Anoplophora glabripennis Motschulsky, 1854, a new introduced pest that could threat hardwood trees in Lebanon (Coleoptera, Cerambycidae)

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(Accepté le 05.X.2017)

Abstract. – The Asian longhorn beetle, Anoplophora glabripennis Motschulsky, 1854, was intercepted as invasive species in Lebanon. Populus nigra and Salix baybilonica, which are frequently used in landscaping gardens and windy lands, are the most susceptible host trees. No natural predators or parasitoids are reported for A. glabripennis in Lebanon. Based on this information, there is a high risk that this introduced species could be established in the country and threat the hardwood trees in urban and forest habitats. Set up quarantine regulations are very crucial to prohibit the importation of infested material and impose fumigation of all solid wood packaging materials infested.

Résumé. – Anoplophora glabripennis Motschulsky, 1854, un nouveau ravageur pouvant menacer les arbres feuillus au Liban (Coleoptera, Cerambycidae). Le Longicorne asiatique Anoplophora glabripennis Motschulsky, 1854, a été intercepté comme espèce invasive au Liban. Populus nigra et Salix baybilonica, qui sont fréquemment utilisés dans les jardins et les terrains en plein vent, sont les arbres hôtes les plus sensibles aux attaques. Aucun prédateur naturel ni parasitoïde contre A. glabripennis n’est documenté au Liban. Sur la base de ces informations, le risque est très élevé que cette espèce s’installe dans le pays et menace les feuillus. Le suivi des mesures phytosanitaires de quarantaine s’impose afin de contrôler les importations de matériaux vecteurs et d’imposer le traitement curatif ou la destruction de tous les matériaux infestés importés.

Keywords. – Asian longhorned beetle, interception, potential risk, Near East.

The genus Anoplophora Hope, 1839 (Coleoptera, Cerambycidae) includes more than 40 species native to Asia. According to Weiwen & Shunan (1998), Lingafelter & Hoebekte (2002), Ohbayashi et al. (2009a), Löbl & Smetana (2010) and Danilevsky (2017), and looking Chang (1960), Duranton (2004), Ohbayashi et al. (2009b) andXie et al. (2012) the true number of species is not well defined and must be estimated between 39 to 45 species.

All species of the genus are xylophagous attacking mainly deciduous trees but also some coniferous (Lingafelter & Hoebekte, 2002). Several species are dangerous pests in their native areas. Anoplophora glabripennis Motschulsky, 1857 [Asian Longhorned Beetle (ALB)] and A. chinensis (Forster, 1771) [Citrus Longhorned Beetle (CLB) quoted as A. malasiaca (Thomson, 1865) now synonym], are quarantine or forbidden species in Australia, Canada, Europe, New Zealand and United States. These species have been intercepted, and introduced in Europe and North America where eradication process is sometimes successfull but mainly still ongoing (CABI, 2017).

Interceptions of Anoplophora glabripennis in Lebanon. – Until now there is no occurrence of an Anoplophora specimen in Lebanon (Cocquempot et al., 2016; Danilevsky, 2017). A. glabripennis was quoted recently from Turkey at Zeytinburnu in the European part of Istanbul (Ayberk et al., 2014) but this information was not confirmed by Turkish NPPO and the species is still officially absent from Turkey (EPPO, 2015), in spite Ayberk & Uyar (2015) confirm this interception. Sahin (2016) finally denies and corrects these information, asserting that it was a misidentification and that these information concerned Anoplophora chinensis as finding in a nursery
One specimen of Anoplophora glabripennis (fig. 1) (Z. Moussa and C. Cocquempot det.) was found in an urban area of Aabrine (North Lebanon) in 2015, June 1\textsuperscript{st} (fig. 2) (34°15'17.71"N - 35°42'5.35"E), another one was found one week later. The year after, on 2016, July 13\textsuperscript{th}, one other specimen was spotted in the same area. All these specimens are typically with large body from 31 to 32 mm in length. The antennae reach 1.5 times the body length which means that they are all females (Lingafelter & Hoebeke, 2002; Meng \textit{et al.} 2015). It is the first interceptions of this species for Lebanon and all the Near East.

This record over two successive years, exactly at the same place, means that it is probably an introduction but not yet an establishment since no monitoring was done to determine the area and the level of infestation.

\textbf{Hypothesis of the origin of ALB in Aabrine.} –

The Asian longhorn beetle was accidently imported to Lebanon following two possible pathways. The importation of infested ornamental trees seems to be improbable and we believe, that as for almost all cases, it is the main known pathway using infested wood packaging material which happens in Aabrine. Looking at the surroundings of Aabrine, it is not possible for the specimens to come here by natural spreading and fly. It means the infestation comes from transport by road with wood packaging used for industrial material or heavy products for works as granite by example. There’s no factory which could import industrial material and we have not seen any works (new road, new large building or factory and no fitting out of the town) which could necessitate heavy material as natural cut stones as in France for example. The small airport in Wuajh Al Hajar is a military base and cannot be the importation site. Tripoli harbour is an important place for international trade and could be the original place of importation, but an introduction from Beirut harbour or airport cannot be excluded and must looked as a serious hypothesis.

Another possibility to explain the occurrence two successive years in the same place is the storage of wood packaging salvaged on a logistical platform or industrial site to be used as heating wood or other secondary use as it was done sometimes in U.S.A. and Germany.

A meticulous monitoring and investigation would be necessary to know exactly the reason of the presence of ALB in Aabrine, but it was impossible until now. We think also, that ALB could occurs in other sites in Lebanon, following the same importation origin of infested material in Aabrine.

\textbf{Some recalls about Anoplophora glabripennis.} – This species was well studied according its pest status and its world spreading as dangerous invasive species since the end of last century. The Asian longhorned beetle is native to China and Korea (Cavey \textit{et al.}, 1998; Lingafelter & Hoebeke, 2002; Williams \textit{et al.} 2004a). Worldwide, one or several interceptions and introductions were reported in United States of America (Haack \textit{et al.}, 1996; MacLeod, 1997; MacLeod...
et al., 2002; Cavay et al., 1998; Poland et al., 1998; Haack, 2006; Dodds & Orwig, 2011; CABI, 2017) and later in Canada (Hopkin et al., 2004; CABI, 2017). It has been intercepted or introduced in European countries including Austria, Germany, France, Italy (Maspero et al., 2007; Cocquempot & Lindelow, 2010), Belgium (OEPP, 2009), Switzerland (OEPP, 2011; Forster & Wermeling, 2012), England (Lewis, 1999; OEPP, 2012), Czech (CABI, 2017), The Netherlands (OEPP, 2010; Loomans et al., 2013), Finland (OEPP, 2015) and Denmark (Scheel, 2009). The report from Poland (Biâooki, 2003) concerned A. chinensis as those from Turkey (Ayberk et al., 2014; Sahin, 2016). However, it was detected in Japan in 2002 (Takahashi & Ito, 2005; CABI, 2017). All these interceptions have been followed by monitoring and eradication process but not all are successful and many are still ongoing.

Anoplophora glabripennis, a dangerous pest. – However, the most dangerous longhorn species listed in the Lebanese fauna are belonging to the genus Cerambyx Linnaeus, 1758 (Cocquempot et al., 2016) because they attack mainly stone fruit trees.

Several longhorn species were introduced or established in Lebanon: Phoracantha semipunctata (Fabricius, 1775) and P. recurva Newman, 1840, Batocera rufomaculata Degeer, 1775, and we do not exclude that Arhopalus ferus (Mulsant, 1839) was also an old introduced species. Recently, one specimen of Monochamus sutor sutor (Linnaeus, 1758), was reported in Lebanon indicating the high risk of introduction of new species by wood packing material or imported timbers (Moussa et al., 2016).

A. glabripennis is considered as destructive species because, unlike other cerambycid, it has a broad host range and can attack healthy as well as trees under stress (Gaag & Loomans, 2014; Sjöman et al., 2014; CABI, 2017). In addition, it spends most of its life at larval stage boring inside trunks and large branches without visual symptoms (Hu et al., 2009; Meng et al., 2015). According to Li & Wu (1993), Keena (2002), Smith et al. (2002), Haack et al. (2010) and Meng et al. (2015), this species causes double damages to infected trees: first when adult females feed on leaves and twigs for ovarian maturation causing damage to living trees and second when larvae feed on the vascular system of crown and main branches causing severe damage and eventually leading to the death of the infected trees. However, adult males have mature spermatozoa before emergence and feeding is necessary only to sustain their normal activity (Hu et al., 2009).

Once introduced and established, the Asian longhorn beetle is more likely to be found along the border than inside the forest (Liu et al., 2012). Smith et al. (2001a) have studied the dispersal of the beetle and found that adult beetles are short fliers and do not disperse far when surrounded by host trees but the flight can be longer if host trees are lacking near the emergency point. Huang (1991) shows that high canopy density and high vegetation coverage reduce the movement of the beetle. However, in mixed stands, their distribution can vary according to the composition of tree species (Wang et al., 2006).

According to MacLeod et al. (2002), A. glabripennis could establish almost all over the world and may cause serious damages to important hardwood forests, urban trees, industrial trees and some fruit tree species.
Lebanon is located at the eastern edge of the Mediterranean, covering a small area of 10,452 km². The country is characterized by a high biodiversity in term of species-area ratio due to its geographic location and its mountainous topography creating different microclimates (UNEP/MoE, 2015). The National Forest Assessement (NFA) estimates the forest area of Lebanon at 13.3 % of the total area of the country and other wooded land of about 10 % (Beydoun & Estephan, 2005). Broadleaved forest occupies the largest area of about 56.6 %, coniferous constitute 32.2 % and mixed forests cover 11.2 % of the total forest area (Beydoun & Estephan, 2005). In broadleaved forests, Quercus calliprinos Webb, Q. cerris L. and Q. infectoria Oliv. (Fagaceae) are dominant. In coniferous forests, Pinus brutia Tenore and P. pinea L. are the most common, followed by Pinus halepensis Miller (Pinaceae), Juniperus excelsa M. Bieb., Cupressus sempervirens L. (Cupressaceae), Cedrus libani A. Rich. and Abies cilicica (Antoine & Kotschy) Carrière (Pinaceae).

Native Oaks and coniferous species in Lebanon are probably not favourable to ALB and the main risk of damages in forests concerns less common tree species (FAO, 2005) as: Acer hermoneum (Bornm.) Schwer., A. obtusifolium Sm., A. hyrcanum tauricolum (Boiss. & Balansa) Yalt. (Sapindaceae), Alnus orientalis Decne, Ostrya carpinifolia Scop. (Betulaceae), Arbutus andrachne L. (Ericaceae), Celtis australis L. (Ulmaceae), Ceratonia siliqua L., Cercis siliquastrum L. (Fabaceae), Eucalyptus spp. (Myrtaceae), Ficus sycomorus L. (Moraceae), Fraxinus ornus L., F. syriacum Boissier (Oleaceae), Juglans regia L. (Juglandaceae), Laurus nobilis L. (Lauraceae), Quercus boissieri Reuter (= Q. microphylla Thiebaut) (Fagaceae), Platanus orientalis L. (Platanaceae), Populus alba L., P. nigra L., P. tremula L., Salix baybilonica L., (Salicaceae), Sorbus flabellifolia (Spach) Schauer (uncertain status), S. torminalis (L.) Crantz (Rosaceae) and Styrax officinalis L. (Styracaceae). The main fruit trees used in agriculture lands in Lebanon that seem not to be the favourite species for ALB are: Olea europea L. (Oleaceae), Citrus spp. (Rutaceae), Malus spp., Pyrus syriaca Boissier, Prunus amygdalis agrestis Boissier and P. ursina Kotschy (uncertain status) (Rosaceae) (Beydoun & Estephan, 2005). Some ornamental tree species introduced for landscaping, among them Tilia spp. (Tiliaceae), Acacia spp. (Mimosaceae), Casuarina equisetifolia L. (Casuarinaceae) and Jacaranda mimosifolia Don (Bignoniaceae) (Dalsgaard, 2005), could be also potential hosts.

Lebanon has mainly a Mediterranean climate, with warm, dry summers, and cool, wet winters. Most rainfalls are irregular and occur in short periods between November and March. According to FAO (2008), the increase in temperature and the decrease in precipitation due to climate change have notable impact on forest through expansion of insect species range and increased frequency of forest fires. The percentage of the forest area in Lebanon affected by fire is about 14.1 % (or 19,652 ha) of which 99.9% are limited to coniferous forests (Dalsgaard, 2005). In addition, forests in Lebanon have long been subject to degradation and fragmentation due to human activities like urbanization, agriculture, overharvesting, and overgrazing. In total, the loss in forest is estimated about 35% of the forest (UNEP/MoE, 2015). Those factors have obviously a negative impact on forest ecosystems and increase the susceptibility of disturbances such insect pests or pathogens

The risk of establishment of A. glabripennis is very high in Lebanon. According to Keena (2006), the estimated optimum temperature for median longevity of the beetle is 18°C, and the upper and lower thresholds are 39 and -3°C for females and 38 and -2°C for males respectively. These indicate that summer temperatures of Lebanon are favourable for the survival and the reproduction of A. glabripennis, especially in areas where host trees are available in addition to the absence of the natural enemies. However, the warm winters over the past half century may increase overwinter survival of the insect and decrease their chance of mortality.
Anoplophora glabripennis and the biodiversity impact in Lebanon. – The introduction of *A. glabripennis* in Lebanon may obviously have a negative impact on the biodiversity of the country. This new invasive species is able to establish because of its strong adaptability and broad host range. Once the beetle established breeding populations and spread rapidly in the country, it could significantly impact the natural hardwood forests and seriously threaten the biodiversity. The less common species (*Acer spp.*) and the floodplain trees (*Populus spp.* and *Salix spp.*) could be impacted seriously. If the beetle spreads among the urban areas, it could threat poplars, plane trees, eucalyptus and other ornamental and deciduous fruit trees (Nowak et al., 2001). Since the beetle remains virtually invisible in infested trees for up to one year (Hu et al., 2009; Meng et al., 2015), early detection becomes difficult.

CONCLUSION

*A. glabripennis* is considered a serious pest risk in Lebanon. Since the beetle was detected for two consecutive years in the same location, the possibility of mating, breeding and establishing in the surrounding areas is very high and new infestations might be expected in the near future. Moreover, forest ecosystems of Lebanon are facing decline and stress due to the climate change and human activities. Rouault et al. (2006) demonstrated that woodborers are positively influenced by drought and high temperature; in addition, fire and prolonged water stress decrease the host tree resistance. This situation may pose real problems on forests in Lebanon and promote the outbreak of this alien woodborer. According to Wargo (1996) and Ayres et al. (2000), the impact of the secondary agents on forest ecosystems may be greater than the impact of the initial stress.

Facing this problem, and to minimize the potential pathways of *A. glabripennis*, Lebanon should implement the International Standards for Phytosanitary Measures (ISPM) 15 regulations from IPPC (2016). In addition, maintaining public awareness and establishing domestic quarantine regulations that prohibit the transport of potentially infested wood and wood products, and impose fumigation of Solid Wood-Packaging Material (SWPM) from areas where *A. glabripennis* infestations have been detected, are required. A rapid action by cutting and burning infected trees and adjacent healthy trees with high risk within the infestation area is an important approach for a successful eradication to prevent future loss in biodiversity.

ACKNOWLEDGEMENTS. – The authors are grateful to Dr Nabil Nemer (Holy Spirit University of Kaslik) for his collaboration. Thanks are also given to the reviewers for their useful comments.

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