pest has already spread over larger distances and subsequent eradication actions will involve removal of large numbers of trees and shrubs. It is worth noting that it has been estimated that *A. glabripennis* was in New York City for 10 years before it was detected.
Evaluation of risk management options		

3.29. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest?	Yes	<u>1. Pest free area</u>: See also ISPM No. 4 “Requirements for the establishment of pest free areas”. It is unknown if areas free of *A. chinensis* are present in China, Japan or South Korea that are suitable to grow *Acer* spp. and other host plants mentioned in the answer to question 1.3. According to Dutch companies that have visited production sites in China, *A. chinensis* is present at high densities in China in areas where *Acer* spp. are grown for export. <u>2. Pest free places of production or pest free production sites</u> (see also ISPM No. 5), options: a. using physical protection (net screens or screened glasshouse preferably with a double door lock gate); b. using a buffer zone (minimum size of buffer 1 km); c. using preventative chemical treatment (soil or stem injection or foliar application; efficacy of these treatments need first to be tested); d. certification scheme (including registration of nurseries as part op option 1, 2a, 2b or 2c). ad 2a. It may be difficult to maintain the production site free of the pest especially in areas with high population densities of *A. chinensis*. Individuals may enter through the gate by movement of plant material (despite a double door) or by unwanted cracks in the net screen. Therefore, intensive inspections of the crop will be needed at least during two years prior to export and especially during the flight season of the beetles (see also 3.20). ad 2b.Buffer zone: the proposed radius of the buffer zone is 1 km. Preferred host plants should be present in the buffer zone at all wind directions from the nursery and should be used as sentinel plants. The maximum reported dispersal distance is more than 2 km but beetles usually fly to the nearest host trees (see the answer to question 1.33). Smith et al (2000, cited in Dumouchel, 2004) reported an average distance of a single flight of 25 – 46 m and a maximum observed flight distance of 420 m of the related species *A. glabripennis.* When host plants are present in the buffer zone, it is very unlikely that beetles will fly directly to the production site and not attack host plants in the buffer zone. Intensive inspections will be needed at the production site and in the buffer zone to guarantee that the production site is free of *A. chinensis*. The inspections should be carried out regularly during the flight season of the beetles using binoculars to look for symptoms in the canopy of trees (maturation phrase on twigs or other symptoms) and also to look for exit holes or saw dust at the base of trunks or on roots surfacing the ground. Official inspections should be carried out during and shortly after the flight season of the beetles. When symptoms and/or beetles are observed at the production site, the status of pest free production place will be lost for at least 3 years since larvae could be present without symptoms in host plants for 2 and in cooler climates possibly 3 years. Small populations sizes of the beetle may easily be overlooked and, therefore, the maximum life cycle + 1 year is proposed as the period needed before a production site can return to its pest free status, unless all relevant host plants at the production place are removed or destroyed. In case the pest is observed in the buffer zone, all infested trees should be removed, including all host plants in the buffer zone within a radius of at least 100 m (radius depending on the population density of the pest and host plants).

Ad 2c.
No option yet. Experiments will be needed to test the efficacy of tree and/or soil injection with systemic insecticides and of foliar application of special formulated insecticides (see also 3.18).

Ad 2d.
Certification including official registration and inspection by authorities will be needed to guarantee the pest freedom of the production place (see also 3.22, 3.27).

3. Consignment moving in trade
a. inspection with destructive sampling and post-entry inspection at nurseries where imported plants are placed before sold to end-consumers.
b. post-quarantine period (see 3.13)
c. treatment of the plants using a systemic insecticide shortly after import

Ad 3a
A fixed percentage of plants can be sampled in a destructive way by cutting plants at several places to look for larval tunnels and larvae. Large numbers of plants may have to be cut to be sure for 95% that you will detect the pest. For example, 299 plants will have to be cut if an infestation percentage of 1% needs to be detected at a 95% probability. In the Netherlands, 1% of the plants is presently sampled in a destructive way up to a maximum of 200 plants per consignment. In that case, the probability that low infestation levels (e.g. 1% of the trees) will not be detected, is higher than 5%:

- Total number of plants 1,000, 10 plants are cut. Probability to detect the pest: $1-0.99^{10}$ = 10% in case of high infestation levels (up to 100%). Probability of 90% that the pest will not be detected and eventually 10 beetles may enter the EU.
- Total number of plants 10,000, 100 plants are cut. Probability to detect the pest: $1-0.99^{100}$ = 37%, in case of high infestation levels.
- Total 70,000 plants, 200 plants are cut. Probability to detect the pest: 87%, in case of high infestation levels. The probability that the infestation will not be detected is 13% and 700 beetles may eventually emerge from plants of this consignment in the EU.

See also Annex 1: Probability of detecting *Anoplophora chinensis.*

In practice, the probability of detecting the pest will probably be higher as inspectors could select plants showing symptoms, like presence of frass, adult feeding on twigs and/or could select for the thicker trees that might be more attractive for egg deposition than thinner trees.

Ad 3b
Plants will have to be placed in quarantine for at least 2 years in southern Europe and for at least 3 years in northern Europe. Specific requirements will be needed (e.g. a double door lock gate) to avoid escape of beetles. Plants will have to be monitored for symptoms during the quarantine period and especially at the end of the period.

		Ad 3c Application of a systemic insecticide, e.g. imidacloprid, as a soil drench might kill larvae inside young trees (see also the answer to question 3.18). After import, young trees could be potted in a restricted (quarantine) area in a glasshouse and imidacloprid could be applied about 4 weeks later when plants are actively growing. Plants could leave the quarantine area when imidacloprid has been taken up by the plants about 1 week after application. Experiments show, however, that this method is not very effective against larvae of the related species *A. glabripennis* and pilot experiments performed in Italy indicate that stem injection is not highly effective against adults of *A. chinensis* (see 3.18). The efficacy of the method will have to be experimentally tested. In the Netherlands, drip irrigation of imidacloprid in floricultural crops grown under protected conditions is allowed to use if the nutrient solution is reused (closed system). The maximum dosage is 14 g formulated product (a.i. 70%) per 1,000 plants (Pesticide database on http://www.ctb.agro.nl; visited February 2008). This dosage may be too low to control *A. chinensis*. It is uncertain if a higher dosage will be accepted for registration and also the fact that plants shortly after application may move to places without a closed recirculation system.
3.30. Taking each of the measures identified individually, does any measure on its own reduce the risk to an acceptable level?	Yes	Yes, measures: - 1: pest free area, when it can be guaranteed that the area is pest free, - 2: pest free production place/site, when it can be guaranteed that the place is pest free, and plants originate from the production place/site - 3b: a post-quarantine period Official certificates will be required for options 1 and 2 to declare that a consignment originates from a pest free production place or production area (see also the answer to question 3.42). At present, there are no plant passport requirements for most host plants of *A. chinensis* as determined by EU Council Directive 2000/29/EC, as amended. It is therefore difficult or often impossible to distinguish between host plants originating in pest free production places/areas and host plants originating in areas where *A. chinensis* is known to occur. (see also Q 3.34). The risk of introduction will still be high for option no. 3a “destructive sampling and post-entry inspection”. However, it can be discussed if this option in combination with eradication actions in case of an outbreak will reduce the risk of permanent establishment of the pest to an acceptable level.
3.31. For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?	Yes	Measure 3a (destructive sampling) in combination with measures 1 (pest free area) or 2 (pest free production place).

3.32 If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures (see question 3.29) should be considered.	N/A	
3.33. Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.		The total production value of tree nurseries in the Netherlands was about 610 million euro in 2007. (source Productschap Tuinbouw: http://www.tuinbouw.nl/ visited March 2008). This includes the production of trees, shrubs, roses, conifers and non-woody perennials. About 65-75% is produced for export of which 90% to other EU-countries (source : http://www.tuinbouw.nl/ and http://www.treeportzundert.nl, visited March 2008). The production value of *Acer* trees imported from China, Japan and South Korea is estimated on 3 - 6 million euro (information obtained from Dutch growers and importers). Thus the production value of *Acer* spp. imported from Eastern Asia is less than 1% of the total production value from nurseries in the Netherlands. Experts of the Productschap Tuinbouw estimate that the Netherlands contribute to about 10-15 % of all tree nursery products in the EU. Dutch importers/growers of *Acer* spp. estimate that about 50% (30-75%) of *Acer* spp. from Eastern Asia are imported via the Netherlands into the EU. Thus *Acer* spp. from Eastern Asia contribute to less than 0.5% to the total production/trade value of nursery products in the EU. The total value of import of agricultural products from China into the Netherlands was 0.5 billion euro in 2006 and the export 0.2 billion (source: http://www.evd.nl/, visited March 2008) The total import of goods (all kind of products) from China into the EU was € 230.8 billion and the export € 71.6 billion in 2007 (source: http://ec.europa.eu/trade/issues/bilateral/countries/china/index_en.htm, website visited September 2008). Thus, the measures mentioned above to reduce the risk of introduction of *A. chinensis* will little interfere with international trade if you relate the total value of host plants imported from Eastern Asia to the total value of agricultural products or all kinds of products imported from that area.

3.34. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.		Each of the measures are cost-effective considering the potentially massive effect of *Anoplophora chinensis* (see also question 2.5): • Option no. 1 (pest free area): will probably stop the import of host plants from China, Japan and South Korea since the pest is probably present in (most) areas where host plants are presently grown for export to the EU. This measure will also prohibit trade of host plants from the infested areas in Lombardy (Italy) and will have a large negative economic impact for growers in this area. This option will not affect small nurseries that sell plants directly to final consumers. Presently, only 1 large nursery is present in the infested areas in Lombardy that sell host plants to persons/companies outside the infested area (source: Lombardy PPS). However, outside the infested area large nurseries are present that sell approximately 300,000 *Acer* trees, 1,000,000 *Malus* trees and 100,000 *Pyrus* trees every year and of which part is sold to persons/companies in other EU-countries. On the nurseries, more than 2,000,000 Acer trees are actually present. If the infested area would enlarge and these large nurseries would become located in the infested area, the economic impact would be very large. • Option no. 2a and 2b (pest free production place): may decrease or even stop the import of host plants from China and possibly also from Japan and South Korea. According to Dutch importers, *Acer* spp. are grown in China in areas with high population densities of *A. chinensis*. Pest free production places may be created using physical barriers (e.g. nets). • Option 3a “destructive sampling and post-entry inspection” in combination with eradication actions in case of an outbreak have the following drawbacks: o Costs to prevent introduction will be relatively high because post-entry inspections are labour-intensive (e.g. in the Netherlands, about 130 nurseries grow *Acer* spp. from China and Japan. Assuming 2 visits per nursery per year with a total time of 20 h needed per nursery, the total costs for post-entry inspection will be: 130 x 20 h x € 100/h = € 274,000. These costs are relatively high compared to the total value of the imported Acer of 3-6 million euro (see Q 1.1)) o Eradication actions will be expensive and may involve the removal of high-value urban trees. o Social and ecological impact of eradications actions will be large o Permanent establishment will only be prevented if eradication measures will not be hampered by public protests since it can include removal of large number of host trees and shrubs Certification (option 2d, see 3.29) should be part of options 1, 2a and 2b to guarantee that host plants originate from pest free areas, production places or production sites. Administration costs for certification (plant passport) of all host plants (plants for planting) traded within the EU will berelatively high because of the wide host range.

3.35. Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?	No	The measures 1. Pest free area, 2. Pest free production place with a 1 km buffer zone or using physical barriers (net screens). This option includes: • Official registration and certification of nurseries, • Official inspections: 3 times per year at appropriate times (beginning, during and at the end of flight period), • Proper eradication measures if the pest or symptoms are being observed at the production places or buffer zone, • Pest free status: no signs or symptoms may have been observed at least during 3 years (4 years in cooler regions where the pest may havea life cycle duration of 3 years). will reduce the risk of introduction to “low” or “very low”. They are cost-effective but will lead to loss of export markets in areas where the pest is present and, therefore, may have undesirable social effects for growers of host plants in exporting countries/areas.
3.36. Envisage prohibiting the pathway		This method will avoid introduction of the pest but will interfere with trade. See also 1.3.
3.37. Have all major pathways been analyzed (for a pest-initiated analysis)?	Yes	
3.38 Have all the pests been analyzed (for a pathway-initiated analysis)?	N/A	
3.39 For a pathway-initiated analysis, compare the measures appropriate for all the pests identified for the pathway that would qualify as quarantine pests, and select only those that provide phytosanitary security against all the pests.	N/A	
3.40 Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment		Import of all host plant species identified in question 1.3 from the areas where *A. chinensis* is present is considered a relevant pathway in the present PRA.

3.41. All the measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners.	Yes	Trading partners can choose among 1. Pest free area 2. Pest free production place with a 1 km buffer zone or using physical barriers (net screens) In countries where *A. chinensis* is present, application of relevant ISPMs would be required for ensuring pest free areas (ISPM 4) or pest free places of production or pest free production sites (ISPM 10). Possibly in the future: 3. Pest free production place using soil or stem injection with systemic insecticides or foliar application of pesticides. This treatments will first need to be experimentally tested for efficacy

3.42. In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPPO Standard PM 1/1(2): Use of phytosanitary certificates)	Yes	Import from third countries: Phytosanitary certificates will be needed to guarantee that plants originate from production places or areas that are free of *Anoplophora chinensis*. Official statement that the plants: (a) have been grown throughout their life in an area free from *A. chinensis*, established by the national plant protection organisation in accordance with relevant International Standards for Phytosanitary Measures; or (b) have been grown in a place of production: (i) which is registered and supervised by the national plant protection organisation in the country of origin, and (ii) where no signs of *A. chinensis* have been observed during 3 official inspections per year carried out at appropriate times during at least 3 years prior to export, and (iii) where the plants were placed in a site with complete physical protection against the introduction of the specified organism, or (iv) where a buffer zone has been established with a radius of 1 km surrounding the place of production and in which no signs of *A. chinensis* have been observed or in case of a finding infested tree(s) have been removed and all host plants in a radius of at least 100 m around the infestation. Trade within the EU: Introduction of plant passport system for relevant host plants of *A. chinensis*. *Acer* spp. (most important pathway, probability of introduction very high) Other host plants (plant species that are attacked in Italy and/or on which *A.chinensis* has been intercepted/found in the EU): *Aesculus hippocastanum*, *Alnus* spp., *Betula* spp., *Carpinus* spp., *Corylus* spp., *Cotoneaster* spp., *Fagus* spp., *Lagerstroemia* spp., *Malus* spp., *Platanus* spp., *Populus* spp., *Prunus laurocerasus*, *Pyrus* spp., *Rosa* spp., *Salix* spp., *Ulmus* spp., *Citrus* spp., *Sageretia* spp., *Chaenomelus* spp., *Cydonia sinensis*., *Celastrus* spp. Probability of introduction or spread by import or trade of these host plants within the EU is presently considered low to medium. This may change if the infested area in Italy would enlarge and nurseries that grow one of the above mentioned host plants for export to other EU-areas would become located in the infested area. New interceptions on host plants other than *Acer* spp imported from Eastern Asia may also change this conclusion (see also the conclusion about the probability of entry in the Pest Risk Assessment part of this PRA). Also note that the total host list of *A. chinensis* is much longer and include species op more than 70 genera (see also the answer to Q 1.1). *Crataegus* spp., *Ficus carica* and *Rhododendron* spp. have been attacked once in Italy as far as known and are considered minor host plant. *Quercus* spp. is a questionable host plant.

3.43 If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented.		Introduction can be prevented, but the effective measures (pest free area and pest free production place) will possibly interfere with international trade since these measures will probably stop or decrease the import of host plants of *A. chinensis* from many areas in China, Japan and possibly also South Korea.
Conclusion of Pest Risk Management. Summarize the conclusions of the Pest Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.		<u>1: pest free area</u> Highly effective: probability of introduction will be very low. This option will have large negative economic impacts for growers of host plant species in infested areas in Eastern Asian Countries and Lombardy. Official registration, surveys and certification will be needed to guarantee that plants originate from pest free areas. <u>2: pest free production place/site</u>, Effective: probability of introduction will be (very) low. This option will possibly have large negative economic impacts for growers of *Acer* spp. and other host plants in China, and possibly also for growers of host plant species grown in Japan and South Korea. Official registration, surveys and certification will be needed to guarantee that plants are grown on pest free production places/sites. <u>3a: inspection with destructive sampling and post-entry inspection at nurseries where imported plants are placed before they are sold to end-consumers.</u> Not effective: probability of introduction still high. Cost for post-entry inspections are high. Eradication actions will probably be needed in the future. <u>3b: a post-quarantine period</u> This option will probably stop the import of most host plant species from areas where the pest is present

References

Adachi, I. 1988. Reproductive biology of the white-spotted longicorn beetle, *Anoplophora malasiaca* (Thomson) (Coleoptera: Cerambicidae), in citrus trees. Applied Entomology and Zoology 23: 256-264.

Adachi, I., 1994. Development and life cycle of Anoplophora malasiaca (Thomson) (Coleoptera Cerambycidiae on Citrus trees under fluctuating and constant temperature regimes. Applied Entomology and Zoology 29: 485 – 497.

Adachi, I. 1990. Population studies of *Anoplophora malasiaca* adults (Coleoptera : Cerambycidae) in a citrus grove. Researches on Population Ecology 32: 15-32.

Anonymous, 2001. Artificially dwarfed plants. Pest Risk Assessment on certain wood boring beetles known to be associated with artificially dwarfed plants (ADP): citrus longhorn beetle (CLB), (*Anoplophora chinensis*), the white spotted longhorn beetle (WSLB), (*Anoplophora malasiaca*), and *Chlorophorus diadema*.

Anonymous, 2002. Aziatische boktor. Natura 99e jaargang no.4: 13 (magazine of the Royal Dutch Society for Natural History)

Anonymous, 2007. Workshop Management of Anoplophora, Wageningen 22-24 November 2006. Report, Dutch Plant Protection Service (available at: http://www.minlnv.nl/portal/page?_pageid=116,1640321&_dad=portal&_schema=PORTAL&p_file_id=22662).

Baker, R., Eyre, D., 2006. Pest Risk Analysis for *Anoplophora chinensis*. CSL, York, UK.

Balder, H., 2003. Risikostudie für den Baumbestand einer Grosstadt. Nachrichtenbl. Deut. Pflanzenschutzd. 55: 85-86.

Beusekamp, 2008. Anne Frankboom kan nog minstens 5 jaar mee. De Volkskrant: http://www.volkskrant.nl, site visited February 2008).

CABI, 2007. CABI Crop Protection Compendium. http://cabicompendium.org/cpc.

De Boer, D., 2004. Distribution potential of three *Anoplophora* species in Europe (Coleoptera: Cerambycidae). A Climex study, PD intern rapport, pp.49.

Dubois, T., Li, Z., Jiafu, H., Hajek, A.E. 2004a. Efficacy of fiber bands impregnated with Beauveria brongniartii cultures against the Asian Longhorned beetle, Anoplophora glabripennis (Coleoptera; Cerambycidae). Biological Control: theory and application in pest management 31 (3): 320-328.

Dubois, T. Hajek, A.E., Jiafu, H., Li, Z. 2004b. Evaluating the efficiency of entomopathogenic fungi against the Asian longhorned beetle, Anoplophora glabripennis (Coleoptera: Cerambycidae), by using cages in the field. Environmental entomology, 33 (1):62-74.

Dumouchel, L., 2004. Plant health risk assessment, Anoplophora glabripennis (Mots.) Asian Longhorn Beetle (Starry Sky Beetle). Canadian Food Inspection Agency, Plant Health Risk Assessment Unit, Ontario, Canada.

EPPO, 2006. Recent interceptions of Anoplophora species in United Kingdom. EPPO Reporting Service No. 5: 2006/098.

Farr, I. & Chesmore, D. 2007. Automated bioacoustic detection and identification of wood-boring insects for quarantine screening and insect ecology. Proceedings of the institute of acoustics, **29** (3) 8pp

GAO, 2006. Invasive forest pests. Lessons learned from three recent infestations may aid in managing future efforts. United States Government Accountability Office (GAO-06-353)

Hansen, J.D., Hara, A.H., 1994. A review of postharvest disinfestation of cut flowers and foliage with special reference to tropicals. Postharvest Biology and Technology 4: 193-212.

Hérard, F., Krehan, H., Benker, U., Boegel, C., Schrage, R., Chauvat, E., Ciampitti, M., Maspero, M., Bialooki, P., 2005a. Anoplophora in Europe: infestations and management responses. Proceedings of the 16th U.S. Department of Agriculture interagency research forum on gypsy moth and other invasive species 2005 GTR-NE-337: 35 – 40.

Hérard, F., Ciampitti, M., Maspero, M., Krehan, H., Benker, U., Boegel, C., Schrage, R., Bouhot-Delduc, L., Bialooki, P. 2006. Anoplophora species in Europe: infestations and management processes. EPPO Bulletin, 36 (3): 470-474.

Hoyer-Tomiczek U., Krehan H., Tomiczek Ch. , 2005. Asiatischer Laubholzbockkäfer Anoplophora glabripennis in Braunau/Österreich: Befallsentwicklung und Bekämpfung in den Jahren 2004 und 2005. Bundesamt und Forschungszentrum für Wald, Naturgefahren und Landschaft, Wien: http://bfw.ac.at/rz/bfwcms.web?dok=4258. 20.12.05

Hoyer-Tomiczek U., Krehan H., Tomiczek Ch. , 2007. Der Asiatische Laubholzbockkäfer (Anoplophora glabripennis) und der Citrusbockkäfer (Anoplophora chinensis) in Europa - ein Situationsbericht. Forstschutz aktuell no.38: 2-5.

Kashio, T. 1996. Microbial control of the white spotted longicorn beetle, Anoplophora malasiaca, by the entomophagous fungus, Beauveria brongniartii in citrus orchards in Japan. Biological pest control in systems of integrated pest management: proceedings of the international symposium on “The use of biological control agents under integrated pest management”, Taipei,Ttaiwan:FFTC ASPAC, 1996. FFTC book series (47): 106-112.

Lieu, K.O.V., 1945. The study of wood borers in China -- I: Biology and control of the citrus-root-cerambycids, *Melanauster chinensis*, Forster (Coleoptera). The Florida Entomologist 27: 61-101.

Lingafelter, S.W., Hoebeke, E.R., 2002. Revision of Anoplophora (Coleoptera: Cerambycidae). Entomological Society of Washington, Washington, D.C., U.S.A. 236 pp.

MacLeod, A., Evans, H.F., Baker, R.H.A., 2002. An analysis of pest risk from an Asian longhorn beetle (*Anoplophora glabripennis*) to hardwood trees in the European community. Crop Protection 21: 635 – 645.

Maspero, M., Cavalieri, G., D’Angelo, G., Jucker, C., Valentini, M., Colombo, M., Herard, F., Lopez, J., Ramualde, N., Ciampitti, M., Caremi, G., Cavagna, B., 2007. *Anoplophora chinensis* Eradication programme in Lombardia (Italy). http://www.eppo.org/QUARANTINE/anoplophora_chinensis/chinensis_it_2007.htm

Poland, T.M., Haack, R.A., Petrice, T.R., Miller, D.L., Bauer, L.S., Gao, R., 2006. Field evaluations of systemic insecticides for control of *Anoplophora glabripennis* (Coleoptera: Cerambycidae) in China. Journal of Economic Entomology 99: 383-392.

Sacco, J., 2004. The attack of the urban forest eaters: how a dedicated and educated group of volunteers is responding to the invasion of Asian long-horn beetles and gypsy moths in Chicago. In: Shaw et al. (eds.) Proceedings 4th International Urban Wildlife Symposium.

Sawyer, A.J., 2007. Spatial and temporal dynamics of Asian Longhorned Beetle infestations in Carteret and Linden, New Jersey. Pp 128-129 in Mastro et al., Emerald Ash Borer and Asian Longhorned Beetle Research and Technology Development Meeting. Cincinnati, Ohio, USA. FHTET-2007-04 (Abstract).

Smith, I.M., McNamara, D.G., Scott, P.R., Holderness, M., 1997. Quarantine Pests for Europe, 2nd Edn., CABI / EPPO, Wallingford, 1425pp.

Smith, M.T., Bancroft, J, Li, G., Gao, R, Teale, S., 2001. Dispersal of Anoplophora glabripennis (Cerambycidae). Environmental Entomology 30: 1036 – 1040.

Smith, M.T., Tobin, P.C., Bancroft, J., Guohong, L., Gao, R., 2004. Dispersal and spatiotemporal dynamics of Asian Longhorned Beetle (Coleoptera: Cerambycidae) in China. Environmental Entomology 33: 435 – 442.

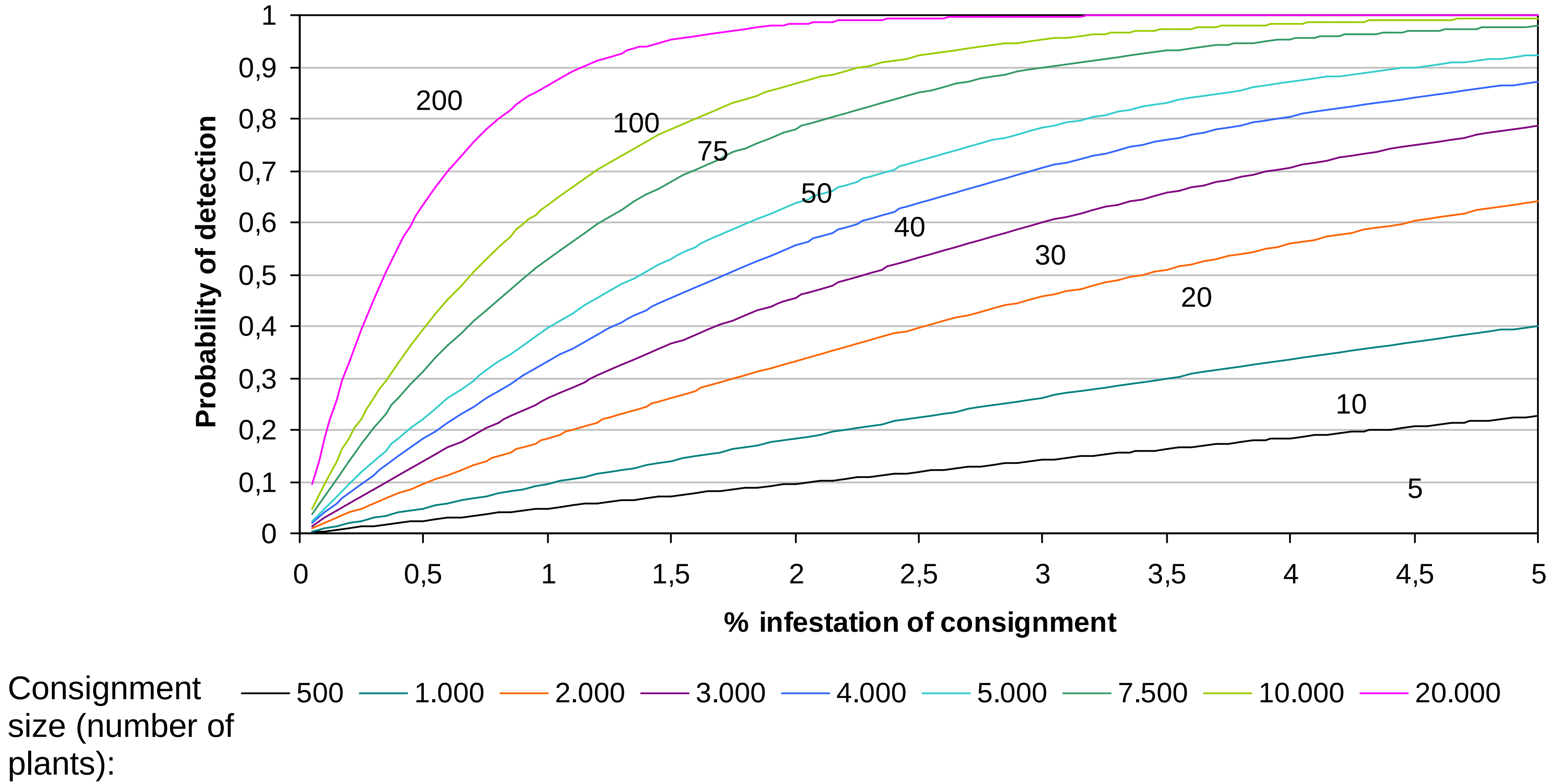
Smith, M.T., Wu, J., Tropp, J.M., He., W., Su, H., Zhang, G., Xu, X., Li, J., 2007. Efficacy of lambda-cyhalothrin for control of the Asian Longhorned Beetle. Pp. 108 - 110 in: Mastro et al., Emerald Ash Borer and Asian Longhorned Beetle Research and Technology Development Meeting. Cincinnati, Ohio, USA. FHTET-2007-04 (Abstract).

USDA, 2008. USDA, 2008. New pest response guidelines - Asian Longhorned Beetle, *Anoplophora glabripennis*. USDA-APHIS-PPQ http://www.aphis.usda.gov/plant_health/plant_pest_info/asian_lhb/downloads/alb_response_guidelines.pdf

Wang, B.,Gao, R., Mastro, V.C., McLane, W.H., Reardon, R.C., 2001. Toxicity and efficacy of imidacloprid to *Anoplophora glabripennis* (Coleoptera: Cerambycidae). Abstract prepared for the USDA Interagency Research Forum on Gypsy Moth and Other Invasive Species, January 16-19, 2001 Annopolis, Maryland. http://www.uvm.edu/albeetle/research/insecticides.html (website visited April 2008).

Wermelinger, B., 2006. Augen auf für einen bislang unbekannten Schädling: Erster Quarantänefall des Chineschen Laubholzbockkäfers in der Schweiz. Der Gartenbau 46: 2-4.

Annex 1: Probability of detecting *A. chinensis* (if evenly distributed) in consignments of 500 to 20,000 plants when destructively sampling 1% up to a maximum of 200 plants per consignment



Note: The numbered labels attached to each coloured line is the number of plants sampled in each consignment