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Phytosanitary Risk Analysis for *Anoplophora chinensis* (Forster, 1771) on fruit crops, broadleaved ornamental and forest tree species for Bulgaria

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Summary

Bulgaria is a traditional agricultural country, where various types of fruit crops, such as apple (*Malus*), pear (*Pyrus*), peach, apricot and plum (*Prunus*), are hosts to *Anoplophora chinensis* (citrus longhorned beetle). In addition, *Anoplophora chinensis* is a serious pest of ornamental and forest tree species, such as poplar (*Populus*), willow (*Salix*), maple (*Acer*), alder (*Alnus*), birch (*Betula*), chestnut (*Castanea*), beech (*Fagus*), oak (*Quercus*), rose (*Rosa*), etc.

Anoplophora chinensis (citrus longhorned beetle) is a widespread pest in Southeast Asia with climate types ranging from tropical to temperate. It has been introduced to the United States, but it has been successfully eradicated. In Europe, outbreaks of *Anoplophora chinensis* have been reported from Italy, Croatia, Denmark, France, Germany, the Netherlands, Switzerland, Turkey and the United Kingdom. The pest has been successfully eradicated in Denmark, Germany, Switzerland, the Netherlands and the United Kingdom. At this moment, there is no evidence that *Anoplophora chinensis* is present in the area for which the phytosanitary risk analysis is being carried out.

The main routes for the entry of *Anoplophora chinensis* into the EU and Bulgaria are through the commercial exchange and movement of planting material (plant material including bonsai plants) and wood products (including logs, timber, wooden packaging material from solid wood without bark and pallets) from host plants originating in countries with established infestation.

The probability of *Anoplophora chinenis* entering Bulgaria naturally is relatively low, despite the fact that outbreaks of the pest have been found in the Black Sea region of Turkey, since the maximum distance of natural spread of the pest in one year is about 194 m.

The presence of host plants, as well as the climatic conditions in Bulgaria, are not a limiting factor, which is why the pest has great potential to enter new areas and/or to adapt to new climatic and/or ecological conditions.

In case of entry, establishment and spread of *Anoplophora chinensis* in Bulgaria, it can have a negative impact, both on fruit production and timber harvesting, as well as on ecology, biodiversity in broadleaved forests and urban landscapes, and last but not least, on the development of the resort industry and tourism.

The effect on exports of agricultural produce and timber would also be negative.

A possible entry, establishment and spread of *Anoplophora chinensis* in our country would also affect the financial situation of farmers.

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Keywords: *Anoplophora chinensis*, citrus longhorned beetle, *Cerambycidae*, Bulgaria.

Reason for carrying out the phytosanitary risk assessment

The reason for carrying out the phytosanitary risk assessment of *Anoplophora chinensis* for Bulgaria is its detection and spread in the Republic of Turkey, a country bordering our country, both by land and by sea - the Black Sea. A population of this pest was first detected in Turkey in 2014, on maple (Acer) and willow (Salix) in a nursery in Istanbul, and since then it has spread significantly, threatening hazelnut (Corylus) production throughout the Black Sea region of Turkey (Turan, A., & Erdoğan, V. 2022)

1. Pest

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The pest *Anoplophora chinensis* (Forster, 1771) is a well-identified species of the order Coleoptera, family Cerambycidae, genus *Anoplophora*. The genus *Anoplophora* consists of 36 species of long-horned beetles native to the temperate and tropical regions of Asia (Lingafelter SW, Hoebeke ER, 2002). The species got its trivial name "Citrus longhorned beetle" from the damage it causes to citrus plantations in its place of origin and natural range - China, and is considered an economically important pest. According to the authors (Lingafelter SW, Hoebeke ER, 2002) *Anoplophora chinensis* (Forster, 1771) has the following synonyms: *Anoplophora chinensis* Breuning 1944, *Anoplophora macularia* (Breuning), *Anoplophora malasiaca* (Thomson), *Anoplophora malasiaca* Samuelson 1965, *Anoplophora perroudi* Pic 1953, *Anoplophora sepulchralis* Breuning 1944, *Callophora afflicta* Thomson 1865, *Callophora luctuosa* Thomson 1865, *Calloplophora abbreviate* Thomson 1865, *Calloplophora macularia* Thomson, *Calloplophora malasiaca* Thomson 1865, *Calloplophora sepulcralis* Thomson 1865, *Cerambyx chinensis* Forster 1771, *Cerambyx farinosus* Houttuyn 1766, *Cerambyx pulchricornis* Voet 17 78, *Cerambyx punctator* Olivier, *Cerambyx sinensis* Gmelin 1790, *Lamia punctator* Fabricius 1777, *Melanauster chinensis* (Forster), *Melanauster chinensis* Matsumura 1908, *Melanauster chinensis* Thomson, Melanauster chinensis macularius Kojima 1950, *Melanauster chinensis var. macularia* Bates 1873, *Melanauster chinensis var. macularis* Matsushita 1933, *Melanauster chinensis var. Sekimacularius* Seki 194, *Melanauster macularius* Kolbe 1886, *Melanauster malasiacus* Pic 195.

Figure 1. Male and female adults of *Anoplophora chinensis* https://www.aloki.hu/pdf/1504_111116.pdf

The adult individuals (Figure 1.) have a black shiny body, in length approximately 21 mm (male) to 37 mm (female). The body is covered with shiny black elytra spattered with 10 to 20 white circular spots (Lingafelter SW, Hoebeke ER, 2002). The pronotum of *Anoplophora chinensis* is entirely black. Males have narrowed elytra towards the end. Females have parallel walls of the elytra and rounded ends. Males are smaller than females and the apex of their abdomen is completely covered by the elytra, in contrast to the partially exposed abdomen of females. The antennae of males are 1.7 to 2 times longer than the body, and the antennae of females are 1.2 times longer than the body. The antennae are black with a blue-gray base and whitish spots on individual segments (Jamba Gyeltshen and Amanda Hodges, 2005).

The eggs are oblong, subcylindrical, white and about 6 mm size. They are laid under the bark. During development, the eggs acquire a yellowish-brown color. (Lieu KOV. 1945).

The larvae have an elongated and cylindrical shape and are cream in color; the head is prognathous and usually retracted into the prothorax (Pennacchio F, et al., 2012.). Mature larvae of *Anoplophora chinensis* are up to 56 mm long and 10 mm wide at the prothorax.

The pupae are light yellow in color and 24–35 mm long. The size of the pupa is determined by whether it hatches into a male or female individual. If a male hatches, the size is smaller, and if a female hatches, the size is larger.

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Biology and life cycle

In tropical and subtropical regions, the pest develops one generation per year, but sometimes, depending on climatic conditions and food, the life cycle lasts two years (Adachi I, 1994, Hérard F and Maspero M, 2019.). In temperate regions, *Anoplophora chinensis* has a longer life cycle (Baker R and Eyre D, 2006, van der Gaag DJ, et al.,2008). Adults live for about 1-3 months, from April-May to August (CABI - Compendium). They are active during the day. Beetle feed on the leaves, petioles and young bark of the host plants. Insects become sexually mature about 10 days after conception. Copulation takes place during the day on stems and thick branches. A week after copulation, the female lays about 70-100 eggs one by one under the bark of the stem (up to 60 cm above the soil surface), near the base of the trunk or on exposed roots (van der Gaag DJ, et al.,2010). To lay her eggs, females cut a T-shaped "notch" in the bark of the ground part of the trunks or exposed roots. The first instar larvae hatch (depending on the temperature, which should be between 20° C and 30° C) about 10 days after egg laying. The newly hatched larvae burrow under the bark and later penetrate the sapwood of the lower part of the stems and roots (Hérard F, et al.,2005). Only young larvae expel wood shavings through holes in the bark, which makes them easier to detect. Older larvae compact the sawdust inside the hole. Pupation takes place in the wood above the feeding site. After imaginal, the adult insects leave the pupal chambers through outlet holes/orifices. Only the exit holes of adult insects are visible. The openings are round, with an average diameter of 10–15 mm, usually slightly larger in females than in males, and are located approximately 25 cm below the oviposition site (Haack RA, et al., 2010).

Damage

Anoplophora chinensis is known as one of the most dangerous pests in nurseries and orchards, where it causes economic damage. The pest mainly harms healthy, young trees. Adults and larvae cause defects. Adults feed on the leaves, petioles, and bark of the host tree but cause little damage (Figure 2). The main harm is caused by the larvae, which after hatching burrow just under the bark and later enter the wood of the stem and roots. The larvae make tunnels/galleries in the branches, stem and roots (Figure 3), feeding on the sap and heartwood of the tree and attacking the conducting tissues. As the larvae develop, the galleries become progressively wider. This feeding damage can lead to structural weakening of the host tree and crown dieback. Trees become susceptible to secondary disease attack and usually die within a few years (Chambers, B., 2002, Keena, MA, et al.,2021., Malumphy, C., et al.,2012).

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Figure 2. Damage by an adult *Anoplophora chinensis* https://planthealthportal.defra.gov.uk/assets/factsheets/anplophoraLonghornBeetle.pdf

Figure 3. Damage by *Anoplophora chinensis* https://planthealthportal.defra.gov.uk/assets/factsheets/anplophoraLonghornBeetle.pdf

Detection of the pest is mainly done by finding adult insects and their exit holes around the base of the infested trees. Larvae are difficult to detect as the older larvae compact the sawdust inside the hole and no sign of activity can be seen from the outside.

Symptoms

Attacked trees can be recognized by the presence of the following symptoms: gnawing of the leaves and young bark during the additional feeding of the adult insects; presence of "cuts" on the ground part of the stems and exposed roots in the egg-laying places; leakage of juice from the "cuts" and entrance holes of the larvae; disposal of sawdust and excrement when the larvae feed, which accumulate at the base of the stem; presence of exit holes at the base of the stems after the adult insects are imaginal (EFSA, PLH Panel, 2019).

2. Hosts

Anoplophora chinensis is a polyphage that attacks more than 100 tree species (healthy broadleaved trees and shrubs) from over 20 families (Peverieri, GS, et al., 2012). In its natural area of distribution - China, it is an economically important pest of Citrus spp. Most host plants of *Anoplophora chinensis* belong to the genera: *Acer* spp. (maple), *Aesculus* spp. (horse chestnut), *Alnus* spp. (alder), *Betula* spp. (birch), *Carpinus* spp. (hornbeam), *Citrus* spp. (citrus), *Cornus* spp. (dogwood), *Corylus* spp. (hazel), *Cotoneaster* spp., *Crataegus* spp. (hawthorn), *Fagus* spp. (beech), *Lagerstroemia* spp., *Liquidambar* spp., *Malus* spp. (apple), *Platanus* spp. (sycamore), *Populus* spp. (poplar), *Prunus* spp. (peach, apricot and plum), *Pyrus* spp. (pear), *Quercus* spp. (oak), *Rhododendron* spp. (rhododendron), *Rosa* spp. (rose), *Salix* spp. (willow), *Sorbus* spp. (rowan) and *Ulmus* spp. (elm) (Haack RA, et al., 2010). These are broadleaved trees found in many orchards, natural forests or cultivated as ornamental trees in parks and recreation areas in urban areas of EU Member States.

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In Europe, the most commonly attacked trees are species of the genus *Acer* spp., followed by species of the genus *Betula* spp. and genus *Corylus* spp. (EFSA, PLH Panel, 2019).

3. Distribution

According to information from the global database of the European and Mediterranean Plant Protection Organization (EPPO) as of 1.12.2023. (EPPO Global Database 2022) *Anoplophora chinensis* originates from Southeast Asia and is widespread in China (all but the northernmost prefectures), the Democratic People's Republic of Korea, the Republic of Korea, and Japan (from the southern part of Hokkaido Island to Okinawa Island). It has been reported by Taiwan, the Philippines, Indonesia, Malaysia, Myanmar, and Vietnam. It was introduced into the United States, where, according to the EPPO global database, it was successfully eradicated. In Europe, outbreaks of *Anoplophora chinensis* have been reported by Italy, Croatia, Denmark, France, Germany, the Netherlands, Switzerland, Turkey and the United Kingdom. Currently, there is evidence of the presence and spread of the pest in Italy, France, Croatia and Turkey, where it is in the process of elimination. The pest has been successfully eradicated in Denmark, Germany, Switzerland, the Netherlands and the United Kingdom (EFSA, PLH Panel, 2019).

By 2023, there is no data that *Anoplophora chinensis* occurs in any part of Bulgaria.

Figure 4 shows the global distribution of *Anoplophora chinensis*, according to the EPPO global database, with the last update as of 20.10.2022.

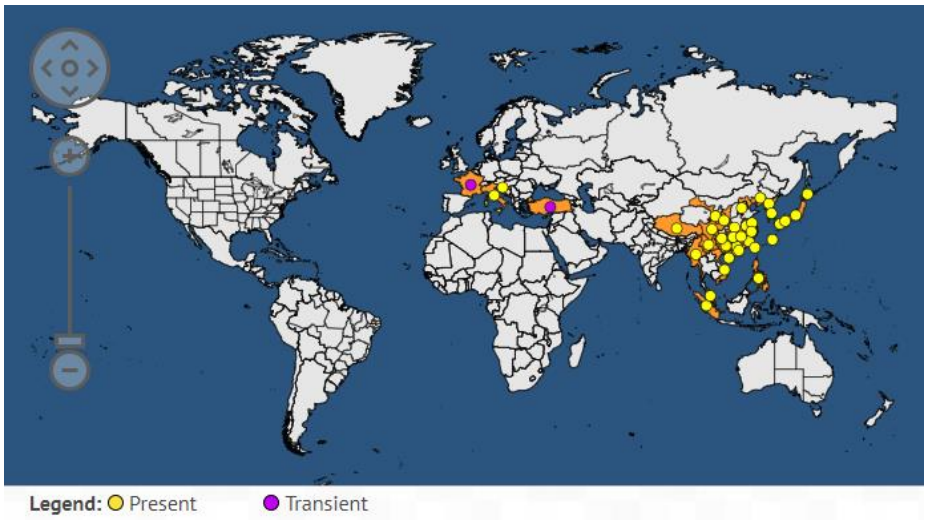

Figure 4. Global distribution of *Anoplophora chinensis* according to EPPO, https://gd.eppo.int/taxon/ANOLCN/distribution

4. Risk analysis and assessment

Probability of the pest entering Bulgaria

The main routes for eventually entrance of *Anoplophora chinensis* on the territory of the EU and Bulgaria are through the international trade and movement of infected (eggs, larvae, pupae) plants for planting - fruit or ornamental saplings or "bonsai" and plant products from the host plants originating from countries with established infestation (Global Invasive Species Database 2023).

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According to the European union notification system for plant health interceptions – (EUROPHYT) database in the last three years, an interception of *Anoplophora chinensis* in the EU was reported on 21.04.2022, on *Acer palmatum* imported from China. On 08/07/2023, *Anoplophora* was detected on an unspecified product imported from India.

In Bulgaria, *Anoplophora chinensis* can be introduced, by accident of omission during phytosanitary checks, with infected plants for planting coming from countries where the pest is present. Plants are visually inspected, and in many cases to see if the plant is infected with *Anoplophora chinensis* when there is no exit hole is impossible, and an indicator of the presence of larvae of the pest is the presence of sawdust. The danger is real and the probability is considered high, due to the global expansion and increasing of trade with plants and the ability of the pest to survive during the transportation and at sub-zero temperatures. *Anoplophora chinensis* larvae present in the plants may survive, as the pest is present in areas with minimum winter temperatures well below freezing (Baker, R., Eyre, D., 2006). This indicates that the probability of surviving of the beetle during the transport is high.

The pest (larvae) could also enter by importing infested wood packing material from solid barkless wood, but this route is less likely as *Anoplophora chinensis* lays its eggs at the base of tree trunks or just above ground level and 90% of larvae are found in wood below ground level. No logs or packing material are harvested from these parts (Hérard F, et al., 2005). Host plant parts such as leaves, flowers, fruits and seeds are not an entry route for *Anoplophora chinensis* (CABI – Compendium).

At the moment, for Bulgaria, the probability of *Anoplophora chinensis* entering naturally is relatively low, despite the fact that outbreaks of the pest have been found in the Black Sea region of Turkey (nursery in the city of Şile, which is located on the Black Sea coast; city of Istanbul; nursery in Barton province, located in the western Black Sea region; Macca district in Trabzon province, also located in the Black Sea region of Turkey) (Turan, A., & Erdoğan, V. 2022). *Anoplophora chinensis* adults live around 1 -3 months, from April-May to August (CABI - Compendium) and according to the information published by EFSA (EFSA PLH Panel, 2019) the maximum distance of natural spread in one year is about 194 m, although according to other studies (Cavagna B, et al., 2013) adults can fly distances from 400 m to 500–663 m, depending on whether the area is agricultural or urban.

Probability of establishing and spreading the pest in Bulgaria

Almost all of the main host plants of *Anoplophora chinensis* (fruit crops - apple, pear, peach, apricot, plum, hazel, blackberry and raspberry, and ornamental and forest tree species - poplar, willow, maple, alder, birch, chestnut, beech, oak, rose, etc.) are found on the territory of the EU (Haack RA, et al., 2010; Päivinen, R., et al., 2001), as well as in Bulgaria.

The pest successfully reproduces and develops in climatic areas with tropical, subtropical and temperate climates (Adachi I, 1994.; Hérard F and Maspero M, 2019; Baker R and Eyre D, 2006.; van der Gaag DJ, et al, 2008.).

Climatic zones according to the Köppen-Geiger classification (Figure 5) in which *Anoplophora chinensis* develops are: Af, Am, Aw, BS, Cs, Cw, Cf and Dw.

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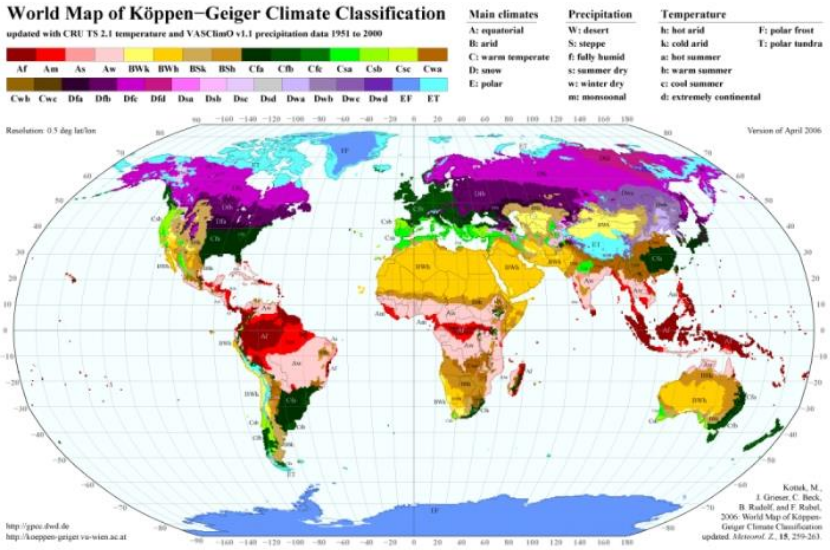

Figure 5: World map of Köppen-Geiger climate types, https://koeppen-geiger.vu-wien.ac.at/present.htm

According to EFSA (EFSA, PLH Panel, 2019), based on the CLIMEX model (The CLIMEX model predicts the effect of climate change on the distribution of species using simulation and modeling techniques. The model tries to mimic the biological mechanisms that limit the geographical distribution of species and determine their seasonal phenology and relative abundance.), *Anoplophora chinensis* could become established throughout the EU due suitable climate conditions (except in northern Sweden and northern United Kingdom), and the host plants are cultivated and distributed throughout Europe. The host plants are found in natural forests, in agricultural areas, as fruit species, but also in urban areas, as ornamental trees.

In the EU countries where the species has been introduced, attack by *Anoplophora chinensis* has generally been limited to single urban trees, trees growing in small groups or rows, trees in small orchards or trees at the border of woodlands. The pest has never been found in natural forests (Haack RA, et al, 2010; Hérard F and Maspero M, 2019)

Bulgaria falls in the transition zone between two climatic regions of Europe - European-continental and continental - Mediterranean climatic region (L. Sabev, St. Stanev, 1959; Zh. Galabov, 1982). This geographical location is characterized by significant temperature fluctuations. The average annual temperature for most of Bulgaria is between 10° C and 14° C, but it varies greatly in different areas of the country. The transition from European-continental and continental - Mediterranean climatic areas is not abrupt, but through the gradual change of the values and mode of the climatic elements. According to the Report on Ecological Assessment in the Republic of Bulgaria 2014 - 2020, six climatic areas are distinguished in Bulgaria (Figure 6), in which the hosts of *Anoplophora chinensis* are distributed to a greater or lesser extent.

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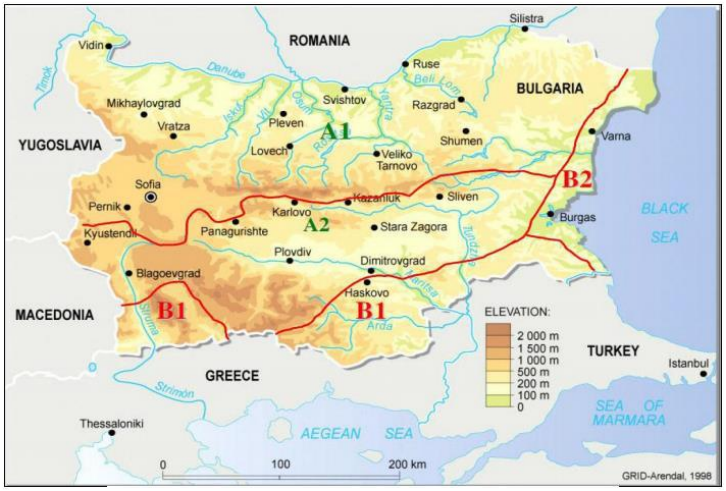

Legend:

A–European-continental climatic region

A1–Temperate-continental climate subregion

A2–Transitional-continental climate subregion

B–Continental-Mediterranean maritime climatic region

B1–South Bulgarian climatic subregion

B2–Black Sea climatic subregion

Figure 6.Climatic regions of Bulgaria,

Based on Climate scenarios for Bulgaria simulated by applying the ALADIN regional model (ALADIN is a spectral model for regional forecasting of meteorological fields and phenomena).(Figure 7).(EAES, 2011, 2020)the following conclusions are made about climate change in Bulgaria:

- Winters will remain milder in the coming decades;
- The frost days will decrease and the high temperature will affect the vernalization in winter of a number of agricultural crops;
- The current summer conditions will gradually disappear as it will be hotter with average maximum air temperatures above 30° C most often in the flat areas of the country;
- The number of summer days will increase to 90 days in the period 2021-2050. The percentage of summer days is expected to increase by 18-20% above 40% in most flat places in southern Bulgaria;
- The number of hot days will increase by 30% by the end of the 21st century.

Therefore, in case of possible introduction of Anoplophora chinensis in Bulgaria, the probability that it will establish and spread in all areas of the country is very high, since biotic factors (presence of host plants) and abiotic factors (suitability of the pest to the climate) are not a limiting factor.

If established, the spread of Anoplophora chinensis could occur not only through commercial exchange and movement of planting material (including bonsai plants) and wooden packaging material (larvae can be found on all parts of host plants, as well as in wooden packaging material from solid wood without bark), but also naturally through the flight of the adult insects.

Based on the available scientific information about the biology and reproductive capabilities of this pest, the probability that the beetle will reproduce effectively in Bulgaria is high. This conclusion is also supported by the availability of hosts favorable for reproduction and development, as well as the environment and climatic conditions in Bulgaria.

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Potential economic consequences of the pest for Bulgaria

Anoplophora chinensis is the most important pest of citrus fruit species in Asia, especially in its natural range of distribution - China, where it causes extremely high economic losses (Wang Q, et al, 1996). In Asia, the insect is also an important pest of many stone and pome fruit species (Li-ying, Liet et al, 1997).

The main damage is caused by the larvae. They penetrate the wood of living trees, reducing the quality and value of the wood. Heavily infested trees die (Eschen R, et al, 2015), and this leads to a decrease in the yield of produce in the infested orchards.

In the United States, the cost of eradicating *Anoplophora chinensis* is as much as, if not greater than, the cost of controlling the related species - *Anoplophora glabripennis* - over five million dollars (Global Invasive Species Database 2023).

In the EPPO area, Turkey, from the introduction of the pest in 2014, until the end of 2021, a total of five hundred and thirty-nine farmers received compensation of about $1,975,000, for the destruction of 286 ha of hazelnut orchards.

In Europe (countries where the pest has been introduced especially along the Mediterranean coast) *Anoplophora chinensis* represents an economic and ecological threat to fruit crops, forestry, ornamental trees in urban settings and parks.

There are no specific ecological estimates of damage or loss due to *Anoplophora chinensis* attack, but in Italy, the pest attacks many host plant species. Infested trees are destroyed as part of the eradication program, but in a few cases trees have been found dying due to heavy infestation. It is believed that most trees attacked by *Anoplophora chinensis* eventually die or weaken. In the infested area in Lombardy (Italy), €1.2 million was spent on surveys, removal of infested trees and research from 2004 to 2007; 10 million euros have been allocated for surveys, tree removal and replanting, research and public awareness raising for the period 2008-2010 (Servizio Fitosanitario Regionale, Regione Lombardia).

In the USA, Canada and Germany, quantitative assessments of the potential damage or losses due to the related species of *Anoplophora chinensis* - *Anoplophora glabripennis* have been carried out.

- in the US, assessments were conducted in nine major cities. It is thought that Anoplophora glabripennis could destroy 35% of the wood of the infested trees, with an estimated loss of $668 billion. These costs do not include the reduced property prices due to the deterioration of the appearance of the landscape and hence the reduction of its value, reduced quality of the environment, etc. (GAO, 2006).
- in Canada, removing an infested tree and replacing it with a healthy one in an urban setting is estimated to cost about C$1,000 (Dumouchel, L., 2004).
- in Germany, the total potential loss for the most preferred host plant, Acer spp., including replanting costs is estimated to be around €96 million for Berlin alone (Balder, H., 2003).

In southern Europe, the economic impact of *Anoplophora chinensis* on the ecology could be higher than that of *Anoplophora glabripennis* because *Anoplophora chinensis* has more host species.

Taking all this into account, the possible establishment and spread of *Anoplophora chinensis* on the territory of Bulgaria may have the following economic consequences:

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- reduction of yield, quality and production of a number of economically important fruit crops and ornamental and forest tree species;
- restricted movement and export of logs and solid wood products;
- reduced planting of broadleaved trees and reduced landscaping in urban settings;
- disruption of biodiversity in broad-leaved forests and urban landscapes due to the destruction of infested trees;
- deterioration of the financial situation of the Bulgarian agriculture and forestry, due to the increase in the cost price of the harvest, because of the need for additional application of plant protection products and phytosanitary measures in gardens, forests, parks and suburban areas.

In general, in case of possible entry and spread of *Anoplophora chinensis* in Bulgaria, it may have a negative impact, on fruit production and timber harvesting, as well as on ecology, biodiversity in broad-leaved forests and urban landscapes, and last but not least, on the development of the resort industry and tourism.

Anoplophora *chinensis* risk assessment

Table 1. Presence of the pest - High risk

High risk	**The pest is found on the Balkan Peninsula**
Medium risk	The pest is found in the EU
low risk	The pest is not found in the EU

Anoplophora chinensis is a quarantine pest for the EU, but according to the EPPO global database, populations of it are already present in the southern part of the EU (Italy, France, Croatia) and the EPPO-Turkey area (the European part of the country is located on the Balkan Peninsula). In these areas, the pest is in the process of being eliminated.

Table 2. Pest entry routes – High risk

High risk	**It is known that there are ways for the pest to enter Bulgaria**
Medium risk	Routes for the pest to enter Bulgaria are possible, but none are known to exist
low risk	The routes for the pest to enter Bulgaria are unlikely

Accidental introduction of this species into the territory of Bulgaria is possible through the import and trade of planting material (fruit, ornamental and/or bonsai type plants) and wooden packaging material from host plants originating from the countries with an established infestation.

Table 3. Capacity for natural entry of the pest – Low risk

High risk	Maximum registered spread - 500-250 km per year
Medium risk	Maximum recorded spread 100-250 km per year
low risk	**Maximum recorded spread 1-100 km per year (wind dispersal; flowing water)**

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At the moment, the risk of *Anoplophora chinensis* entering Bulgaria naturally is relatively low, despite the fact that outbreaks of the pest have been found in the Black Sea region of Turkey (nursery in the city of Şile, which is located on the Black Sea coast, and the city of Istanbul). The decision is also based on the fact that the adults of *Anoplophora chinensis* live from 1 to 3 months, and the maximum distance of natural distribution of the pest in one year is about 194 m.

Table 4. Climatic conditions for establishing the pest - High risk

High risk	**It is estimated that >40% of the territory of Bulgaria is suitable for establishment of the pest**
Medium risk	It is estimated that >20% of the territory of Bulgaria is suitable for establishment of the pest
low risk	It is estimated that >0 to 20% of the territory of Bulgaria is suitable for establishment of the pest

According to EFSA, based on the CLIMEX model that was used to define the area of potential distribution of the pest, *Anoplophora chinensis* could become established throughout the EU as the climate is suitable for its establishment (except the northern part of Sweden and the northern part of the United Kingdom).

Given the global warming and the tendency for winters to be milder in Bulgaria in the coming decades, there is no doubt about the possibility that this species, if it enters in the future, will be able to establish itself in all areas of our country.

Table 5. Presence of host plants – High risk

High risk	**>10% of host plants are found in Bulgaria**
Medium risk	>1 to 10% of host plants are found in Bulgaria
low risk	>0 to 1% of the host plants are found in Bulgaria

Almost all the main host plants of *Anoplophora chinensis* are found on the territory of Bulgaria (fruit crops - apple, pear, peach, apricot, plum and hazel, decorative and forest tree species - poplar, willow, maple, alder, birch, chestnut, beech, oak, rose, etc.).

Table 6. Spread of the pest after establishment - High risk

High risk	**It is known that there are ways for the spread of the pest in Bulgaria**
Medium risk	The routes for the spread of the pest in Bulgaria are possible, but are not known to exist
low risk	The routes for the spread of the pest in Bulgaria are unlikely

Once established, the spread of *Anoplophora chinensis* could occur not only through commercial exchange and movement of planting material and wooden packing material, but also naturally through the flight of the adult insects, albeit over short distances.

Table 7. Development (reproductive potential) of the pest after establishment - Low risk

High risk	The annual reproductive potential of a female is >500 eggs

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Medium risk	The annual reproductive potential of a female is 100 to 500 eggs
low risk	**The annual reproductive potential of a female is <100 eggs**

In tropical and subtropical regions, the pest develops one generation per year, but in temperate regions *Anoplophora chinensis* has a two-year development cycle. The reproductive potential of a female is 70-100 eggs, which she lays singly under the bark of the stem (up to 60 cm above the soil surface), near the base of the trunk or on the exposed roots of the tree. The embryonic period lasts 10 days at an optimal temperature of about 20° C -30° C.

In most of Bulgaria, the climate is moderate, and in case the pest becomes established in its territory, it would have a two-year development cycle.

Table 8. Economic impact - High risk

High risk	**The pest appears as a problem in its native range and the areas where it has entered**
Medium risk	The pest appears as a problem only in areas where it has entered
low risk	Not reported as a problem outside the place of origin

Anoplophora chinensis is the most important pest of citrus fruit species in Asia. It also damages many stone and pome fruit species. It is known as one of the most dangerous pests in nurseries and orchards and damages mainly healthy and young trees.

In the United States, where *Anoplophora chinensis* has been introduced, it has had the potential to become an economically important pest of forests and native forest ecosystems. The North American Forestry Commission has rated the risk of the pest's establishment and spread as "very high" because, due to its large number of hosts, it could easily adapt to native trees. The impact on fruit trees (pome, stone, berry and nut/shell) has also been of significant concern to these agricultural industries.

In Europe (the countries where the pest has been introduced) *Anoplophora chinensis* represents an economic and ecological threat to fruit crops (pome and stone fruits, as well as citrus production, especially in countries along the Mediterranean coast), forestry, urban trees and parks (ornamental/forest trees).

Since the pest has a large number of hosts, including many economically important fruit crops and ornamental plants that are grown in Bulgaria, in the event of its establishment and spread on the territory of our country, it could have a direct negative economic and ecological impact, through: deterioration of the phytosanitary health of the attacked host plants; disruption of the further production and cultivation of these crops and plant species in the country; disruption of biodiversity in broadleaved forests and urban landscapes; restricted movement and export of logs and solid wood products; impact on the financial situation of farmers and the Bulgarian agriculture and forestry as a whole. The cost price of the harvest will increase, due to the need for additional implementation of PPPs, undertaking and implementation of preventive and phytosanitary measures in gardens, forests, parks and peri-urban areas.

From the above it is concluded that the risk of entry, establishment and spread of the pest *Anoplophora chinensis* is high.

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5. Levels of uncertainty

Uncertainties that could limit the effectiveness of measures to prevent the entry/introduction, establishment and spread of the pest:

- it is assumed that the presence of one male and one female adult in the same location is sufficient for creating a new population, but some uncertainty exists;
- the probability of plants with a very small stem and root diameter, for example less than 1 cm, being attacked is lower than if the stem diameter is greater than 1 cm, i.e. there is uncertainty as to whether *Anoplophora chinensis* would fully develop in trees with small stem and root diameters;
- the pest is difficult to detect, both in the field and in the goods intended for import and trade. Trees with no visible symptoms may contain eggs and/or larvae because if there are no exit holes it is difficult to see if the plant is infested as the older larvae compact the sawdust inside the hole and no sign of activity can be seen from the outside;
- the climate throughout the EU (except the northernmost parts) is considered suitable for the establishment and development of *Anoplophora chinensis*;

The uncertainty of the environmental consequences (uncultivated plants) of *Anoplophora chinensis* infestation is greater than the uncertainty of *Anoplophora chinensis* infestation on cultivated plants. This is due to the lack of information related to ecosystems, other pests, hosts or habitats.

6. Risk Management

According to the EPPO categorization, *Anoplophora chinensis* has the characteristics of a quarantine pest and was included in EPPO List A2 in 1994/2007. The European and Mediterranean Plant Protection Organization has also developed the following Standards regarding the management of the pest (EPPO Global Database 2022) : PM1/002(32) - EPPO A1 and A2 Lists of pests recommended for regulation as quarantine pests (2023); PM3/076(2) - Trees of *Malus*, *Pyrus*, *Cydonia and Prunu*s spp. - inspection of production sites; PM3/079(1) - Consignment inspection for *Anoplophora chinensis and Anoplophora glabripennis*; PM3/087(1) - Monitoring and Inspection of Consignment of Wood Chips and Bark for Quarantine Pests; PM7/149(1) - *Anoplophora glabripennis and Anoplophora chinensis* + erratum + corrigendum; PM8/004(1) - *Castanea*, PM8/005(1) - *Quercus*; PM8/006(1) - *Betula*; PM8/007(1) - *Populus*, PM8/008(1) - *Salix*; PM8/009(1) - *Fagus*; PM8/010(1) - *Ulmus*; PM8/012(1) - *Juglans*; PM8/013(1) - *Acer*; PM8/014(1) - *Platanus*; PM9/016(1) - *Anoplophora chinensis* : official control procedures + addendum.

Anoplophora chinensis is a priority pest for the EU as defined in Article 6 of Regulation (EU) 2016/203, It is also included in the list of priority pests for the EU, which is specified in Delegated Regulation (EU) 2019/1702.

The pest *Anoplophora chinensis* is listed in Annex II, Part B of Commission Implementing Regulation (EU) 2019/2072 as a quarantine pest of EU concern, and in Annex VI of Commission Implementing Regulation (EU) 2019/2072 indicates the list of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited (including item 11, of Annex VI of the same Regulation, where Citrus *L. plants are specified, and their hybrids,*

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other than fruits and seeds, which host Anoplophora chinensis and their introduction into the Union from third countries is prohibited).

In Europe, *Anoplophora chinensis* is subject to emergency measures under Implementing Decision 2012/138/EU concerning emergency measures to prevent the introduction and spread of *Anoplophora chinensis* within the Union, Implementing Decision2014/356/EU and Commission Implementing Regulation (EU) 2021/127 of 3 February 2021 laying down the requirements for the introduction into the territory of the Union of wooden packaging material used in the transport of certain goods originating in certain third countries, and for the phytosanitary checks on this material, as well as for the repeal of Implementing Decision (EU) 2018/1137.

The official phytosanitary authorities of Bulgaria, represented by the Bulgarian Food Safety Agency, conduct annual observations/monitoring for the pest *Anoplophora chinensis* in accordance with Implementing Decision 2012/138/EU and Implementing Regulation (EU) 2021/127. They carry out monitoring of: border checkpoints (BCPs) for imports; in warehouses for storing host plants, including packaging material used in transporting the host plants; ornamental nurseries; greenhouses; garden centers; parks and public green spaces and commercial establishments.

Phytosanitary inspectors make regular inspections of host plants with a diameter of at least 1 cm at the stem or root collar throughout the year (at least quarterly) in garden centers, nurseries, botanical gardens, greenhouses, parks, private yards and gardens, boundaries of forest plantations, places of import and storage of host plants, including packaging material. The marks are sought at the base of the plants and roots!

If the presence of a pest is suspected, samples are taken and sent for laboratory examination.

7. Conclusion

Anoplophora chinensis is one of the most important pests of citrus crops in its natural range - Southeast Asia. This species is polyphagous.

In Bulgaria, *Anoplophora chinenis* can be accidentally introduced, in the event of an omission during phytosanitary inspections, with infested (eggs, larvae, pupae) host plants for planting - fruit or ornamental saplings or "bonsai" type plants, entering from countries where the pest is present. Due to the global expansion and increasing volume of plant trade and the ability of the pest to survive transport and sub-zero temperatures, the risk of introduction is determined to be high.

The pest (larvae) could also enter through the import of infested wood packaging material from solid barkless wood, but the risk of this route of entry is rated as medium.

At the present time, for Bulgaria, the probability of *Anoplophora chinenis* entering naturally is relatively low, despite the fact that outbreaks of the pest have been found in the Black Sea region of Turkey (the maximum distance of natural spread in one year is about 194 m).

Almost all the main host plants of *Anoplophora chinensis* are found on the territory of Bulgaria (fruit crops - apple, pear, peach, apricot, plum and hazel, ornamental and forest tree species - poplar, willow, maple, alder, birch, chestnut, beech, oak, rose, etc.) and taking into

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account climate changes and the trend towards warming in most regions of the country (the pest successfully reproduces and develops in climatic areas with tropical, subtropical and temperate climates), there is no doubt about the possibility that this species, at possible entry in the future, will be able to establish, survive, reproduce and develop in all regions of Bulgaria.

After possible introduction and establishment of the pest on the territory of Bulgaria, it could spread to a greater distance, through the movement and trade of planting material (including bonsai-type plants) and wooden packaging material from the host plants, but also locally, through the flight of the adult individuals.

In case of possible entry, establishment and spread of *Anoplophora chinensis* in Bulgaria, it could have a negative impact, both on fruit production and timber harvesting, as well as on ecology, biodiversity in broad-leaved forests and urban landscapes, and last but not least, on the development of the resort industry and tourism.

The effect on exports of agricultural produce and timber would also be negative.

Based on the above, the most adequate measure that can be applied is monitoring. It is enshrined as a phytosanitary measure in Commission Implementing Decision 2012/138/EU on urgent measures to prevent the introduction and spread within the Union of *Anoplophora chinensis* (Forster) and in our country it is applied annually and responsibly. At this stage, this is the most easily applicable and economically effective measure, which aims at taking timely measures to limit and eliminate any possible outbreak.

In order to ensure the rapid detection and reporting of an attack by the pest, the involvement of farmers and the local population is vital. It is essential to make the people aware of the risks, damage and symptoms associated with the pest, as well as to contact with official services in case of suspicion of *Anoplophora chinensis*.

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