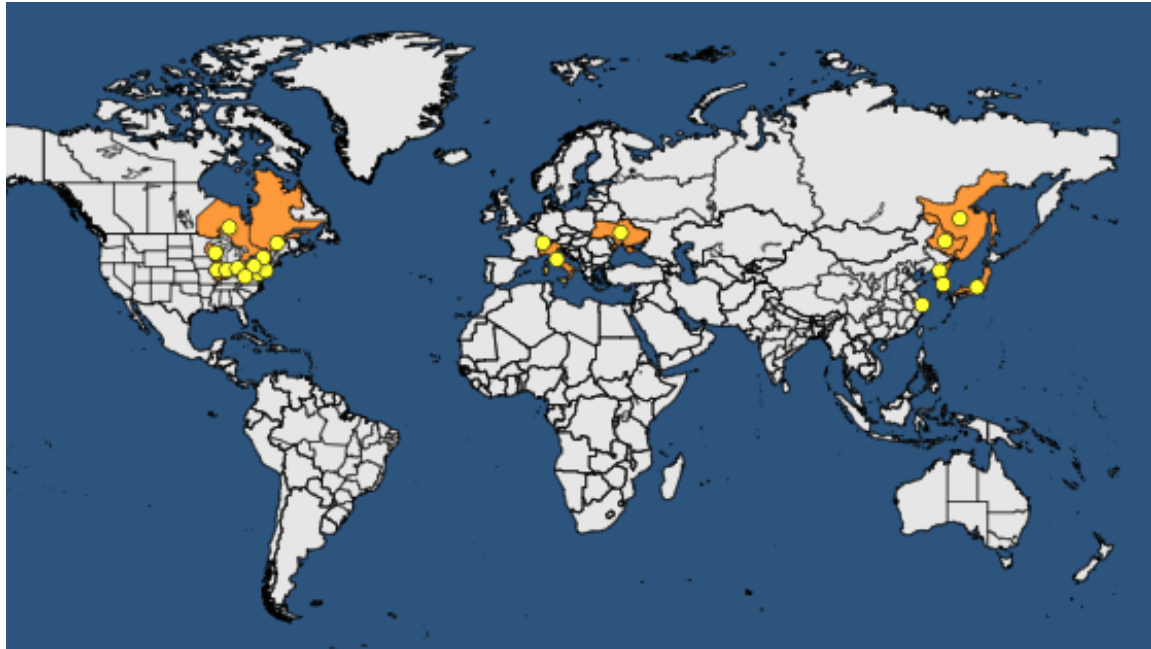


# Express Pest Risk Analysis (PRA) for: *Anisandrus maiche* (Kurentzov)

Based on the Express PRA-Template of the European and Mediterranean Plant Protection Organization  
**Organisation Européenne et Méditerranéenne pour la Protection des Plantes (EPPO PM 5/5(1))**



Summary of the Express Pest Risk Analysis for <i>Anisandrus maiche</i>			
<b>PRA area:</b> <i>Switzerland</i>			
<b>Describe the endangered area:</b> <i>All of Switzerland where host trees occur (except for high-elevation areas), and adjacent countries and probably most of Europe.</i>			
<b>Main conclusions</b> <i>Overall assessment of risk:</i> The probability of further human-assisted and natural spread without phytosanitary measures is high. Any measures taken to mitigate spread and impacts should be in proportion to the damage caused by the species; however, what level of damage <i>A. maiche</i> is causing to different trees has not been studied in Switzerland and not much elsewhere. It is recommended that studies on its host range and any damages caused (directly or via associated plant pathogens) will be undertaken. As no substantial damage has been reported so far, neither from Switzerland nor from other countries where <i>A. maiche</i> occurs, it appears that phytosanitary measures that could affect trade are not justified.  <i>Phytosanitary Measures:</i> Further delimitation of the area infested by <i>A. maiche</i> in Switzerland is advised. Disinfestation of risk commodities traded domestically or internationally and measures for containment or reduction of the rate of spread are not recommended at this time as the extent of damages appears to be limited, the infested area is already large, and no major phytosanitary measures appear to be undertaken in neighbouring countries. Enhanced inspection of high-risk imports that may be associated with <i>A. maiche</i> or other ambrosia beetles is recommended to better understand pathways and modes of spread. Eradication of the established populations in southern Switzerland is considered impossible to achieve given the widespread distribution, and eradication is probably unnecessary.			
<b>Phytosanitary risk for the <i>endangered area</i></b> (Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document)	High <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	Low <input type="checkbox"/>
<b>Level of uncertainty of assessment</b> ( <i>see section 17</i> for the justification of the rating. Individual ratings of uncertainty of entry, establishment, spread and impact are provided in the document)	High <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	Low <input type="checkbox"/>
<b>Other recommendations:</b> <ul style="list-style-type: none"> <li>• Since the pest (a non-European Scolytinae) is regulated as a quarantine pest in the European Union and Switzerland, the EU, EPPO and IPPC have already been informed.</li> <li>• Relevant stakeholders have been informed.</li> <li>• A more detailed PRA is not needed at this point as all known sources of information have already been considered here.</li> <li>• Further surveys to determine the extent of the distribution of <i>A. maiche</i> and the extent of potential damages, including from associated plant pathogens, are recommended to confirm its pest status.</li> </ul>			

**Express Pest Risk Analysis:**  
***Anisandrus maiche* (Kurentzov)**

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**Date 10 October 2022, final version 17 May 2023**

**Stage 1. Initiation**

**Reason for performing the PRA:**

An established population of *Anisandrus maiche* was detected in ethanol-baited traps Switzerland in June 2022 in large areas of the Canton Ticino and an adjacent area of the Canton Grisons. Around the same time, an outbreak in Northern Italy was reported by Colombari et al. (2022) and Ruzzier et al. (2022), which was detected based on beetles trapped between May and July 2021).

**PRA area:** Switzerland

**Stage 2. Pest risk assessment**

**1. Taxonomy**

*Anisandrus maiche* (Kurentzov, 1941) (Scolytinae, Curculionidae, Coleoptera, Animalia).

**Synonyms** (mainly from Park (2020), with some adaptations):

*Xyleborus maiche* Kurentsov, 1941: 192 (as *Xyleborus maiche* Stark)

*Xyleborus maiche* Eggers, 1942: 36. Synonymy: Pfeffer, 1944: 131.

*Xyleborus (Anisandrus) maiche* (Stark): Stark 1952: 430.

*Xyleborus maiche* (Stark): Wood and Bright 1992: 749.

*Anisandrus maiche* Stark, 1936: Hulcr et al 2007: 578.

**2. Pest overview**

***Life cycle & biology (for illustrations see Appendix 1)***

The biology of the ambrosia beetle *Anisandrus maiche* (Figure 1, 2) has not been studied thoroughly, neither in its native area in eastern Asia nor in the non-native areas in Europe and North America. However, some information is available from Ukraine (Terekhova and Skrylnik 2012), Russia (Stark 1952 (in Russian)) and the USA (Ranger et al. 2015).

The female adult beetles of *A. maiche* can be differentiated from other species of *Anisandrus* by their comparatively smaller body size, with a length of less than 2.5 mm (Rabaglia et al. 2009). Park (2020) states that the length of females ranges from 2.2-2.5 mm but Rabaglia et al. (2009) give a length ranging from 1.8-2.3 mm. Specimens of the Swiss population ranged from 1.8-2.5 mm (Ribeiro-Correia et al. 2023).

Only females have been found outside of galleries in infested wood. Males remain in the maternal breeding galleries in the wood where mating takes place. Males are flightless and do not disperse. Males are considerably smaller than females; however, as males occur only inside the gallery, they are rarely found and measured. In Ukraine, Terekhova and Skrylnik (2012) found galleries of *A. maiche* in *Populus tremula*, *Quercus robur* and *Quercus rubra* (reported under the synonym “*Quercus borealis*”) trees. They reared the larvae found in these galleries, all of which developed into females, indicating that males of *A. maiche* are much less common than females, as is typical of xyleborine ambrosia beetles. In Switzerland, all specimens of *A. maiche* were caught in traps (and all are females). Galleries (which may contain males) have not been found yet in Switzerland.

Some information on the life stages of *A. maiche* is known from the native range in far-eastern Russia (Kurentsov 1941) and from the invasive population in Ukraine detected in 2007 (Terekhova & Skrylnik 2012). The larvae develop in thin stems and branches of trees inside egg galleries in the wood which are made by the adult maternal beetle. The galleries are described either as ring-like (Kurentsov 1941) or relatively straight in the direction of the pith (see photos in Terekhova & Skrylnik 2012). In its native range, the species is apparently rare («sporadic», Terekhova & Skrylnik 2012), and it occurs mainly in hardwood and floodplain stands, where it infests the wood of deciduous broadleaved trees (Stark 1952 as cited in Terekhova & Skrylnik 2012). In the USA, the species has been recovered from stems and branches of flood-stressed *Cornus florida* trees (Ranger et al. 2015).

In Ukraine, colonies were found mainly in thin stems and branches of young standing oak trees (*Quercus robur* and *Q. rubra*) that were apparently drought-stressed and in recently dead branches lying on the ground (Terekhova & Skrylnik 2012). At another site, infestations occurred mainly on the thin upper branches (2-4 cm diameter) of standing *Populus tremula* that «had dried out» (so were probably either drought-stressed or had recently died) (Terekhova & Skrylnik 2012). In eastern Siberia (Primorsky krai), *A. maiche* was found to be abundant when conditions were favourable, for example where large amounts of woody debris remained after tree felling (Mandelshtam et al. 2018). In Siberia, it may also occur in burned forests with damaged understorey, and it colonises mainly thin stems and branches of drought-damaged trees (Mandelshtam et al. 2018).

Attacks (tunnel / gallery entries) were noticed mainly in areas of rough bark and near branch attachments (Terekhova & Skrylnik 2012). The gallery diameter is approximately 1.0 mm at the entrance, and the diameter is becoming noticeably wider about 6 mm from the entrance. Galleries may be branched (see photos in Terekhova & Skrylnik 2012).

The gallery walls are lined with a symbiotic ambrosia fungus (Mandelshtam et al. 2018), as is typical for ambrosia beetles. In the USA, *A. maiche* has been found to be associated with *Ambrosiella cleistominuta* (Mayers et al. 2017), and the same ambrosia fungus has been identified (Ribeiro-Correia et al. 2023) from beetles captured in Switzerland.

Although Stark (1952) reported damage to green and drying stems from Siberia, we are unaware of any firm evidence that *A. maiche* causes any economic damage. The few thin galleries are probably not leading to reduced tree growth, although the galleries could impact the appearance of wood used for furniture, for example. The ambrosia fungus (*Ambrosiella cleistominuta*) associated with *A. maiche* can cause some discoloration near the tunnel walls, but it is unlikely to cause any noticeable damage. Preliminary investigations of fungal associates carried out at the Swiss Federal Institute for Forest, Snow and Landscape Research WSL revealed several other fungi that may be vectored by *A. maiche*. Most of these are not known to be damaging pathogens. However, one culture of *Fusarium lateritium* Nees (Ascomycota, Nectriaceae), a globally distributed plant pathogen, was isolated from *A. maiche* in Ticino (Ribeiro-Correia et al. 2023).

There are no records of impacts on the live plant trade although it is conceivable that plant nurseries could be affected if nursery plants are attacked by *A. maiche*, which may impede trade or require phytosanitary treatments. This could also cause social impacts (e.g., for owners of plant nurseries).

Even though economic impacts may be limited, *A. maiche* is likely to have some environmental impacts in invaded areas. In parts of North America, *A. maiche* is now one of the most abundant ambrosia beetles (Ranger et al. 2019). It is possible that it is displacing native ambrosia beetles.

To our knowledge, no further information on the biology of *A. maiche* in the recently invaded areas in northern Italy and southern Switzerland is available because the species has only been caught with traps, and no infested trees have been found or studied yet (except one attack of a *Hakea* shrub in a botanic garden on Brissago Island in Lago Maggiore).

However, based on the temporal distribution of trap catches with traps being in place in Ticino from April until the end of September, it appears that the species is univoltine (one generation per year), with most catches occurring between June and August. This is consistent with Skrylnik et al. (2019) who reported that the species is univoltine.

The climatic requirements of *A. maiche* appear to be relatively unspecific as it can persist and is apparently tolerant of the humid continental climate (Köppen) in NE Asia and eastern Ukraine, as well as the humid subtropical climate in northern Italy (Veneto and Lombardy), and the cooler conditions in central Ticino.

### **Host plants**

The host plants in the native range are mainly Asian species in the genera *Acer* (maple), *Alnus* (alder), *Betula* (birch), *Carpinus* (hornbeam), *Corylus* (hazel), *Fraxinus* (ash), *Juglans* (walnut), *Quercus* (oak), *Ulmus* (elm). Other genera and even conifers can be hosts.

In Ukraine, *Betula pendula*, *Quercus robur*, *Populus tremula*, *Ulmus minor* and the North American *Quercus rubra* have been reported.

For more details on host plants see section 7.

### **Symptoms**

Visible symptoms of attack by *A. maiche* are galleries with entry holes of 1.0 mm diameter from which boring dust is ejected. Based on our current (limited) understanding of impacts on the health of attacked trees, direct effects on tree health appear to be unlikely. Wilting or dieback of attacked trees is more likely to be caused by tree stress due to drought or flooding, and *A. maiche* appears to attack only such already weakened trees.

### **Detection and identification**

#### *Traps:*

In Switzerland, *A. maiche* has been caught in four types of traps. ‘Trap’ types 1-4 (below) were used by WSL while type 5 was used in another project.

1. Bottle traps (based on Grégoire et al. (2003) as modified by Gossner et al. (2018)) with ethanol as a lure and propylene glycol as preservative; height: ca. 1 m. This trap and lure combination is very effective in trapping *A. maiche*. More than 300 individuals of *A. maiche* were caught with this trap.
2. Funnel traps (green) with propylene glycol as preservative and baited with alpha-pinene, ethanol and an 8-component blend (as described by Fan et al. (2019)); height: about 10 m. So far, about 20 *A. maiche* were caught with this trap type.
3. Funnel traps (black) with propylene glycol as preservative and alpha-pinene, ethanol and 8-component blend; height: 2-3 m. So far, seven *A. maiche* were caught with this trap type.
4. The following method was not successful in ‘trapping’ *A. maiche*; but other ambrosia beetles were trapped: Log sections of beech, spruce and chestnut (ca. 50 cm long, 5-10 cm diameter) baited with ethanol, as described by Monterrosa et al. (2021) were unsuccessful in trapping *A. maiche*; however, several specimens of *A. maiche* were collected from around and in the cork used to seal the ethanol reservoir of one log. Another method that is successful in trapping other ambrosia beetles such as *Xylosandrus germanus*, which uses short sections of beech branches (about 20 cm long, 2-4 cm diameter) soaked in 70% ethanol, was not successful either in trapping *A. maiche*.
5. In an independent biodiversity project funded by the Canton Ticino (Museo cantonale di storia naturale and Ufficio della natura e del paesaggio), David Frey (Al Ciòs Consulenze ambientali, Melano) and Andreas Sanchez (info fauna – CSCF, Neuchâtel) caught and identified about 50 *A. maiche* with unbaited Polytrap intercept traps.

#### *Morphological determination:*

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Identification was based on the keys in Stark (1952) and comparison with voucher specimens.

- Identification keys are given in Rabaglia et al. (2009) and Gomez et al. (2018).

*Molecular diagnostics:*

- Were carried out at WSL's molecular diagnostics laboratory (Forest Health and Biotic Interactions, Phytopathology) in Birmensdorf
- Method: DNA-Barcoding (Sanger Sequencing, Coverage 2x)
- Fragment length: 586 bp
- Reference database: BOLD (<https://boldsystems.org/>)
- Best species match: *Anisandrus maiche*
- Match: 100%

**3. Is the pest a vector?**                      Yes    ☒    No    ☐

As an ambrosia beetle, *A. maiche* is associated with an obligate ambrosia fungus. In the USA, it has been found to be associated with *Ambrosiella cleistominuta* (Mayers et al. 2017). The same ambrosia fungus has been identified from beetles captured in Switzerland (Ribeiro-Correia et al. 2023). There is only limited information on whether *A. maiche* can vector other pathogens. Preliminary investigations of fungal associates carried out at WSL revealed several other fungi that may be vectored by *A. maiche*. Most of these appear to be benign, but one culture of *Fusarium lateritium* Nees (Ascomycota, Nectriaceae), a globally distributed plant pathogen, was isolated from *A. maiche* in Ticino (Ribeiro-Correia et al. 2023). In general, symbioses between invasive ambrosia beetles (and other wood-boring insects) and their fungal associates are a growing threat to forest ecosystems worldwide (Ranger et al. 2015).

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

**5. Regulatory status of the pest**

*Anisandrus maiche* is regulated as a quarantine pest in Switzerland (PGesV (2018) and PGesV-WBF-UV EK (2019)) and the EU, as are all non-European Scolytinae.

**6. Distribution**

Continent	Distribution	Provide comments on the pest status in the different countries where it occurs	Reference
North America	USA (introduced)	Pennsylvania in 2005, Ohio & West Virginia in 2006, Wisconsin, Illinois, Indiana, Maryland, New Jersey, New York	Rabaglia et al. 2009), Gomez et al. (2018), Haack et al. (2013)
	Canada (introduced)	Quebec, Ontario	Thurston et al. (2022)
South America	absent		
Europe	Western Russia, Italy, Switzerland, Ukraine (introduced)	European part of Russia (Moscow, Moscow oblast/ Kurebino, Belgorod oblast) 2007 (introduced) Ukraine (Donetsk oblast, Kharkiv, Sumy) 2007 Italy 2022 (Veneto and Lombardy): under monitoring Switzerland 2022 (Ticino and SE Grisons): under monitoring	Nikulina et al. (2007), Nikulina et al. (2015), Terekhova & Skrylnik (2012), Nikitskii (2009), Kovalenko & Nikitski (2013), Colombari et al. (2022)

Continent	Distribution	Provide comments on the pest status in the different countries where it occurs	Reference
Africa	absent		
Asia	China	Heilongjiang, Shanghai	Knížek M (2011) EPPO (2022), Terekhova & Skrylnik (2012), Smith et al. (2020)
	Japan	Honshu, Hokkaido	Smith et al. (2020)
	Russia	Russian Far East (Kunashir Island, Primorsky krai), Western Siberia	Krivolutskaya (1996), Mandelshtam et al. (2018)
	South and North Korea		Park et al. (2020), Smith et al. (2020), Chu (1964 cited in Rabaglia et al. (2009))
Oceania	absent		

Potentially all areas in Europe where host trees of *A. maiche* occur and where the climate is suitable can be colonised.

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

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>Acer barbinerve</i>	No**	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutsкая (1996, cited in Mandelshtam et al. (2018))
<i>Acer mandshuricum</i>	(Yes**)	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutsкая (1996, cited in Mandelshtam et al. (2018))
“ <i>Acer mono</i> ” (= <i>Acer pictum</i> subsp. <i>mono</i> )	(Yes**)	Russian Far East	Mandelshtam et al. (2018)
“ <i>Alnus crispa</i> ” (= <i>Alnus alnobetula</i> , = <i>Alnus viridis</i> subsp. <i>crispa</i> )	(Yes**)	(Country not provided)	UK Plant Health Risk Register (2022)
“ <i>Alnus fruticosa</i> ” (= <i>Alnus alnobetula</i> subsp. <i>fruticosa</i> )	(Yes**)	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutsкая (1996, cited in Mandelshtam et al. (2018))
<i>Alnus hirsuta</i>	(Yes**)	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutsкая (1996, cited in Mandelshtam et al. (2018))
<i>Alnus japonica</i>	(Yes**)	Russian Far East	EPPO (2022)
<i>Betula dahurica</i>	No**	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutsкая (1996, cited in Mandelshtam et al. (2018))
<i>Betula japonica</i> (= <i>Betula platyphylla</i> , = <i>Betula platyphylla</i> var. <i>japonica</i> )	(Yes**)	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutsкая (1996, cited in Mandelshtam et al. (2018))
<i>Betula pendula</i>	Yes	Ukraine	Nikulina et al. (2015), Skrylnik et al. (2019)
<i>Carpinus cordata</i>	(Yes**)	Russian Far East	Mandelshtam et al. (2018)

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, <i>major/minor habitats</i> *)	References
<i>Cercis canadensis</i>	(Yes**)	USA (Ohio)	Ranger et al. (2016), Ranger et al. (2020)
<i>Cornus florida</i>	(Yes**)	USA (Ohio)	Ranger et al. (2015), Mayers et al. (2017)
<i>Corylus mandshurica</i> (= <i>Corylus sieboldiana</i> var. <i>mandshurica</i> )	(Yes**)	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutskaya (1996, cited in Mandelshtam et al. (2018)), UK Plant Health Risk Register (2022)
<i>Euonymus</i> sp.	(Yes**)	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutskaya (1996, cited in Mandelshtam et al. (2018))
<i>Fraxinus mandshurica</i>	No**	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutskaya (1996, cited in Mandelshtam et al. (2018)), Mandelshtam et al. (2018)
<i>Gleditsia triacanthos</i>	Yes	USA (Ohio, from a naturally infested tree growing in a commercial ornamental nursery)	Mayers et al. (2017)
<i>Hakea</i> sp.	(Yes**)	Switzerland (Ticino)	Ribeiro-Correia et al. (2023)
<i>Juglans mandshurica</i>	(Yes**)	Russian Far East	Mandelshtam et al. (2018))
<i>Ligustrina amurense</i>	No**	Russian Far East	Krivolutskaya (1996, cited in Mandelshtam et al. (2018))
<i>Magnolia hypoleuca</i> (= <i>Magnolia obovata</i> )	(Yes**)	Russian Far East	Krivolutskaya (1996, cited in Mandelshtam et al. (2018))
<i>Magnolia</i> sp.	Yes		EPPO (2022); UK Plant Health Risk Register (2022)
<i>Phellodendron amurense</i>	(Yes**)	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012)), Krivolutskaya (1996, cited in Mandelshtam et al. (2018))
<i>Picea jezoensis</i>	(Yes**)	Russian Far East (Primorsky Krai)	Mandelshtam et al. (2018)
<i>Populus tremula</i>	Yes	Russia (Moscow oblast), Ukraine	Terekhova & Skrylnik (2012); Mandelshtam et al. (2018)
<i>Quercus robur</i>	Yes	Ukraine	Terekhova & Skrylnik (2012); Nikulina et al. (2018)
<i>Quercus rubra</i> (as “ <i>Q. borealis</i> ”)	Yes	Ukraine	Terekhova & Skrylnik (2012); Nikulina et al. (2018)
<i>Salix</i> sp.	Yes	Russian Far East (Trees & shrub willows)	Mandelshtam et al. (2018)
<i>Styrax japonicus</i>	(Yes**)	USA (Ohio)	Ranger et al. (2019)
<i>Syringa amurensis</i>	No**	Russian Far East	Stark (1952, cited in Terekhova & Skrylnik (2012))
<i>Syringa reticulata</i> var. <i>mandschurica</i>	(Yes**)	(Country not provided)	UK Plant Health Risk Register (2022)
<i>Syringa</i> sp.	(Yes**)	(Country not provided)	EPPO (2022)
<i>Tilia amurense</i>	No**	Russian Far East	Mandelshtam et al. (2018)
<i>Ulmus</i> sp.	Yes		Wood and Bright (1992, cited in Terekhova & Skrylnik 2012)

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, <i>major/minor habitats</i> *)	References
<i>Ulmus minor</i>	Yes	Ukraine	Nikulina et al. (2015)

\*\* Presence in PRA area marked with Yes\*\* means that the species is not native and not widely planted but occurs to a limited extent as a planted tree in urban areas based on a dataset of urban trees in Switzerland, while No\*\* means it is not native and is not known to occur as a planted tree in urban areas (pers. comm. Benno Augustinus, WSL).

#### *Comments about host plants in Europe:*

For Europe, there exists only the host list from Ukraine and western Russia which includes *Betula pendula*, *Quercus robur*, *Quercus rubra*, *Populus tremula* and *Ulmus minor* (Terekhova & Skrylnik 2012, Nikulina et al. 2015). Because of the polyphagous nature of *A. maiche* and the lack of any host information for Switzerland or northern Italy, we have limited knowledge of what potential hosts are at how much risk in Switzerland. To our knowledge, all finds in Switzerland and Italy originate from trap catches where the host plants from which the beetles originated are not known. However, given the wide array of host trees across many families *A. maiche* colonises in its native range in east Asia and in the invaded regions in the United States, the actual range of host trees in Europe is likely to be very large and comprise mainly broadleaved tree species.

#### *Comments about habitats:*

Based on information from the native range and from invaded regions in Europe and the United States, *A. maiche* occurs in a range of forest habitats. These include a variety of broadleaved deciduous forests in Ukraine (Terekhova & Skrylnik 2012) and “hardwood [broadleaved] and floodplain stands” in parts of the USA (Mayers et al. 2017). There appears to be a preference for stressed trees affected by drought or flooding (Stark 1952, Ranger et al. 2015). Based on the observations of Ranger et al. (2015), stems are preferred over branches. But attacks appear to focus on smaller diameter material (Terekhova & Skrylnik 2012). In addition to standing stressed trees, fresh deadwood on the ground has also been documented as being attacked (Terekhova & Skrylnik 2012).

## 8. Pathways for entry

No information exists about pathways by which *A. maiche* may be moved with international trade and, to our knowledge, the species has not been intercepted (and identified) during inspections of imports. Mandelshtam et al. (2018) consider it most likely that the species invaded Europe in the process of the natural expansion of its range to Western Siberia and further west. However, this seems unlikely given the apparently discontinuous distribution in Europe (and the eastern USA) and the high likelihood of transport with internationally traded goods. Mandelshtam et al. (2018) also state that goods transported with the Trans-Siberian Railroad may have contributed to the invasion in Europe. But since the native range of *A. maiche* also includes South Korea, Japan and parts of China, regions with high trade volumes to Europe, it is perhaps more likely that it has been moved with exports from those countries.

It is most likely that the species was introduced with infested wood (e.g., wood packaging material such as pallets) or live plants (e.g., infested small trees of ornamental species such as maples which are imported from NE Asia).

The following pathways could play a role in its invasions (for details see the text below the table):

Possible pathways (in order of importance)	Short description explaining why it is considered as a pathway	Pathway prohibited in the PRA area? Yes/No	Pest already intercepted on the pathway? Yes/No

Plants for planting	Saplings and small trees of broadleaved trees (see text for details)	No	No
Wood and wooden products	Fire wood, wood packaging material, logs (see text for details)	No	No
Natural spread	Across the border with Italy (see text)	--	No
Hitch-hiking	Adult female beetles could hitchhike with various commodities (see text)	--	No

#### *Plants for planting:*

Given that stems and branches of live woody plants (as small as a few centimetres in diameter) can be attacked, international trade of woody plants for planting could be a possible pathway for *A. maiche*. There is some international trade in saplings and small trees of broadleaved tree species such as maples. However, we are not aware of any interceptions of *A. maiche* with imported live plants.

#### *Plant parts and plant products:*

Imports of branches and plant products such as wicker chairs may be a possible pathway.

#### *Wood and wood products:*

Internationally traded firewood and wood packaging made from broadleaved trees are highly likely to be suitable pathways. Log imports may be a possible pathway. To our knowledge, no interceptions of *A. maiche* with wood products have been recorded, but wood packaging is probably the most important pathway as many other xyleborines have been intercepted with wood packaging material.

#### *Natural spread:*

Natural spread from an outbreak in Italy (close to the Swiss border) is a likely pathway. Specimens have been trapped in Lombardy less than 30 km from Chiasso (Ruzzier et al. 2022). There is no scientific report on the maximum spread of *A. maiche* in one year.

#### *Hitchhiking:*

Adult beetles could be moved as hitchhikers with different commodities that are traded internationally. This could occur during the flight period of the beetles depending on the climatic zone (in Switzerland apparently mainly in June - August). Given that *A. maiche* is a typical ambrosia beetle with a mating system that involves inbreeding (sib-mating in the maternal gallery), new female beetles leaving the gallery have already mated and could establish a new population by themselves.

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

## **9. Likelihood of establishment outdoors in the PRA area**

In its native range in China, Korea, Far East Russia, and Japan, *A. maiche* can be found in forests and peri-urban areas. Apparently, it can live under a range of environmental conditions as long as host plants are available and the climate is suitable. *Anisandrus maiche* is thought to be able to establish in most of the EPPO region because it occurs already in climates ranging from the continental climate of Western Russia and Ukraine to the sub-tropical climate of northern Italy. Given the polyphagous nature of *A. maiche* with many broadleaved trees and apparently even some conifers being suitable hosts, many of which have close relatives in the same genera that are common in Europe. In Switzerland, *A. maiche* only occurs in the Canton of Ticino and an adjacent area in the SW of Canton Grisons, but it is highly likely that it would also be able to establish in northern Switzerland.

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

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

If the host plants are grown in nurseries in greenhouses or shade houses, *A. maiche* could also occur there. However, the typical host plants are normally grown outdoors and therefore, occurrences in protected conditions are less likely.

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

## 11. Spread in the PRA area

### *Human assisted spread*

Human-assisted transport (via the possible pathways described above) was probably involved in the initial establishment within the PRA area (Switzerland) and probably also contributed to its dispersal within the area.

### *Natural spread*

Given the wide known distribution across much of Canton Ticino from Chiasso in the south to Biasca more than 60 km in the north, it is highly likely that *A. maiche* dispersed naturally within the area, and it has probably been undetected in the area for many years. Based on trap catches, natural dispersal in Switzerland occurs mainly from June to August, the flight period of *A. maiche* in Switzerland (Ribeiro-Correia et al. 2023). As *A. maiche* is rather small (< 2.5 mm), it may not be able to fly very long distances; however, wind dispersal may also play a role.

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

## 12. Impact in the current area of distribution

We are not aware of any reports of substantial damage or economic, ecological or social impacts in any of the regions where *A. maiche* occurs. For example, Terekhova & Skrylnik (2012) state that *A. maiche* “has no significant economic impact” in Ukraine. The assessment by Mandelshtam et al. (2018) is that “the economic significance of the species is very low”. However, Skrylnik et al. (2019) assess its impact as “noticeable” and give it an intermediate ‘impact’ rating for birch (*Betula pendula*) in Ukraine with a “physiological harmfulness score” of 5 out of 14 (based on damage from the galleries and its ability to vector potential pathogens. Orlova-Bienkovskaya (2016) write that *A. maiche* is one of several species that “may become potential key species and bring great damage to forests in European Russia”; however, this is a hypothetical statement, and the exact nature of the damage is not explained (but perhaps more details can be found in Nikitskii (2009) which is cited regarding damage).

The impact of *A. maiche* in Italy and Switzerland is as yet unknown because, so far, no signs of attacks on trees have been observed. However, many attacks must have occurred in Italy and Switzerland, judging by the many trap catches in the infested regions (Ruzzier et al. 2022, Ribeiro-Correia et al. 2023).

The assessments of limited impacts of *A. maiche* in its native and invaded regions appear to be based on the limited damage to the wood of attacked trees, which have no apparent effects on plant health. Attacks occur mainly on stems and branches of weakened trees affected by drought, fire or flooding (Terekhova & Skrylnik 2012, Ranger et al. 2015, Mandelshtam et al. 2018). It also attacks standing dead trees and fresh woody debris on the ground (e.g., after tree felling) (Mandelshtam et al. 2018). Structural damage of wood resulting from *A. maiche* attacks is probably also low because it appears to prefer stems and branches of small diameter (Terekhova & Skrylnik 2012, Ranger et al. 2015).

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

### 13. Potential impact in the PRA area

#### *Direct impacts*

Within the PRA area, direct impact on host plants are likely to be similar to the limited impacts recorded in the Russian Far East, Ukraine and the USA (see above). This means trees stressed by drought, flooding or other biotic agents, as well as damaged or dying branches may be attacked. However, such attacks on their own do not appear to cause any further decline in tree health, as the galleries of *A. maiche* are relatively small and mostly have a diameter of only 1 mm. Any observed decline in tree health is more likely to be related to other, primary abiotic or biotic causes.

Given that drought stress of host trees is forecast to increase as a result of climate change, it is possible that live trees prone to attack by *A. maiche* will become more common in the future. *Anisandrus maiche* could therefore become even more common than it already appears to be, based on the many beetles caught in ethanol-baited traps at some sites in Ticino. Also of interest is that in the USA, *A. maiche* populations have been growing and at some locations the species is now more abundant than *Xylosandrus germanus* which has been present in the USA for a longer period of time.

#### *Host trees and susceptibility*

Congeneric species to the main hosts in the native area are common or at least present in the PRA area, and given the high degree of polyphagy of *A. maiche*, most broadleaved trees and perhaps even some conifers could be attacked (*Picea jezoensis* has been reported as a host – see point 7). Furthermore, the Swiss climate is within the range of climates in the native region of *A. maiche*.

#### *Indirect impacts*

The galleries of *A. maiche* could provide access to plant pathogens, although there is limited information on this. *Ambrosiella cleistominuta*, the ambrosia fungus associated with *A. maiche*, does not appear to be pathogenic. Other fungi can be carried from other trees to those newly infested by *A. maiche*. Several fungi including species in the genera *Leptographium* and *Fusarium* have been recovered from *A. maiche* collected in Switzerland (Ribeiro-Correia et al. 2023). Although most of these are benign, *Fusarium lateritium* is a pathogen known to attack trees such as hazelnut and boxelder maple. In Switzerland, *F. lateritium* was isolated from one beetle trapped in Ticino. Nevertheless, there are cases where fungi associated with invasive ambrosia beetles cause lethal disease in host trees in the invaded area. The most notable case of this is the case of *Xyleborus glabratus* and its associated pathogen *Raffaelea lauricola*, the causal agents of laurel wilt, which cause large-scale mortality of many trees in the family Lauraceae in the southeastern United States (Fraedrich et al. 2008, Hughes et al. 2017).

#### *Impact on domestic and international trade*

As *A. maiche* is a quarantine organism, it remains to be determined whether there are implications for domestic or international trade of nursery stock of broadleaved tree species, wood or wood products within Switzerland or regarding imports (from infested areas outside Switzerland) or exports from Switzerland. However, given that the impacts reported from *A. maiche* so far are rather minor, it is probable that its presence in southern Switzerland will not have any trade implication.

Will impacts be largely the same as in the current area of distribution? **Yes** (probably)

#### **If No**

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

### 14. Identification of the endangered area

All regions of Switzerland where host plants are available could be colonised. *Anisandrus maiche* could also occur in tree nurseries.

## 15. Overall assessment of risk

The probability of further spread without phytosanitary measures is high. However, any measures taken must be in proportion to the limited damage caused by the species. As no significant damage has been reported so far, this should be taken into account, at least until other findings are available.

## Stage 3. Pest risk management

### 16. Phytosanitary measures

Potential phytosanitary measures that could be considered in Switzerland are:

#### *Delimitation of the current area of infestation:*

- Delimitation: Further trapping over a larger area in southern Switzerland (e.g., tree nurseries, forests and other potential habitats in other regions of Ticino where no trapping has been undertaken yet) as well as in high-risk areas in northern Switzerland (such as locations where nursery stock, fire wood and other risk commodities were shipped from the infested areas in southern Switzerland or northern Italy) to delimit the infested area of infestation (see point 2).

#### *Disinfestation of traded commodities at risk of infestation*

- Measures for the disinfestation of materials at risk of attack by *A. maiche* (see above) that are destined for domestic and international trade, such as those measures described in ISPM 15 (for wood packaging materials), ISPM 36 (plants for planting), ISPM 14 (systems approaches ...), could be applied, but given the limited potential for damage by this beetle, such measures do not appear to be justified.

#### *Eradication or containment of the populations present in southern Switzerland*

- *Anisandrus maiche* is already so widespread and abundant in southern Switzerland that attempts to eradicate the species from Switzerland would not be successful. Eradication over such a large area would also be very costly and given the very low likelihood of success and the limited potential for damages caused by *A. maiche*, the cost-benefit ratio of such an attempt would be highly unfavourable. The same applies to measures for containment or reduction of the rate of spread.

#### *Enhanced surveillance for *Anisandrus maiche* and other ambrosia beetles*

- *Anisandrus maiche* (and several other invasive ambrosia beetle species) have been detected in Switzerland and/or neighbouring countries in recent years. Expanded surveillance activities for non-European ambrosia beetles are recommended.

#### *Targeted inspection of imports for *Anisandrus maiche* and other ambrosia beetles*

- Knowledge of the most relevant introduction pathways and main commodities remains scant. Enhanced inspection of imports targeted at ambrosia beetles associated with broadleaved trees and conifers could be undertaken to gain a better understanding of pathways that may be insufficiently regulated and may require further phytosanitary measures.

### 17. Uncertainty

The main sources of uncertainty within the risk assessment and risk management include:

- Host plants: There is uncertainty regarding the host plants of *A. maiche*, because all records from Switzerland so far are based on trap catches (without knowledge of the host trees in which the beetles bred, with the exception of one known attack of a *Hakea* shrub in Ticino).
- Extent of potential damage caused: The level of damage inflicted on trees attacked by *A. maiche*, especially when heavy infestations occur.
- Associated plant pathogens: Although preliminary studies have been undertaken (so far not revealing any pathogens of particular concern), this is based on a limited number of samples.

- Life cycle: The number of possible generations per year (the species is probably univoltine but this requires confirmation).
- Key pathways: Little is known about the pathways by which *A. maiche* invaded the PRA area, although imports of nursery stock, wood packaging and firewood could be involved, assisted by natural spread.
- Effectiveness of potential phytosanitary measures: For example, phytosanitary measures applied to nursery stock have not been investigated for this species.

## 18. Remarks

None.

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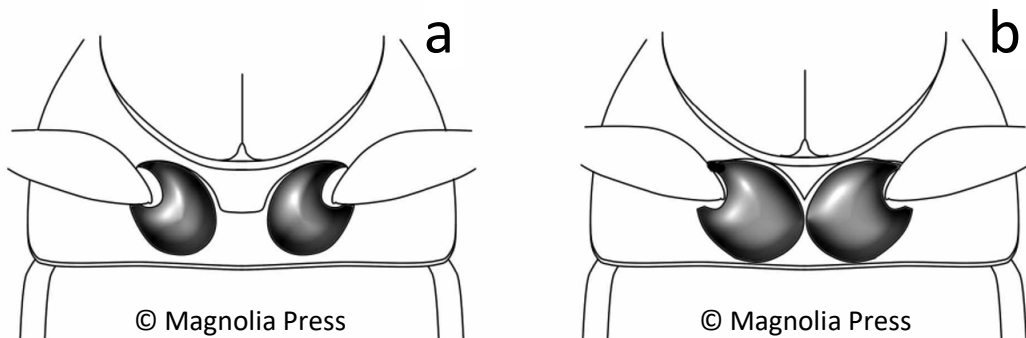
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## Appendix 1. Relevant illustrations



**Figure 1.** *Anisandrus maiche* adult trapped at Serravalle-Leggiuna 1 (Ticino), dorsal and lateral. Specimen length approximately 2.0 mm. Photos by Carl-Michael Anderson, WSL. (L1\_13.5.22\_AM\_sm\_1 / L1\_13.5.22\_AM\_sm\_1\_lateral).



**Figure 2.** Ventral view showing procoxae of (a) *Xylosandrus* spp. (coxae well separated) and (b) *Anisandrus* spp. (coxae contiguous, nearly touching). Images from Rabaglia et al. (2009), © Magnolia Press, reproduced with permission from the copyright holder.