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Pest Risk Analysis
for the Asian Ambrosia Beetle (*Xylosandrus crassiusculus* (Motschulsky,
1866))

This Pest Risk Analysis has been prepared according to and follows the EPPO Standard PM 5/5(1) Decision-Support Scheme for an Express Pest Risk Analysis.

Summary of the Express Pest Risk Analysis for the Asian Ambrosia Beetle “*Xylosandrus crassiusculus* (Motschulsky, 1866)”

PRA area: Slovenia (EU)

Description of the endangered area:

In a major part of the PRA area (Slovenia) the ecological conditions are very similar to the ecological conditions in areas where *X. crassiusculus* is currently present and causing damage. From areas with similar ecological conditions around Europe, where this species is established, there are no reports of negative impacts due to the presence of *X. crassiusculus*. Owing to numerous uncertainties, and to inadequate knowledge of the biology of the species in particular, obscurity as to hosts in Europe, inadequate knowledge of its habitat-expanding capabilities, and of the climate change impacts, the endangered area is in fact difficult to define.

Main conclusions

Overall assessment of risk

Entry: The likelihood of entry of *X. crassiusculus* into the PRA area is high, with a high level of confidence and can enter in the PRA area by natural spread from Italy, where it is present in the area directly along the Slovenian-Italian border. At the time of drawing-up this risk analysis, the first interception of *X. crassiusculus* in the PRA area was confirmed, in the traps set for insects in a woody area in two locations in the western part of the country. It is assumed that the beetle had naturally spread to the PRA area from Italy, where it is present in the area directly along the Slovenian-Italian border.

Establishment: The likelihood is also high that the species will establish in the PRA area; however, on the account of obscurity for the host use in Europe, inadequate knowledge of the biology of the species, and of the unpredictable climate change impacts, the level of uncertainty for the establishment is medium. Favourable conditions for establishment in natural environment are present in most part of PRA.

Potential impact: In the PRA area, *X. crassiusculus* could have major negative impacts; however, the level of uncertainty for the impact is high. *X. crassiusculus* was found in Europe only on two plant species and no reports on any damage were reported. These two species are present in a PRA area in negligent quantity and have no important value. There are some information on presence of *X. crassiusculus* on sweet chestnut (*Castanea sativa* L.) in Italy, which is widespread in PRA area. Given the un-sufficient knowledge of the biology of the species and of the climate change impacts, it is not possible to envisage, whether this species can establish itself in the PRA area, and spread and multiply up to a degree to cause damage.

Spread: The spread of *X. crassiusculus* within the PRA area would on short distances occur by natural pathway and human-assisted on long distances. Given the obscurity as to host plants in Europe, inadequate knowledge of the biology of the species and of its spatial expansion, the range of expansion of *X. crassiusculus* in the PRA area is difficult to anticipate. In case of establishment of *X. crassiusculus* in the PRA area, the eradication of the species would most probably not be possible and the suppression of spread would be highly demanding and linked to high expenses.

Phytosanitary measures

As areas of highest risk of introduction of *X. crassiusculus* were recognised:

- The western part of the country, including the areas along the Slovenian-Italian border,
- Points of entry into the country (the Port of Koper, the Ljubljana Airport, the Post Office of Slovenia, border crossings),

- Direct surroundings of importers of wood of deciduous trees, wooden products and of WPM of the wood of deciduous trees originating from areas, in which *X. crassiusculus* is present,
- Direct surroundings of saw-mills and wood-processing plants,
- Nurseries and plantations,
- Direct surroundings of Garden Centres, where trade takes place in host plants originating from the PRA areas, in which *X. crassiusculus* is present,
- Direct surroundings of the main rail/road links.

Considering that the species had been established in Italy, we **conclude that the spread of *X. crassiusculus* to Slovenia by natural pathway from Italy cannot be contained anymore.**

The species was already found on two locations in the PRA area, and its establishment and negative impact in the PRA area are not completely excluded on account of numerous uncertainties.

The authors of this analysis propose that due to uncertainties on the host plants, the presence of *X. crassiusculus* in Europe and potential impact, **the implementation of official phytosanitary measures for this species on imports from third countries and movement within the European Union (EU) is not reasonable.**

Irrespective of the opinion above the authors of this risk analysis believe that in case of **interception at the points of entry, it is reasonable to immediately destroy all the infested material.** The **intensive survey** should be carried out in Slovenia to monitor **the species in the PRA area.** In case of interception of the beetles on host plants (which are only few species in Europe), the **immediate removal of infested plants and destruction of all infested material** should be implemented.

It is reasonable that at new interceptions, in view of the spread and impact of *X. crassiusculus* as well as the biology of the species, the proposed measures should be reviewed.

Phytosanitary risk for the <u>endangered area</u> (this document provides the individual assessments for the possibilities of entry, establishment, scope of spread, and impacts)	High <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	Low <input type="checkbox"/>
Level of uncertainty of risk assessment:	High <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/>	Low <input type="checkbox"/>

Rapid risk assessment
Xylosandrus crassiusculus

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The PRA was reviewed and comments provided by the Administration for Food Safety, Veterinary Sector and Plant health (Anita Benko Beloglavec, Erika Orešek, Alenka Zupančič) and Expert working group for PRA (Gregor Urek, Irena Mavrič Pleško (Agricultural Institute of Slovenia), Sebastjan Radišek (Slovenian Institute of Hop Research and Brewing), Dušan Jurc (Slovenian Forestry Institute), Tanja Dreo (National Institute of Biology).

Stage 1. Initiation

Reasons for performing the PRA:

The Asian Ambrosia Beetle (*Xylosandrus crassiusculus*) is considered a pest posing a health risk to a broad spectrum of species of deciduous trees (relevant literature cites more than one hundred species) in nurseries, plantations, orchards, parks and gardens, and in forests. The species originates from Asia, from where it has spread to other parts of the world, and is currently present also in the relevant area in Europe (CABI 2017, EPPO 2017).

X. crassiusculus is currently not regulated within the EU legislation, nor in the legislation at the level of individual European countries. Owing to the negative impact of the species on its host plants and a high potential of spreading to new areas, in particular through trade with host plants and their parts and wood of such plants, the European and Mediterranean Plant Protection Organisation (EPPO) entered the species *X. crassiusculus* in the EPPO Alert list (EPPO 2009) as a species presenting a plant health risk in the EPPO region member states.

The species is particularly problematic, because the females are parthenogenetic, meaning that they can lay and brood eggs and create a new generation without prior fertilisation. Thus, a single female suffices for creating an active *X. crassiusculus* population. Additionally, the species is not linked to a certain plant host, as the progeny does not feed on plant tissue (wood), but on symbiotic fungus grown in their tunnel system in the host wood. At selection of an appropriate host for colonization and brood development, the principal restrictive factor is the adequate wood moisture that facilitates the growth of the fungus.

In Europe, the species *X. crassiusculus* was detected in several locations in Italy, in a single location in France (Pennacchio *et al.* 2003, EPPO 2013, EPPO 2014), and most recently, in a single location in Spain (EPPO, 2017; Gallego *et al.* 2017). Whilst in France and in Spain the species eradication procedure is under way, the population in Italy has successfully established and its eradication is not feasible anymore (EPPO 2009). Population in Italy is showing northerly expansion and is already present in the northwest areas of the country; it occurs also in the farthest northeast, in Friuli-Venezia Giulia, in the direct proximity of the Slovenian-Italian border (Dr. Iris Bernardinelli, Regional Agency for Rural Development / Agenzia regionale per lo sviluppo rurale) – personal communication, 7. 4. 2016).

As the species shows a trend of expanding within areas of its presence, *inter alia*, in the neighbouring Italy, in the direct proximity of Slovenia, there is a high probability that *X. crassiusculus* will expand its range to Slovenia in the near future. For this reason, in 2016, the Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection (AFSVSPP) entered the species *X. crassiusculus* on the list of species in relation to which survey has been carried out in the territory of Slovenia (AFSVSPP 2016). The species is a priority and the risk assessment of its entry, spread, establishment and impacts in Slovenia urgently necessary.

PRA area: PRA area is Slovenia.

1. Taxonomy:

Xylosandrus crassiusculus (Motschulsky, 1866)

Domain: **Eukaryota**

Kingdom: **Animalia** (also Metazoa)

Phylum: **Arthropoda**

Class: **Insecta**

Order: **Coleoptera** (beetles)

Family: **Curculionidae** (true weevils)

Subfamily: **Scolytinae** (bark beetles)

Tribe: **Xyleborini**

Genus: *Xylosandrus*

Species: *X. crassiusculus* (Motschulsky, 1866)

The correct scientific name of the above species is *Xylosandrus crassiusculus* (Motschulsky, 1866). However, several synonyms exist:

- *Dryocoetes bengalensis* Stebbing, 1908
- *Phloeotrogus crassiusculus* Motschulsky, 1866
- *Xyleborus declivigranulatus* Schedl, 1936
- *Xyleborus ebriosus* Niisima, 1909
- *Xyleborus mascarenus* Hagedorn, 1908
- *Xyleborus okoumeensis* Schedl, 1935
- *Xyleborus semigranosus* Blandford, 1896
- *Xyleborus semiopacus* Eichhoff, 1878
- *Xylosandrus semigranosus* (Blandford, 1896)
- *Xylosandrus semiopacus* (Eichhoff, 1878)

In Slovenia, the species *Xylosandrus crassiusculus* has been given the common name of “**azijski ambrozijski podlubnik**.” Foreign literature uses the following two names, “Granulate ambrosia beetle”, and “Asian ambrosia beetle” (Löbl and Smetana 2010, <http://www.discoverlife.org/mp/20q>, <http://www.cabi.org/isc/datasheet/57235>, http://xyleborini.speciesfile.org/public/site/scolytinae/home/browse_taxa?genus=Xyleborus).

2. Pest overview

INTRODUCTION

- *Xylosandrus crassiusculus* are scolytids, whose life cycle takes place in the wood of numerous (more than one hundred) deciduous tree species. They cause irreparable damage on host plants and normally the decline of the entire plant, on account of which they bring about major economic loss in certain countries.

DESCRIPTION

- Adult *X. crassiusculus* are small reddish-brown scolytids with distinctive gender dimorphism. Females are short and stout bodied, 2–3 mm long. The head of *X. crassiusculus* is completely hidden by the pronotum in dorsal view, the antennal club appears obliquely cut. The prothorax is equally wide and long. The elytra are somewhat longer than wide and widely rounded in the apical section. The elytral apex is convex and relatively steeply descending towards the end of the abdomen. Males are distinctively smaller, wee and only approximately 1.5 mm long. Larvae are whitish in colour and have an approximately 3 mm long body, curved in ventral view and “C” shaped. Larvae have a well-developed head capsule and are legless. Eggs and pupae of the species *X. crassiusculus* have not been described. The species *X. crassiusculus* can reliably be distinguished from related species by the morphological characteristics of adult beetles. Eggs, larvae and pupae of the species are not distinguishable from related species solely morphologically.
- Extreme polygamy is characteristic of the species *X. crassiusculus*. The ratio between females and males is approximately 10 : 1.

LIFE CYCLE

- Adult *X. crassiusculus* are active from spring to autumn. Unlike males, which are flightless and spend all their lives in galleries within the host plant of hatching, the females have well-developed wings and can fly, and are crucial for the colonization of new host plants. Colonisation of new host plants and/or flight continue throughout the year, but are most intensive in spring.
- When a female beetle lands on a new host plant, it begins to bore into twigs, branches or small trunks, excavating a system of tunnels. It prefers parts of host plant that are 2.5–8 cm thick, and at times also thicker (up to 30 cm). Females bore through the bark, creating brood galleries of varied sizes and irregular forms in the wood. This causes substantial mechanical damage to the vital parts of the host, affecting its vital functions and vitality. The female lays and deposits 10–40 eggs in the brood gallery. At host colonisation, the female releases into plant tissue the fungal spores of the genus *Ambrosiella*, the fungal symbiont of *X. crassiusculus*, as the fungus constitutes the main feed source for the larvae and adult beetles. In the galleries colonised by *X. crassiusculus*, there always appear the characteristic dark grey coatings created by the fungal mycelium.
- Species-specific is the inbreeding (breeding of females with their brothers). Moreover, characteristic of females is the parthenogenesis, meaning that they can lay and brood eggs and create a new generation without prior fertilisation. Thus, a single female may in favourable conditions suffice for successful establishment of an active *X. crassiusculus* population in a certain area.
- Larvae developing from eggs live in brood chambers and graze on symbiotic fungus. Moulting occurs several times before pupation. The life cycle from egg-laying to hatching takes approximately 55 days. In moderate climatic conditions, which are present in Slovenia (PRA area), in one season (from March to September), two beetle generations may develop. Winter is spent latently in galleries within the host, well protected against inclement weather. Mostly adults overwinter and survive temperatures below freezing (Mizzel and Riddle, 2004). In spring, females emerge and attack new host plants. There is no overwintering of the species in the tropics, and breeding continues throughout the year, with overlapping generations. This means that several developmental stages of the species may simultaneously be present in the host. High humidity is crucial to the symbiotic fungus development and growth.

HOST PLANTS

- The development of *X. crassiusculus* is linked to deciduous trees. The species is extremely polyphagous, which means that as host plants a broad spectrum of species of different orders and families are suitable (list of host plants of significance for the PRA area is under point 7). Considering that these beetles do not feed directly on plant tissue, but on symbiotic fungus cultivated in tunnels within the host, the suitability of a particular host plant is conditioned by its suitability as a fungus growth medium.
- Unlike its related species, normally occurring as secondary pests and preferentially attacking the weakened and/or injured plants, *X. crassiusculus* is very likely a primary pest, as in areas to which it has spread, it attacks also the apparently healthy host plants that show no symptoms of weakness or injury.

SYMPTOMS

- Symptoms showing the presence of *X. crassiusculus* in a plant include the wilting foliage and saplings, ruptures of saplings and branches, die-off of plant parts, overall decrease in vitality, and finally, the die-off of an entire plant. When boring galleries, frass is pushed out in the form of a compact cylinder which may reach 3 to 4 cm long. On host plants of the genus *Prunus*, abundant gummosis is produced as a result of presence of *X. crassiusculus* on the bark (Kovach and Gorsuch 1985; Pennacchio *et al.* 2003, Salsbury 2004, Rabaglia *et al.* 2006, <http://www.cabi.org/isc/datasheet/57235>).
- As *X. crassiusculus* is small, inconspicuously coloured and its entire development is hidden within the host plant, more or less deep in the wood, its presence is frequently difficult to detect. In particular in the initial phase of colonisation, when the symptoms of damage to host plant are not clearly expressed.

MONITORING

- In monitoring the activity of *X. crassiusculus*, mostly simple traps, including common plastic receptacles or funnel traps of the Lindgren type (“Lindgren funnel trap”) are used, in combination with ethanol as attracting medium (Cote 2008, Atkinson *et al.*, 2014, Van Der Laan and Ginzler 2013, Ranger *et al.* 2015, <http://www.cabi.org/isc/datasheet/57235>).

3. Is the pest a vector? Yes No

X. crassiusculus is the vector (carrier) of fungus of the genus *Ambrosiella* (*A. roeperi*), with which it lives in symbiotic relation, as the fungus constitutes the main feed source for the larvae and adult *X. crassiusculus*. Fungus is transferred from one host plant to another by adult females, which constantly carry fungus spores on their body, in specific cuticular structures called mycangia. The consequence of introduction of the fungus into the plant is the characteristic bluish discoloration of the wood of the host plant, which reduces the technical value of the wood. In addition to symbiotic fungus, *X. crassiusculus* can carry on its body also other fungus species, thus constituting a potential risk of transfer of phytopathogenic fungi, as for instance of the genus *Fusarium*, and alien fungus species, whose impacts on new environment are unknown (Harrington *et al.* 2014, <http://www.cabi.org/isc/datasheet/57235>).

4. Is a vector needed for pest entry or spread? Yes No

Introduction and spread of *X. crassiusculus* take place without the presence of the vector.

5. Regulatory status of the pest

In Europe, *X. crassiusculus* is directly regulated neither in the legislation of the individual Member States, nor in the EU legislation (<http://www.cabi.org/isc/datasheet/57235>). As from 2009, the species has been listed in the EPPO Alert list (EPPO 2009).

Non-European species of insects of the family Scolytidae (according to the most recent valid classification, these insects belong to the subfamily *Scolytinae* (family *Curculionidae*)), where also *X. crassiusculus* belongs to, are listed under point 28 of Annex II.A.I to Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community (Council Directive 2000/29/EC). By this provision, these species are as *Scolytidae* spp. (non-European species) regarded as pests, which may not be present on coniferous plants (*Coniferales*), which are higher than 3 m (except for fruits and seeds), on the wood of coniferous with bark, or on isolated bark of coniferous originating from non-European. However, this provision does not include the introduction of *X. crassiusculus*, as according to data available so far, the host plants of this species are only deciduous trees. In addition, the species itself, as well as its hosts, are already present in Europe.

Council Directive 2000/29/EC regulates the species *X. crassiusculus* indirectly through the regulation of imports of certain plant species and of the wood of such plants, including certain host plants of *X. crassiusculus*. To avoid the introduction of certain pests from certain third countries requires Council Directive 2000/29/EC for certain plant species and for wood of deciduous trees, prior to importation into the EU, the prescribed phytosanitary certificate and inspection checks, and/or compliance with the specific phytosanitary requirements. The phytosanitary certificate could include optional clause that plant material does not contain any pests, plant diseases or other harmful organisms to plants, including *X. crassiusculus*. However, *X. crassiusculus* is an extremely polyphagous species, linked to host plants of a great number of deciduous trees species (relevant literature cites more than one hundred species), so that phytosanitary import requirements do not comprise the plants and the wood of certain plant species, which are also important host plants to *X. crassiusculus*.

Species and/or genera of plants subjected to controls at import into the EU:

- *Acer* spp., *Aesculus* spp., *Alnus* spp., *Betula* spp., *Carpinus* spp., *Cercidiphyllum* spp., *Corylus* spp., *Fagus* spp., *Fraxinus* spp., *Koelreuteria* spp., *Platanus* spp., *Populus* spp., *Salix* spp., *Tilia* spp. and *Ulmus* spp., from third countries with known presence of *Anoplophora glabripennis*.
- *Acer saccharum* and *Betula* (from the USA and Canada),
- *Fraxinus* L., *Juglans ailantifolia*, *Juglans mandshurica*, *Ulmus davidiana* and *Pterocarya rhoifolia* originating from Canada, China, Democratic People's Republic of Korea, Japan, Mongolia, Republic of Korea, Russia, Taiwan and the USA,
- *Populus* from countries of the American Continent,
- *Platanus* from Armenia, Switzerland and the USA,
- *Quercus* from the USA.

Banned from imports into the EU are:

- Plants of *Castanea* Mill. *Quercus* L. with foliage, excluding fruits and seeds, from non-European countries,
- Plants of *Populus* L. with foliage, excluding fruits and seeds, from North-American countries,
- Isolated bark of *Castanea* Mill. from third countries,
- Isolated bark of *Quercus* L., excluding *Quercus suber* L., from North-American countries,
- Isolated bark of *Acer saccharum* Marsh. from North-American countries,
- Isolated bark of *Populus* L. from countries of the American Continent,

- Plants of *Vitis* L., excluding fruits, from third countries,
- Plants of *Malus* Mill. and *Prunus* L. for planting, excluding dormant plants, without foliage, blossoms or fruits, from non-European countries,
- Plants of *Malus* Mill., *Prunus* L., and their hybrids, for planting, excluding the seeds, from the non-European countries, excluding the Mediterranean countries, Australia, New Zealand, Canada, and from the continental countries of the USA.

In movements within the EU, certain species of plants for planting shall be accompanied by a plant passport, including *inter alia* numerous ornamental species, which are hosts of *X. crassiusculus*; however, there is a great number of hosts of this species, and for movements of certain such plants no plant passport is required. In Slovenia, *X. crassiusculus* has as from 2016 been included in the so-called plant pest survey programmes. Pest species included in the survey programmes and the detailed contents of the survey programmes are defined by the Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection (AFSVSPP) in compliance with the regulations and/or the *EU work programme for the implementation of survey programmes for pests*, which is adopted by the European Commission based on Regulation (EU) 652/2014 (AFSVSPP 2016).

On New Zealand, *X. crassiusculus* is listed as a quarantine pest occurring on wood and wood products at import of goods into New Zealand ('List of regulated pests potentially associated with woodware') (MAF New Zealand 2011).

6. Distribution of the pest

The species *X. crassiusculus* supposedly originates from Asia, from where it spread through centuries to other parts of the world, to Africa, America, and Europe. In Europe, the species was first found in Italy in 2003, in traps for monitoring of alien insect species in the tree population of maritime pine trees (*Pinus pinaster* Aiton) and Turkey oak (*Quercus cerris* L.) in Tuscany (Pennacchio *et al.* 2003). Later, the beetles were found in several other locations in Tuscany, in natural parks and in the sea-port of Livorno; however, only in traps, and there were no reports of damage to the plants in any of the cases. In 2007 and in 2008, *X. crassiusculus* was confirmed also in Friuli-Venezia Giulia (Dr. Iris Bernardinelli, Regional Agency for Rural Development (Agenzia regionale per lo sviluppo rurale) – personal communication, 7. 4. 2016). *X. crassiusculus* has spread in N, NE and NW part of Italy, where is probably widespread, which is regularly confirmed with findings on traps (Dr. Iris Bernardinelli, Agenzia regionale per lo sviluppo rurale) – personal communication, 7. 4. 2016; prof. dr. Massimo Faccoli, University of Padua (Department of Agronomy, Food, Natural Resources, Animals and the Environment, University of Padua) – personal communication, 9. 10. 2017).

In 2014, the species was found for the first time also in France (Nageleisen *in sod.* 2015). The beetles were found at a single location in Nice (Côte d'Azur area), on several carob trees in an urban area. According to certain data, *X. crassiusculus* was found in this area also on the Judas tree (*Cercis siliquastrum* L.) (Frédéric Delpont, Chef du Département de la santé des forêts, Ministère de l'agriculture et de l'alimentation, Direction générale de l'alimentation – personal communication, 24. 8. 2017). The species had most probably spread to France by natural paths from Italy (Nageleisen *et al.* 2015). Immediately after detection, the implementation of the monitoring and eradication programme commenced in the affected area. Current status of the species in France is "in process of eradication" (EPPO, 2017). More recently (October 2016), detection of *X. crassiusculus* was reported also from Spain (Valencia). The beetles were found in an abandoned orchard on six carob trees. As in France, the affected trees were immediately felled and destroyed also in Spain, and the implementation of monitoring for potential host

plants commenced (Gallego *et al.* 2017). In August 2017 *X. crassiusculus* was confirmed in Slovenia in the insect traps, in the woody areas at two localities in the western part of the country (SI NPPO 2017).

Distribution of *X. crassiusculus* is summarised in Table 1.

Continent	Presence (list of countries, or general indication, e.g. present in Western Africa)	Please state the data on the pest status in the different countries of its presence (e.g. distributed, indigenous, introduced)	References
<i>Africa</i>	Cameroon, Democratic Republic of Congo, Ivory Coast, Equatorial Guinea, Ghana, Kenya, Madagascar, Mauretania, Mauritius, Nigeria, Seychelles, Sierra Leone, Tanzania	Present, introduced, non-invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	Gabon	Present	EPPO, 2014
<i>North America</i>	USA	Present, introduced, invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	Alabama, Arkansas, Delaware, Kansas, Michigan, Missouri, Nebraska, New Jersey, New York	Present	Rabaglia in Valenti, 2003; Horn and Horn, 2006; CABI/EPPO, 2009; EPPO, 2014
	Florida, Georgia, Hawaii, Indiana, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia	Present, introduced, invasive	Wood and Bright, 1992; Oliver Mannion, 2001; Bright and Skidmore, 2002; Bambara and Casey, 2003; Pierce <i>et al.</i> , 2005; CABI/EPPO, 2009; EPPO, 2014
	Ohio, Oregon, Washington	Present, introduced	LaBonte <i>et al.</i> , 2005; Lightle <i>et al.</i> , 2007; CABI/EPPO, 2009; EPPO, 2014
<i>Middle America and the Caribbean</i>	Costa Rica Panama Guatemala	Present	CABI/EPPO, 2009; EPPO, 2014; EPPO 2017
<i>South America</i>	Argentina, Brazil (Amapá, Pernambuco, Rio de Janeiro, São Paulo), French Guiana, Uruguay	Present	Fletchmann & Atkinson, 2016; Landi <i>et al.</i> , 2017; EPPO, 2017

Continent	Presence (list of countries, or general indication, e.g. present in Western Africa)	Please state the data on the pest status in the different countries of its presence (e.g. distributed, indigenous, introduced)	References
Asia	Bhutan	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	China (Fujian, Hong Kong, Hunan, Sichuan, Tibet, Xizhan, Yunnan)	Present, native, not invasive	Yin <i>et al.</i> , 1984; Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014; EPPO 2017
	India (Andaman and Nicobar Islands, Assam, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal)	Present, native, not invasive	Sreedharan <i>et al.</i> , 1991; Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	(Kerala)	Present	CABI/EPPO, 2009; EPPO, 2014
	Indonesia (Irian Jaya, Java, Kalimantan, Moluccas, Sulawesi, Sumatra)	Present, native, not invasive	Schedl, 1940; Kalshoven, 1959; Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	(Nusa Tenggara)	Present	EPPO, 2014
	Israel	Present	Buse <i>et al.</i> 2013
	Japan (Bonin Island, Hokkaido, Honshu (including Ogasawara Islands), Kyushu, Shikoku)	Present, native, not invasive	Murayama, 1953; Wood and Bright, 1992; CABI/EPPO, 2009
	Democratic People's Republic of Korea	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	Republic of Korea	Present, native, not invasive	Murayama, 1931; Choo <i>et al.</i> , 1983; CABI/EPPO, 2009; EPPO, 2014
	Malaysia (Peninsular Malaysia, Sabah, Sarawak)	Present, native, not invasive	Browne, 1961; Schedl, 1964; Wood and Bright, 1992; Chey, 2002; CABI/EPPO, 2009; EPPO, 2014
	Burma (Myanmar)	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014

Continent	Presence (list of countries, or general indication, e.g. present in Western Africa)	Please state the data on the pest status in the different countries of its presence (e.g. distributed, indigenous, introduced)	References
	Nepal	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	Pakistan	Present	Khuhro <i>et al.</i> , 2005; CABI/EPPO, 2009; EPPO, 2014
	Philippines	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	Sri Lanka (Democratic Socialist Republic of Sri Lanka)	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	Taiwan	Present, native, not invasive	Murayama, 1934; Eggers, 1939; CABI/EPPO, 2009; EPPO, 2014
	Thailand	Present, native, not invasive	Beaver and Browne, 1975; CABI/EPPO, 2009; EPPO, 2014
	Vietnam	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
<i>Europe</i>	Italy (Liguria, Tuscany, Veneto)	Present, introduced	Pennacchio <i>et al.</i> , 2003; CABI/EPPO, 2009; EPPO, 2014
	France (Nice, Île Sainte-Marguerite)	Present, introduced, in the process of eradication	EPPO, 2014
	Spain (Valencia)	Present, introduced, in the process of eradication	EPPO, 2017
<i>Oceania</i>	New Caledonia, Palau	Present, introduced	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	New Zealand	Absent – interception, introduced	Brockhoff <i>et al.</i> , 2003; CABI/EPPO, 2009; EPPO, 2014
	Papua New Guinea	Present, native, not invasive	Wood and Bright, 1992; CABI/EPPO, 2009; EPPO, 2014
	Samoa	Present, introduced, invasive	Beaver, 1976; Beeson, 1929; CABI/EPPO, 2009; EPPO, 2014
<i>Australia</i>	Queensland	Restricted distribution	IPPC, 2017

7. Host plants/habitats and their distribution in the PRA area

Development of *X. crassiusculus* beetles takes place in the wood of deciduous trees of a wide spectrum of species, genera and families, which are important as forest, agricultural and ornamental plants (EPPO 2009; EPPO 2107; CABI 2017). As suitable host plants for *X. crassiusculus* the literature cites more than 100 species (Wood, 1982). *X. crassiusculus* should supposedly not occur on coniferous trees, though certain sources report that beetles of this species successfully develop also on cedars (*Juniperus* spp.) (Horn and Horn 2006) and taking into account that coniferous trees are host plants of certain related species of the genus *Xylosandrus*. Wood (1982) cites among the hosts of *X. crassiusculus* also the genus *Pinus*.

In the PRA area, one half of the territory is covered in woods (58 %), where a good half of growing stock consists of deciduous trees (54.7 %) (Slovenia Forest Service / Zavod za gozdove Slovenije 2016). Of the growing stock of deciduous trees, the highest share consists of beech trees (32.3 %), which is followed by the oak trees (7.0 %), valuable broad-leaved trees (5.2 %), other non-coniferous hardwood trees (8.4 %) and non-coniferous softwood trees (1.7 %) (Slovenia Forest Service / Zavod za gozdove Slovenije 2016). In the PRA area, there is a high share of agricultural plantations of fruit species of wood plants and vines, i.e. 25875 ha or 5.4 % of surfaces of all agricultural land in use, or 1.3 % of surfaces of the PRA area (SURS 2016). Most these plants are the potential hosts of *X. crassiusculus* and, at the same time, these plants are highly important as economic plants in the PRA area, as cornerstones of ecosystems, and also as ornamental plants; for instance, the species of the genera *Acer*, *Alnus*, *Betula*, *Castanea*, *Cornus*, *Fraxinus*, *Malus*, *Populus*, *Platanus*, *Prunus*, *Quercus*, *Salix*, *Ulmus*, *Vitis* and the species *Diospyros kaki*.

According to available data, as hosts of *X. crassiusculus* in Europe have directly been confirmed only three species; two ornamental species: the carob tree (*Ceratonia siliqua* L.) (EPPO 2013, 2014, 2017) and the Judas tree (*Cercis siliquastrum* L.) (Frédéric Delpont, Chef du Département de la santé des forêts, Ministère de l'agriculture et de l'alimentation, Direction générale de l'alimentation – personal communication, 24. 8. 2017), which occur in Slovenia in few numbers, and on sweet chestnut (*Castanea sativa* Mill.) (prof. dr. Massimo Faccoli, University of Padua (Department of Agronomy, Food, Natural Resources, Animals and the Environment, University of Padua) – personal communication, 9. 10. 2017). Sweet chestnut is widespread forest species in Slovenia and covers 253000 ha of forest areas with 1,8 % of growing stock (Grebenc in sod. 2011, Kušar in sod. 2015). However, considering that in Italy beetles were detected in traps in natural habitats (Pennacchio *et al.* 2003; EPPO 2017, Dr. Iris Bernardinelli, Regional Agency for Rural Development (Agenzia regionale per lo sviluppo rurale) – personal communication, 4. 9. 2017; prof. dr. Massimo Faccoli, University of Padua (Department of Agronomy, Food, Natural Resources, Animals and the Environment, University of Padua) – personal communication, 9. 10. 2017), there is a probability that the species in Europe, in addition to the two aforementioned hosts, is linked also to other hosts, which have to date not been detected.

Table 2 summarises the genera of host plants, which are important for the PRA area.

Host Scientific name (common name) / <i>habitats</i> *	Presence in PRA area (Yes/No)	Comments (e.g. total area, major/minor crop in the PRA area, major/minor habitats*)	References
<i>Acer</i> (maple tree)	Yes	Important forest plants, ornamental plants	CABI/EPPO, 2009; EPPO, 2014; EPPO 2017; Reed <i>et al.</i> 2015
<i>Alnus</i> (alder tree)	Yes	Important forest plants, ornamental plants	

Host Scientific name (common name) / habitats*	Presence in PRA area (Yes/No)	Comments (e.g. total area, major/minor crop in the PRA area, major/minor habitats*)	References
<i>Azalea</i> (rhododendron)	Yes	Ornamental plants	
<i>Betula</i> (birch tree)	Yes	Important forest plants, ornamental plants	
<i>Castanea</i> (chestnut tree)	Yes	Important forest plants, important agricultural plants, ornamental plants	
<i>Cornus</i> (dogwood tree)	Yes	Important forest plants, ornamental plants	
<i>Diospyros kaki</i> (kaki)	Yes	Important agricultural plants	
<i>Ficus carica</i> (fig tree)	Yes	Important agricultural plants	
<i>Fraxinus</i> (ash tree)	Yes	Important forest plants, ornamental plants	
<i>Juglans nigra</i> (black walnut tree)	Yes	Important forest plants, ornamental plants	
<i>Malus</i> (apple tree)	Yes	Important agricultural plants	
<i>Platanus</i> (plane tree)	Yes	Ornamental plants	
<i>Populus</i> (poplar tree)	Yes	Important forest plants, ornamental plants	
<i>Prunus</i> (peach tree, apricot tree, plum tree, cherry tree, bird cherry)	Yes	Important agricultural plants, ornamental plants	
<i>Quercus</i> (oak tree)	Yes	Important forest plants, ornamental plants	
<i>Salix</i> (willow tree)	Yes	Important forest plants, ornamental plants	
<i>Ulmus</i> (elm tree)	Yes	Important forest plants	
<i>Vitis</i> (vine)	Yes	Important agricultural plants	
<i>Camellia sinensis</i> , <i>Carica papaya</i> , <i>Carya illinoensis</i> , <i>Cercis siliquastrum</i> , <i>Ceratonia siliqua</i> , <i>Cocos nucifera</i> , <i>Coffea arabica</i> ,	Yes	Ornamental plants – individual plants	

Host Scientific name (common name) / <i>habitats</i> *	Presence in PRA area (Yes/No)	Comments (e.g. total area, major/minor crop in the PRA area, major/minor habitats*)	References
<i>Koelreuteria</i> , <i>Lagerstroemia</i> , <i>Liquidambar</i> , <i>Mangifera indica</i> , <i>Theobroma cacao</i> , <i>Aucoumea leineana</i> , <i>Tectona grandis</i>			

*Please define the habitat of invasive plants, and host plants of other pests.

8. Pathways for entry

Spread of *X. crassiusculus* to new areas is by natural means and human-assisted. Females are crucial in colonising new host plants and spreading to new areas by natural paths as, unlike the males, they can fly. Though only females are active in transmission, males and earlier developmental instars may be introduced into new environment as well. Introduction of eggs, larvae, pupae and beetles of both genders may occur through movements of host plants and parts of such plants, through movements of wood (with or without bark), of wooden products and wood packing material (WPM) made of wood of host plants originating from areas, in which *X. crassiusculus* is present. Potential introduction is possible through isolated bark and products made of bark of host plants, through chopped wood, wood slivers, sawdust, wood shavings, and through wood waste and wood rests, which are entirely or partly obtained from host plants. In theory, beetles may enter new areas as a hitch-hiker.

In potential spreading to new areas, an important characteristic of the species is its parthenogenesis, meaning that a female may lay and brood eggs and create a new generation of beetles without prior fertilisation. Thus, an active *X. crassiusculus* population may potentially be established in a certain area through introduction of a single female of this species.

It is not known, by which of the above paths the species *X. crassiusculus* was introduced to Europe, but it is known that within the EU, the species has successfully been expanding its area by natural paths.

Possible pathways (in order of importance)(by importance)	Short description explaining why it is considered as a pathway	Pathway prohibited in the PRA area? Yes/No	Pest already intercepted on this pathway? Yes/No
Natural spread (by flight, by wind)	Flight is one of the principal pathways of spreading of beetles to new areas in places, where the species is present. <i>Inter alia</i> , because <i>X. crassiusculus</i> prospers in different ecological conditions, is extremely polyphagous, and has a very broad spectrum of hosts. At species <i>X. crassiusculus</i> , only	No	Yes

	<p>females are able to fly and thus of key importance in colonising new host plants. No data exist on the capabilities of spread of this species, but based on data on the capabilities of spread of similar species it may be concluded that the beetles can cover by flight several 100 metres or kilometres (Grégoire <i>et al.</i> 2001, Putz 2014), and by help of wind, they may passively travel over much longer distances. Considering that the species is present in Italy, in the direct vicinity to the Slovenian border, and that its eradication is not feasible there anymore, the species will most probably spread to the PRA area by natural means, by flight, or by wind.</p> <p>Probability of entry – high Level of confidence – high</p>		
Wood (with or without bark) and wood products from host plants	<p>Examples show that introduction to new areas of the species <i>X. crassiusculus</i> is possible through wood and wood products in which live individuals of this species are present (Brockerhoff <i>et al.</i> 2003, Haack and Rabaglia 2013). Probability of introduction in this way is high, in particular on account of the deficient phytosanitary requirements for imports and movements of such products, which do not include certain species of deciduous trees that are important hosts of <i>X. crassiusculus</i>. (Explanation under point 5)</p> <p>In the past decade, Slovenia imported per annum approximately 0.5 million m³ of round wood of different tree species (SORS 2014), and for this reason, this pathway constitutes a potential risk of introduction of the species <i>X. crassiusculus</i> into Slovenia.</p> <p>There are no exact data on the quantities of wood and wood products made of deciduous trees coming into Slovenia by imports and movements from the areas, in which <i>X. crassiusculus</i> is present.</p> <p>Probability of introduction through wood and wood products – moderate Level of confidence – moderate</p>	Indirectly, through the regulation of other quarantine pests (more detailed under point 5).	No
Wood packing material produced from host plants	<p>All wood packing material (WPM) originating outside the EU and entering the EU shall be treated in accordance with the International Standard for Phytosanitary Measures No. 15) (IPPC 2017). The Standard requires that WPM shall be without bark and appropriately treated, ensuring the destruction of all living forms of pests present in the WPM. Nevertheless, WPM</p>	Yes from third countries (ISPM 15). No at movements within the EU.	No

	<p>does constitute an important pathway of introduction and spread of pests. Despite the requirement for treatment of WPM originating from third countries according to ISPM 15, reports of interceptions of pests regularly come from different parts of the world (Marini <i>et al.</i> 2011), and numerous examples of non-compliant consignments with the ISPM 15 requirements in imports into the EU (Europhyt 2016) are known. Percentages of WPM with pests present are very low indeed, but one needs to take into account the extremely great quantities of WPM that are present in the international trade. As the ISPM 15 standard applies only to imports of WPM from third countries, and not within the EU, the movements of WPM from Italy with <i>X. crassiusculus</i> already present, are not subjected to this particular safeguard mechanism, and for this reason, this particular path does constitute a potential risk of introduction of the species into the PRA area. On entry of beetles by this pathway, the risk of spread of the species within the PRA area constitutes the storage of WPM with live <i>X. crassiusculus</i> beetles, in open air for a longer period of time, which may facilitate the transfer of beetles from the WPM to host plants in the surroundings.</p> <p>There are no exact data on the quantities of WPM coming to Slovenia through imports and movements from the PRA areas, in which <i>X. crassiusculus</i> is present.</p> <p>Probability of introduction through WPMs – moderate</p> <p>Level of confidence – moderate</p>		
<p>Plants for planting</p>	<p>The species constitutes an important pest in nurseries and plantations, in particular in the USA (Atkinson 2014, Cote 2008). Nevertheless, the spread of the species to new areas (including the PRA area) by this pathway is less probable for several reasons. Firstly, damaged saplings either quickly deteriorate or they are not interesting for the market on account of poor appearance, and thus, they are normally not even included in further marketing. Secondly, the new EU and Slovenian legislations in preparation envisage stricter phytosanitary rules for imports of saplings from areas outside the EU. Thirdly, there is poor evidence of the spread of the species through saplings from nurseries. Nevertheless, certain risk does</p>	<p>Indirectly, through the regulation of other quarantine pests (more detailed under point 5).</p>	<p>No</p>

	<p>exist. Namely, whilst for imports of plants for planting from third countries a phytosanitary certificate is required, at movements of plants for planting within the EU the plant passport is mandatory only for certain plant species, and there are numerous plant species excluded from this obligation, which include also the potential hosts of <i>X. crassiusculus</i>.</p> <p>There is no direct import of plants for planting from third countries into PRA area (AFSVSPP 2017 – personal communication), but there exists the import of plants for planting from third countries into the other EU Member States. Within the EU, the movements of plants for planting are very active, but there exist no data on the quantities of host plants for planting coming to Slovenia from those MSs that are importing plants from third countries, and from the MSs in which <i>X. crassiusculus</i> is present (Italy) (AFSVSPP 2017 – personal communication).</p> <p>Probability of entry through plants for planting – moderate</p> <p>Level of confidence – low</p>		
Parts of host plants	<p>Parts of plants with live <i>X. crassiusculus</i> present constitute one of the possible pathways of spread of the species to new areas, in case they come into contact with host plants in the new area. However, the spread of the species to new areas, including the PRA area, by this pathway is less probable. Parts of plants, as branches in blossom or in leaf, are normally used for ornamental products, which mostly do not get into nature. In addition, there exist no data on trade in plant parts between Slovenia and areas in which the species is present.</p> <p>Probability of entry through plant parts – low</p> <p>Level of confidence – low</p>	Indirectly, through the regulation of other quarantine pests (more detailed under point 5).	No
Isolated bark and products made of bark of host plants	<p>Isolated bark is mostly not cited in relevant literature as a possible pathway of entry and spread of <i>X. crassiusculus</i>; however, the introduction of beetles by this pathway is potentially possible (CABI 2017). Beetles may be present on the bark, though for a short period of time immediately after completing their life cycle in the wood and coming to the bark surface, from where they fly to a new host. After landing on a new</p>	Indirectly, through the regulation of other quarantine pests (more detailed under point 5).	No

	<p>host, they are present on the bark for a short period of time prior to boring a tunnel system into the bark and into the wood.</p> <p>Probability of entry through isolated bark and products made of bark of host plants – low</p> <p>Level of confidence – low</p>		
<p>Chopped wood, wood slivers, sawdust, wood shavings, and wood waste and wood rests, entirely or in part obtained from deciduous trees</p>	<p>Chopped wood, wood slivers, sawdust, wood shavings, and wood waste and wood rests, in entirety constitute a potential pathway of entry and spread of <i>X. crassiusculus</i> under the condition that the wood has the appropriate characteristics (humidity) and that the parts are big enough. However, the relevant literature does not cite any data on entry and spread of <i>X. crassiusculus</i> by this pathway.</p> <p>Probability of entry through chopped wood, wood slivers, sawdust, wood shavings, and wood waste and wood rests, entirely or in part obtained from deciduous trees – low</p> <p>Level of confidence – low</p>	<p>Indirectly, through the regulation of other quarantine pests (more detailed under point 5).</p>	No
<p>Hitch-hiking</p>	<p>Potentially, <i>X. crassiusculus</i> could enter a new area as a hitch-hiker and spread in this way, but the relevant literature does not cite any data on entry and spread of <i>X. crassiusculus</i> by this pathway.</p> <p>Probability of entry as hitch-hiker – low</p> <p>Level of confidence – low</p>	No	No

Rating of the likelihood of entry	Low <input type="checkbox"/>	Moderate <input type="checkbox"/>	High <input checked="" type="checkbox"/>
Rating of uncertainty	Low <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/>	High <input type="checkbox"/>

9. Likelihood of establishment outdoors in the PRA area

The species *X. crassiusculus* has spread from Asia into the different parts of the world, where it is colonising most diverse areas in the equatorial and moderate climate zones, mostly in places of prevalent high air humidity levels (classification according to Köppen-Geiger).

For establishment of the species *X. crassiusculus*, most part of the PRA area is appropriate, as in the most part of Slovenia the ecological conditions prevail, which are either most similar to or even identical to conditions in areas of its current distribution, inter alia, in the neighbouring Italy, in the northeast of the country, in the direct proximity of the Slovenian-Italian border. Lesser possibility of establishment of the species is in the mountainous areas of the northwest of the PRA area, with lower temperatures and prevailing coniferous plants, grasses and other non-lignified plants, and in the far northeast with longer periods without precipitation.

An additional factor that would favourably influence the establishment of the species in the PRA area is the physiological weakness of hosts, as a consequence of climate change, more and more frequent forces of nature, and different anthropogenic impacts. Physiologically weakened and

damaged trees are namely particularly susceptible for the colonisation of *X. crassiusculus* (Ranger *et al.* 2016).

However, the presence of *X. crassiusculus* in Europe is accompanied by numerous uncertainties, and therefore, it is impossible to envisage with certainty, whether the species will be able to establish itself in the PRA area.

According to available data, as hosts of *Xyloasandrus crassiusculus* in Europe have directly been confirmed two ornamental plant species, namely the carob tree (*Ceratonia siliqua*) (EPPO 2013, 2014) and the Judas tree (*Cercis siliquastrum*) (Frédéric Delpont, Chef du Département de la santé des forêts, Ministère de l'agriculture et de l'alimentation, Direction générale de l'alimentation – personal communication, 24. 8. 2017) which do not occur in Slovenia in mentionable quantities, and one forest tree species, namely sweet chestnut (*Castanea sativa* Mill.) (prof. dr. Massimo Faccoli, University of Padua (Department of Agronomy, Food, Natural Resources, Animals and the Environment, University of Padua) – personal communication, 9. 10. 2017), which is an important tree species in the PRA area. Sweet chestnut is widespread forest species in Slovenia and covers 253000 ha of forest areas with 1,8 % of growing stock (Grebenc in sod. 2011, Kušar in sod. 2015). However, considering that in Italy beetles were found in traps in natural habitats (Pennacchio *et al.* 2003; EPPO 2017, Dr. Iris Bernardinelli, Regional Agency for Rural Development (Agenzia regionale per lo sviluppo rurale) – personal communication, 4. 9. 2016), there exists the probability that in Europe, in addition to the aforementioned hosts, the species may be linked to other hosts, only that it has not yet been determined, which ones. Most tree species that are present in areas where *X. crassiusculus* is present in Italy are present also in the PRA area.

Furthermore, the overall biology of the species, and the impacts of temperature and moisture on the development and survival of beetles in moderate climate conditions, characteristic of the PRA area, are poorly known.

There is high uncertainty how climate change will impact the behaviour of the species in the PRA area. By global warming, the ecosystems in the PRA area would change, and conditions would arise, which would facilitate the perseverance of active population of *X. crassiusculus*, its propagation and area expansion.

<i>Rating of the likelihood of establishment outdoors</i>	Low <input type="checkbox"/>	Moderate <input type="checkbox"/>	High <input checked="" type="checkbox"/>
<i>Rating of uncertainty</i>	Low <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	High <input type="checkbox"/>

10. Likelihood of establishment in protected conditions in the PRA area

In the area of its distribution, *X. crassiusculus* does not occur on hosts, which would in any developmental phase be linked to closed, physically isolated premises, as greenhouses, for instance. Considering that the species of deciduous trees, which are appropriate as host plants of *X. crassiusculus*, do not occur in closed premises in the PRA area, either, the probability of establishment of the pest in closed premises within the PRA area is minimal, with a high level of confidence.

<i>Rating of the likelihood of establishment in protected conditions</i>	Low <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/>	High <input type="checkbox"/>
<i>Rating of uncertainty</i>	Low <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/>	High <input type="checkbox"/>

11. Spread in the PRA area

The spread of *X. crassiusculus* in the PRA area is possible by natural means, by active flight of beetles, or passively, by wind carrying the beetles, or human-assisted, through inland movements of wood of host plants, wood products and of WPM produced of such plants, and through movements of host plants intended for planting.

At species *X. crassiusculus*, only adult females are capable of flight. Taking into account the morphology and physiology of the beetles, and as compared to related species, the spread of *X. crassiusculus* to new areas by active flight is possible on short distances only. There exist no accurate data on distances, which an adult *X. crassiusculus* female could actively cover. Research in a related species, *X. germanus*, showed that the beetles were supposedly able to cover up to 2 km (Grégoire *et al.* 2001), and it is known of certain other species of the subfamily Scolytinae that they can fly up to 100 or several 100 metres at the most (Putz 2014). Thus, we suppose that the distance, which the *X. crassiusculus* beetles are able to actively cover, some 100 metres at the most, and not more than 2 km. The wind plays an important role in spreading the beetles by flight, as they are small and lightweight, and cannot withstand strong air masses. By wind, beetles travel passively and the distance covered depends on wind intensity and direction. Under suitable windy conditions, beetles may even be carried much further than they would be able to actively fly.

Unlike the above, by way of human-assisted spread, in a very short time all the developmental forms of *X. crassiusculus* beetles may be carried over extremely long distances. The spread through man would in the PRA area be possible by movements of host plants and parts of such plants, of wood (with or without bark), wood products, WPM and other products (chopped wood, wood waste, etc.), produced of wood of host plants. The spread of beetles in the PRA area would be possible by movements of isolated bark and products of bark of host plants, and as hitch-hiker in the means of transport. In the PRA area, the movements of the above products, produced of deciduous tree plants, take place by road and rail. Thus, *X. crassiusculus* might be carried over to any part of the PRA area in some hours, or no later than in a single day.

Taking into account the spread by natural means, and the spread through man, the species *X. crassiusculus* may, on establishing its population in a certain area, rather quickly spread to new areas. There exist no data on the factual velocity of area spread of *X. crassiusculus*, but there do exist data for the related species, *X. germanus*, which may within a single year spread its area by several 10 km (Henin and Versteirt 2004).

Areal spread depends, *inter alia*, on adequate ecological conditions, including adequate climatic conditions and the presence of hosts. It is not completely clear, which host plants are attacked by *X. crassiusculus* in Europe, and there are many obscurities as to the impact of temperatures on the development and survival of the species in moderate climatic conditions present in the PRA area. The impacts of climate change on ecosystems in the PRA area constitute a further obscurity.

Due to the unknown capability of areal spread of *X. crassiusculus*, and a small number of cases showing unequivocally that the spread of the species is human-assisted, and numerous open questions as to the biology, hosts and impacts of climate change, the factual speed and scope of spread of the species in the PRA area is very difficult to forecast at the present moment.

Rating of the magnitude of spread	Low <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	High <input type="checkbox"/>
Rating of uncertainty	Low <input type="checkbox"/>	Moderate <input type="checkbox"/>	High <input checked="" type="checkbox"/>

12. Impact in the current area of distribution

It is known that *X. crassiusculus* causes damage on different species of deciduous trees in nurseries, orchards and other gardens and plantations in the different parts of the world, but the data on the factual economic loss are very poor (CABI 2017; EPPO 2017). Though the species attacks also plants appearing in forests and other natural habitats, there exist no data on the factual impacts of the species on the natural habitats and related branches of economy (CABI 2017; EPPO 2017).

In its natural areas of distribution in Asia, the species colonises in particular the fresh felled or otherwise damaged trees and warehoused wood as long as it is fresh. Reports from the parts of the world, to which the species had been introduced, mainly indicate the disintegration of healthy and undamaged young trees by *X. crassiusculus* in nurseries (Ito and Kajimura 2009), gardens and on plantations (Brownie 1963). Young plants normally decline in a short period of time, and on older and higher ones, the withering and loss of vitality of the branches is first seen, but in the long run, these plants die away as well. On account of damage, the plants become susceptible for other pests and diseases. *X. crassiusculus* is additionally problematic as it causes the infection by a fungus of the genus *Ambrosiella*, which causes the wood to turn blueish in appearance, which negatively impacts the market value of such wood. In addition, *X. crassiusculus* is a potential carrier of phytopathogenic fungi, which has but not been confirmed by extensive research yet.

In Europe, *X. crassiusculus* was found in natural habitats, orchards and gardens. There are reports of damage caused by *X. crassiusculus* in Europe on carob tree (*Ceratonia siliqua* L.), Judas tree (*Cercis siliquastrum* L.) and sweet chestnut (*Castanea sativa* Mill.) but without any negative impact.

Rating of the magnitude of impact in the current area of distribution in non-European countries	Low <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	High <input type="checkbox"/>
Rating of uncertainty	Low <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	High <input type="checkbox"/>

Rating of the magnitude of impact in the current area of distribution in Europe	Low <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/>	High <input type="checkbox"/>
Rating of uncertainty	Low <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/>	High <input type="checkbox"/>

13. Potential impact in the PRA area

In the PRA area, *X. crassiusculus* could cause considerable economic loss and damage to the ecosystem, as numerous tree and shrub species cited in relevant literature as suitable hosts of *X. crassiusculus* are widespread and numerous within the PRA area, and are important economically, for the ecosystem, and as ornamental plants (description under point 7). As we assess that ecological conditions, which could potentially facilitate the establishing of *X. crassiusculus* in the PRA area, are present in the major part of Slovenia, the impacts of *X. crassiusculus* may be expected in the major part of the PRA area.

In Slovenia, *X. crassiusculus* could have equally extensive negative impacts as in other areas in the world, where it is already present. As elsewhere in the world, also in the PRA area, losses would occur on account of *X. crassiusculus* through the destruction of saplings, loss of yield in nurseries, orchards and gardens, and through damage and devaluation of adult trees and loss of value of freshly felled timber.

Considering that the beetle attacks also plants linked to different natural habitats, the species could potentially negatively impact the natural ecosystems, e.g. forests. In such a case, in addition to economic losses, consequences would occur at the level of the ecosystems, as the

occurrence of a new organism triggers changes at several levels within an ecosystem, which are hard to fully envisage.

Nevertheless, all the detections in Europe, where the beetles were in fact found on plants, were linked to three plant species only, namely the carob tree, the Judas tree, and sweet chestnut. The carob tree and the Judas tree are ornamental plants which are present in the PRA area in a negligible quantity, and have no mentionable value. On the other hand, sweet chestnut is a widespread forest tree species in the PRA area and has significant economic value. However, there have been no reports of any economic loss or ecological harm due to *Xylosandrus crassiusculus* in Europe. In addition, the relevant literature does not cite any data on *X. crassiusculus* having caused any damage in natural habitats.

As the host plants of *X. crassiusculus* in Europe are unclear, and the biology of the species and its capacity of development and survival in moderate climatic conditions are unknown, due to numerous uncertainties posed by climate change, the unknown spatial spread of the species as it does not cause damage in Europe, and as there are few reports on the actual damage on account of this species in general, and as there are no reports on the impact of the species on natural habitats, the possible impact of *X. crassiusculus* in the PRA area is very difficult to forecast at the present moment.

Will impacts be largely the same as in the current area of distribution? Yes/No

Rating of the magnitude of impact in the area of potential establishment	Low <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/>	High <input type="checkbox"/>
Rating of uncertainty	Low <input type="checkbox"/>	Moderate <input type="checkbox"/>	High <input checked="" type="checkbox"/>

14. Identification of the endangered area

Slovenia is situated in moderate geographical latitudes, in the central and/or south-eastern Europe, at the juncture of the Alps, the Dinaric Mountain Chains, the Pannonian Plain, and the Mediterranean. The climate is a mix of influences of the alpine, Mediterranean and continental climate. Quantity of precipitations decreases from west towards east, from approximately 2500 mm down to 800 mm. Most precipitations fall in the mountainous northwest. Average temperature of the coldest month is around 0 °C, and of the warmest at 20 °C. Characteristic are the diverse geological structure and a lively relief. Of the aggregate there prevails the limestone. The surface of Slovenia spreads over four biogeographical areas (Alpine, Continental, Mediterranean, and Pannonian), which enables a high biological diversity.

In the context of diversity of plant and animal species, Slovenia is the hot-spot of Europe. A good half of its territory is covered in forests (58.3 %), with the characteristic great variety of sylvatic associations. A good half of growing stock constitute the deciduous trees (54.7 %) (Slovenia Forest Service / Zavod za gozdove Slovenije 2016). Of the deciduous tree growing stock, the greatest share has the beech (32.3 %), and there follow the oak (7.0 %), the premium deciduous trees (5.2 %), other hard deciduous trees (8.4 %) and soft deciduous trees (1.7 %) (Slovenia Forest Service / Zavod za gozdove Slovenije 2016).

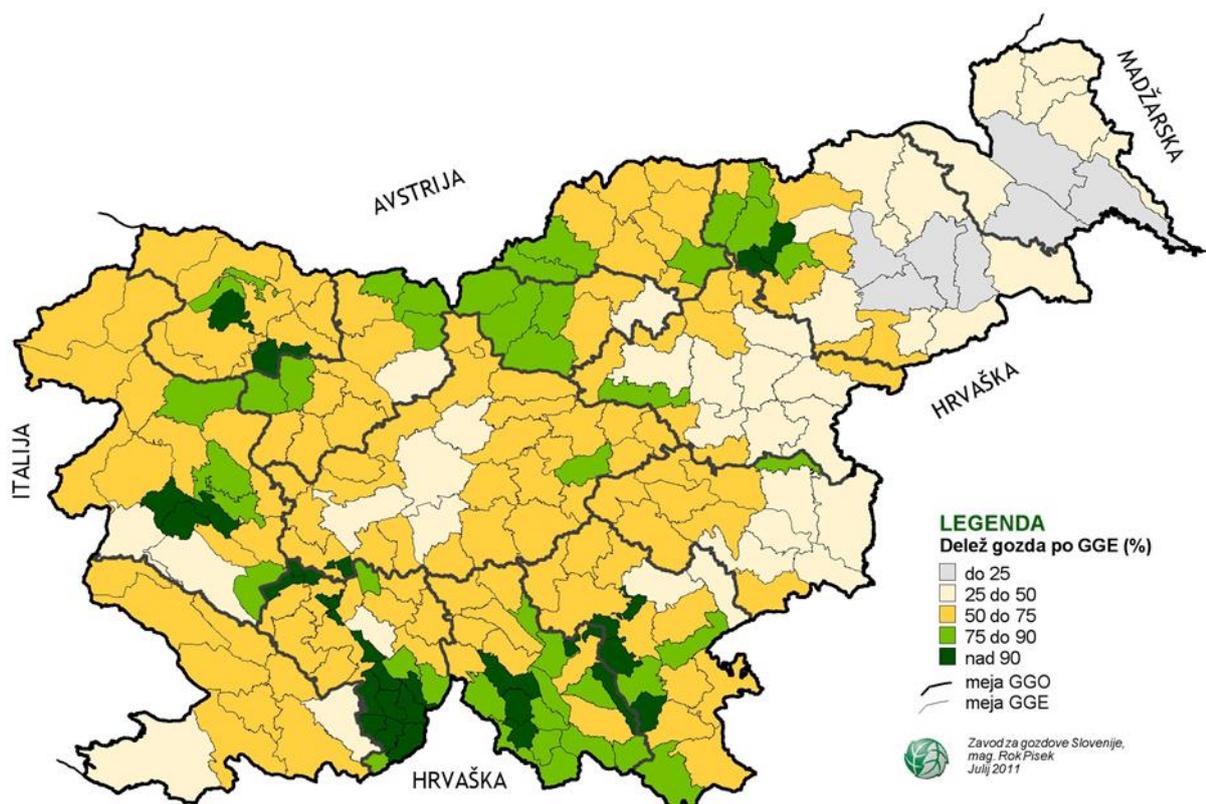


Figure 1: Slovenia's forest cover

There is also a high share of agricultural plantations of fruit species of ligneous plants and of vines in the PRA area, as the fructiculture and viniculture are extremely important agricultural branches in this area (Chamber of Agriculture and Forestry of Slovenia (CAFS) / Kmetijsko gozdarska zbornica Slovenije 2017). Agricultural plantations of fruit species of ligneous plants, and of vines, cover 25,875 ha or 5.4 % of the surfaces of all agricultural land in use, or 1.3 % of surface of the PRA area (SORS 2016).

The species *X. crassiusculus* colonises ecologically most diverse regions in the equatorial and moderately warm climate zones, mainly there, where a high level of air humidity prevails (classification according to Köppen-Geiger).

We estimate that in the most part of PRA area there prevail ecological conditions, which are either very similar or even equal to conditions in areas of current distribution of *X. crassiusculus*, inter alia, in the neighbouring Italy, in the northeast of the country, in the direct vicinity of the Slovenian-Italian border, and for this reason, *X. crassiusculus* constitutes a potential risk for the most part of the PRA area. Lesser is the possibility of establishment of the species in the mountainous areas in the northwest of the PRA area, with lower temperatures, and with conifers, grasses and other non-ligneous plants as the prevailing plants, and in the farthest northeast, with the more frequent periods without precipitations.

However, owing to numerous uncertainties, as the inadequate knowledge of the biology of the species, obscurity as to host plants in Europe, few data on damage, inadequate knowledge of its habitat-expanding capabilities, and uncertainty as to climate change, the endangered area is in fact very difficult to define

15. Overall assessment of risk

Common risk assessment

Entry: The likelihood of entry of *X. crassiusculus* into the PRA area is high, with a high level of confidence and can enter in the PRA area by natural spread from Italy, where it is present in the area directly along the Slovenian-Italian border. At the time of drawing-up this risk analysis, the first interception of *X. crassiusculus* in the PRA area was confirmed, in the traps set for insects in a woody area in two locations in the western part of the country. It is assumed that the beetle had naturally spread to the PRA area from Italy, where it is present in the area directly along the Slovenian-Italian border.

Establishment: High is also the likelihood that the species would establish in the PRA area; however, on account of obscurity as to hosts in Europe, inadequate knowledge of the biology of the species, and of the unpredictable climate change impacts, the level of uncertainty for the establishment is medium. Favourable conditions for establishment in natural environment are present in most part of PRA.

Potential impact: In the PRA area, *X. crassiusculus* could have major negative impacts; however, the level of uncertainty for the impact is high. *X. crassiusculus* was found in Europe only on two plant species and no reports on any damage were reported. These two species are present in a PRA area in negligent quantity and have no important value. There are some information on presence of *X. crassiusculus* on sweet chestnut (*Castanea sativa* L.) in Italy, which is widespread in PRA area. Given the un-sufficient knowledge of the biology of the species and of the climate change impacts, it is not possible to envisage, whether this species can establish itself in the PRA area, and spread and multiply up to a degree to cause damage.

Spread: The spread of *X. crassiusculus* within the PRA area would on short distances occur by natural pathway and human-assisted on long distances. Given the obscurity as to host plants in Europe, inadequate knowledge of the biology of the species and of its spatial expansion, the range of expansion of *X. crassiusculus* in the PRA area is difficult to anticipate. In case of establishment of *X. crassiusculus* in the PRA area, the eradication of the species would most probably not be possible and the suppression of spread would be highly demanding and linked to high expenses.

Phytosanitary measures

As areas of highest risk of introduction of *X. crassiusculus* were identified:

- The western part of the country, including the areas along the Slovenian-Italian border,
- Points of entry into the country (the Port of Koper, the Ljubljana Airport, the Slovenian Post Office, and border crossings),
- Direct vicinity of importers of wood of deciduous trees, of wood products, and of WPM made of the wood of deciduous trees originating from areas, in which *X. crassiusculus* is present,
- Direct vicinity of sawmills, and of wood-processing plants,
- Plant nurseries and plantations,
- Direct vicinity of garden centres, where the trade in host plants originating from the PRA areas, with the presence of *X. crassiusculus*, takes place,
- Direct vicinity of the main (road and rail) traffic lines.

Considering that the species had been established in Italy, we **conclude that the spread of *X. crassiusculus* to Slovenia by natural pathway from Italy cannot be contained anymore.**

The species was already found on two locations in the PRA area, and its establishment and negative impact in the PRA area are not completely excluded on account of numerous uncertainties.

The authors of this analysis propose that due to uncertainties on host plants, the presence of *X. crassiusculus* in Europe and potential impact, **the implementation of official phytosanitary measures for this species on imports from third countries and movement within the European Union (EU) is not reasonable.**

Irrespective of the opinion above the authors of this risk analysis believe that in case of **interception at the points of entry, it is reasonable to immediately destroy all the infested material.** The **intensive survey** should be carried out in Slovenia to monitor **the species in the PRA area.** In case of interception of the beetles on host plants (which are only few species in Europe), the **immediate removal of infested plants and destruction of all infested material** should be implemented.

It is reasonable that at new interceptions, in view of the spread and impact of *X. crassiusculus* as well as the biology of the species, the proposed measures should be reviewed.

Stage 3. Pest risk management

16. Phytosanitary measures

X. crassiusculus has great potential of areal expansion and in certain areas of its present distribution it causes considerable economic loss.

As from 2003, the species has been present in the EU, and as from 2009, it has been listed on the EPPO Alert list, and certain Member States are implementing investigation programmes of the species.

As a quarantine pest, against which relevant measures are implemented, *X. crassiusculus* is directly regulated in New Zealand, based on a regulation governing the imports of wood products from all the countries of the world (MAF New Zealand 2011).

Presently the most effective measure against *X. crassiusculus*, after the beetles first appear in a new area, is to fell the colonised trees or remove the host plants, wood and wood products in which the species is present, and the destruction of the species in all plant material. The fundamental preventive measure is raising the awareness on the pest and maintaining the optimum state of health of host plants (Ranger *et al.* 2016). In certain countries, pesticide treatment is used as a preventive measure (Katovich 2004, Ranger *et al.* 2016).

In Europe, *X. crassiusculus* was found only on three plant species, and there are no reports of damage. Whilst in Italy no measures were implemented, in France and in Spain the eradication and intensive monitoring were launched. There are no reports of any possible measures adopted at imports and movements of goods in these countries.

Due to numerous uncertainties accompanying the presence of *X. crassiusculus* in Europe, and as from areas in Europe, in which *X. crassiusculus* was found, there are no reports of any damage, it is not possible to reliably foresee the actual impacts of *X. crassiusculus* in the PRA area.

17. Uncertainty

At risk assessment of *X. crassiusculus* in the PRA area there are many uncertainties. The principal uncertainties include the inadequate knowledge of the biology of the species, obscurities as to hosts in Europe, lack of data on its capability of spatial expansion, and inadequate knowledge of the impacts of *X. crassiusculus* on natural ecosystems. In addition, it

is not completely clear, why the species causes damage in certain areas, and no damage in others, and how the behaviour of the species will be impacted by climate change.

18. Remarks

Investigation of the insect biology in temperate climate (PRA area) is suggested.

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Appendix 1. Significant illustration photos (for information only)

Photo 1 (adult female of the species *Xylosandrus crassiusculus*)



*Andreja Kavčič, Slovenian Forestry Institute /
Gozdarski inštitut Slovenije, Ljubljana, Slovenia*

Photo 2 (the frass pushed out of galleries in a typical toothpick fashion)



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Albenga, Italy*