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First detection of Pine Wood Nematode Vector, *Monochamus sutor sutor* (Linnaeus, 1758) in Lebanon (Coleoptera, Cerambycidae, Lamiinae)

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Abstract. − An adult of *Monochamus* (*Monochamus*) *sutor sutor* (Linnaeus, 1758) has been found alive in Lebanon in 2014. This potential vector of the phytoparasitic pine nematodes *Bursaphelenchus spp*., the causal agents of pine wilt disease, is a serious threat to Lebanese forest. The circumstances of the discovery are given, followed by information about the genera *Monochamus* and *Bursaphelenchus* applied to Lebanon. An evaluation of the risk for forests of Lebanon is specified.

Résumé. − **Premier signalement du vecteur du Nématode du Pin, *Monochamus sutor sutor* (Linnaeus, 1758) au Liban (Coleoptera, Cerambycidae, Lamiinae)**. Un adulte de *Monochamus* (*Monochamus*) *sutor sutor* (Linnaeus, 1758) vivant a été découvert au Liban en 2014. Ce vecteur potentiel des Nématodes phytoparasites *Bursaphelenchus spp*., agents du dépérissement des Conifères, représente une menace sérieuse pour la forêt libanaise. Les circonstances de la découverte sont données et suivies des informations sur les genres *Monochamus* et *Bursaphelenchus* appliquées au Liban. Une évaluation du risque encouru par les forêts du Liban est précisée.

Keywords. − *Bursaphelenchus spp*., Pine wilt disease, Lebanon, interception, risks.

Monochamus Dejean, 1821 (Coleoptera, Cerambycidae, Lamiinae) is a large genus of wood-boring beetles comprising approximately 150 species reported in Asia, Europe, Africa and North America (Villiers, 1978; USDA-APHIS, 2011). They are commonly named pine sawyer beetles since larvae bore galleries into trunk and main branches of coniferous trees, specially pine trees (CABI, 2010).

Several *Monochamus* species are vectors of pinewood nematodes. *Bursaphelenchus xylophilus* (Steiner & Buhrer, 1934) (Nematoda, Parasiticaphelenchidae) is the main causal agent of pine wilt disease (PWD) (Linit, 1988; Magnusson & Schroeder, 1989; Tomminen *et al*., 1989; Mota & Vieira, 2008), but *Bursaphelenchus mucronatus* (Mamiya & Enda, 1979), which is sometimes associated with *Monochamus* (*Monochamus*) *sutor* (Linnaeus, 1758) and described as not pathogenetic (Mamiya, 1999), was recognized recently as a possible PWD vector under some natural conditions and in artificial screenings (Akbulut *et al*., 2007).

No *Monochamus* species are known from Lebanon until now (Löbl & Smetana, 2010; Sama *et al*., 2010; Danilevsky, 2015; Cocquempot *et al*., 2016), but a recent interception of one specimen of the small white-marmorated longicorn *Monochamus* (*Monochamus*) *sutor sutor* suggests its possible introduction, mainly by wood packaging or timber import, and could become a high risk of mortality for pine forests in the country.

Interception of* Monochamus *(*Monochamus*)* sutor sutor *in Lebanon. – One specimen of *Monochamus* (*M.*) *sutor* was found alive on March 2014 in the town of Jdaidet (El Metn District, Mount Lebanon) (33°53’32.39”N - 35°34’3.62”E), near Beirut. It was a female with a body length of 27 mm (fig. 1) and antennae of 33 mm length.

According the description from Pic (1898) (see also http://www.cerambycidae-slama.cz/fotky/7%20Lamiinae/Monochamus%20sutor%20Linnaeus,%201758.html), the specimen be-

longs to the nominative subspecies *sutor* and not to the subspecies *longulus* Pic, 1898; it means that the origin of the specimen is probably Europe or Russia but not China or Korea.

Jdaidet is located less than one kilometer of the coast, along which there are many wood factories and importation of heavy industrial material. All this imported material comes from Beirut harbour (one kilometer West to Jdaidet). The specimen emerged certainly from timber or from wood packaging stored from one of these industrial sites or from the harbor and was intercepted during its spreading.

***Some recalls about* Monochamus *(*Monochamus*)* sutor**. – *Monochamus* (*M.*) *sutor* was synonymized recently with *M.* (*M.*) *rosenmuelleri* (Cederhjelm, 1798) (Löbl & Smetana, 2010; Danilevsky, 2015). There are two subspecies, the nominative widely distributed from Europe to West Siberia, and *longulus* in the Far East of Mongolia, China, Korea, Japan (and Kazakhstan ?).

M. (*M.*) *sutor* is distributed through Europe to Russia, China and Japan. It is known in the following countries. Asia: China (Heilongjiang Henan, Jilin, Liaoning, Nei Mongol, Qinghai, Shandong, Xinjiang, Zhejiang), Iran, Japan, Kazakhstan, Mongolia, North Korea, Russia (West Siberia), South Korea, and Europe: Albania, Andorra, Austria, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Georgia, Great Britain, Greece, Hungary, Italy, Latvia, Liechtenstein, Lithuania, Moldavia, Netherlands, Norway, Poland, Romania, Russia (South, Central and North European territories), Serbia and Montenegro, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine (Cherepanov, 1983; Sama, 2002; Löbl & Smetana, 2010; USDA-APHIS, 2011; Danilevsky, 2015).

The larval stages, biology and behavior of this species are well known. The life cycle is one year generally, but it takes two or three years in the northern countries (Duffy, 1953; Hellrigl, 1971; Cherepanov, 1983; USDA Forest Service, 1991; Bakke & Kvamme, 1992; Schroeder *et al*., 1999; Sama, 2002; Ciesla, 2004; CABI, 2010).

M. sutor attacks fir (*Abies spp*.), spruce (*Picea spp*.), pine (*Pinus spp*.) and larch (*Larix spp*.) (Pinaceae). In Europe the beetle is reported from *Abies alba* Miller, *Picea abies* (L.) H. Karst, *Pinus wallichiana* A. B. Jackson (= *excelsa* Wallich ex Don) and *P. sylvestris* L. In China, *Larix gmelinii* Ruprecht, *Pinus sylvestris* var. *mongolica* Litvinov. In Siberia and the Russian Far East, the beetle is detected on *Abies holophylla* Maximowicz, *A. nephrolepis* Trautvetter ex Maximowicz, *A. sibirica* Ledebour, *Larix gmelinii*, *L. sibirica* Ledebour, *Picea koraiensis* Nakai, *P. jezoensis* (Siebold & Zuccarini) Carrière, *P. obovata* Ledebour, *Pinus sylvestris*, *P. nigra* R. Legay, *P. mugo* Turra and *P. sibirica* Du Tour. The deciduous *Betula platyphylla* Sukachev (Betulaceae) is listed as host in China (Zhang *et al.,* 1993).

The small white-marmorated longicorn is reported as a serious conifer pest and a vector of pine nematodes, mainly *Bursaphelenchus mucronatus* (Tomminen *et al*., 1989; Schroeder & Magnusson, 1992; Akbulut *et al*., 2007; Mota & Vieira, 2008; USDA-APHIS, 2011; Abelleira *et al*., 2015; Errico *et al*., 2015).

Monochamus *(*M.*)* sutor *and the Pine Wood Nematodes (PWN)*. – *Monochamus spp*. are the main vectors for the pine nematodes *Bursaphelenchus spp*. Until now, in Europe and Mediterranean Basin, and by excluding the invasive species *M. alternatus* Hope, 1843, only *M.* (*M.*) *galloprovincialis* (Olivier, 1795) is known to be host of *B. xylophilus*, the most dangerous PWN. Monitoring carried out in several countries has never revealed their association with *M.* (*M.*) *sutor*.

Genera of Aphelenchoidea were reviewed by Nickle (1970) and the taxonomy of *B. xylophilus* studied after by Nickle *et al*. (1981).

Bursaphelenchus mucronatus was found often associated with *M.* (*M.*) *sutor*. This PWN was recognized recently as possible responsible of the PWD under stress conditions, for

younger trees and under artificial experimentations (Schroeder & Magnusson, 1992; Akbulut *et al*., 2007). In the Mediterranean countries, *B. mucronatus* was detected in Greece, Italy, France, Portugal, Spain and Turkey on *Pinus spp*. (Akbulut *et al*., 2007; Errico *et al*., 2015).

By feeding on phloem and cambium of the pine bark, the sawyer larvae of *Monochamus* cause direct damage to the host tree (Duffy, 1953; Hanks, 1999), however their main phytosanitary problem is being vector of PWN, mainly the two species *Bursaphelenchus xylophilus* and *B. mucronatus* (Linit, 1988; Magnusson & Schroeder, 1989; Tomminen *et al*., 1989; Schroeder & Magnusson, 1992; PHRAME, 2007; Mota & Vieira, 2008) that could kill pine trees and deteriorate the pine forests.

Individuals of *Monochamus* passively carry up the nematode from an infected conifer tree to a healthy one during maturation feeding on young shoot and also to a weakened tree during females' oviposition (Linit, 1990; Evans *et al*., 1996; Hanks, 1999). The infected tree wilts, dies and become a host for females to mate and lay eggs (Cherepanov, 1983).

To become vector of *B. xylophilus*, *M.* (*M.*) *sutor* must be in contact with the nematode, which is not possible actually but could happen if *B. xylophilus* was introduced accidentally in its area of distribution or by expansion of the infested area from Portugal and Spain.

Risk for Lebanese forests. – There is no information on the presence of *Bursaphelenchus* species in Lebanon and there is no analysis of the host potentiality of the *Monochamus* female found in Jdaidet. The level of the risk of introduction of a pathogenic nematode through this specimen seems to be low. However, this risk should be increased in case of several specimens spreading through the natural landscape and forests.

The coniferous species of the country are *Abies cilicica* (Antoine & Kotschy) Carrière, *Cedrus libani* A. Richard, *Pinus brutia* Tenor, *P. halepensis* Miller and *P. pinea* L. (Bouvarel, 1950; Berjaoui, 1952; Jaradi, 2011). These species are not recorded as hosts of *M.* (*M.*) *sutor* (see above) until now, but must be considered as potential hosts. The pine forests of Lebanon cover an area of about 17,000 hectares, forming 14.91 % of the total forest area (Ministry of Environment, 2012). The Stone pine stands (*Pinus pinea*) are the most abundant coniferous forest (about 7900 hectares) and they are distributed in El Metn, Beirut, Baabda and Jezzine Districts (Jaradi, 2011; Khoury *et al*., 2015). While, the Calabrian pine forest (*P. brutia*) occupies a large area in the North and the Alepo pine, *P. halepensis*, extends over an area of 400-500 hectares in the Southern part of the country (MoA/UNEP/GEF, 1996). However, the pine forests are subjects to stress due to climate change, ecosystem fragmentation and fire, making the trees more vulnerable to exotic invasive pests.

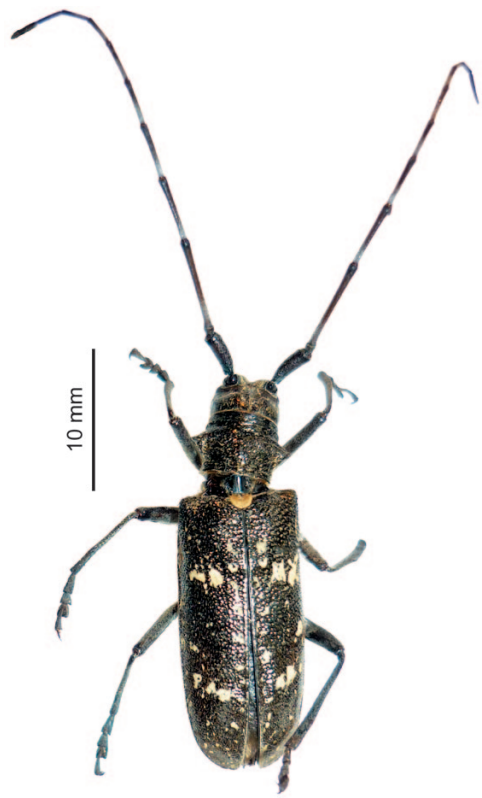

Figure 1. – *Monochamus* (*Monochamus*) *sutor sutor* (Linnaeus), female from Jdaidet (Lebanon).

The female intercepted at Jdaidet, was imported from the industrial area or from the Beirut

harbour. It was intercepted during its research of host plants which are sporadic in the town but become dense about two kilometers East from the interception point.

According Ciesla (2004), Davis *et al*. (2006) and Halbig (2013), *M*. (*M*.) *sutor* is a strong flyer which could cover several kilometers if the biotic ressource is far from its emergency point, but this distance is often limited to 400 meters. This flying ability shows the possibility for specimens coming from the harbour or the industrial area of the coast, to reach easily the main pine forests of El Metn District.

The establishment of *M*. (*M*.) *sutor* in Lebanon seems to be difficult however. A recent study of the potential area of spreading and establishment shows that the risk is very low or does not exist for Lebanon (Estay *et al*., 2014). In fact, this species could develop in the forests of the mountainous parts of the country, but these forests are far from the coast. Moreover, *Cedrus libani*, the symbol of Lebanon, which is not known as host plant, as all the genus *Cedrus*, can be quiet for the moment.

Conclusion

The discovery of one female of *Monochamus* (*M*.) *sutor* in Lebanon, which could worry all management for forestry, must call the authorities about the potential risks following introduction of an invasive species vector of the main agent of Pine Wood Disease. However and until now, *M*. (*M*.) *sutor* is potential host for *Bursaphelenchus mucronatus* which less dangerous than *B. xylophilus* and seems to be not able to settle in Lebanon. This situation could evolve in the future and needs to follow seriously the development of the status of the *Monochamus* species all over the world.

There are much more risks with the close species *M*. (*M*.) *galloprovincialis* which is known vector of *B. xylophilus* (Sousa *et al*., 2001; Penas *et al*., 2006) and which have strong probabilities to be established in Lebanon in case of introduction (Estay *et al*., 2014).

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