Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

SLU Risk assessment of plant pests

SLU ua 2019.2.6-2532

June 14, 2019

Callidiellum rufipenne a new longhorn beetle for Sweden – risks associated with a potential establishment

Summary

Callidiellum rufipenne is an invasive pest on conifers which has spread extensively around the world with plants for planting and wood products. The first record in Europe was made already more than 100 years ago. There are some inconsistencies in the literature with regard to whether *C. rufipenne* can infest healthy trees and whether it can infest host species of the genera *Pinus* and *Picea*. Based on the provided evidence our assessment is that the answer is no in both cases. Stressed trees may however be infested and heavy infestations has been associated with branch and even tree death. The potential damage associated with an establishment of *C. rufipenne* in Sweden is damage to stressed trees of native *Juniper communis* and other non-native species within the family Cupressaceae. Several non-native species within Cupressaceae are planted widely in private gardens and parks etc in Sweden. Trees grown on marginal sites are especially at risk. Management measures to eradicate and to prevent entry/spread are available for *C. rufipenne.*

Assignment

Callidiellum rufipenne is a pest on conifers that recently has been found in Sweden. The unit of Risk assessment of plant pests at the Swedish university of agricultural sciences was requested by the Swedish board of agriculture to perform a quick review of the literature relevant for guiding the assessment of the risks associated with a potential establishment of this species in Sweden.

Identity of the species

Preferred Scientific Name: *Callidiellum rufipenne* (Motschulsky, 1860)
Taxonomy: Cerambycidae, Coleoptera, Insecta
Other Scientific Names: *Callidium rufipenne, Palaeocallidium rufipenne* (Motschulsky)
Common names: Cedar longhorn beetle, Cedar long-horned beetle, Japanese cedar longhorn beetle, small cedar longhorn beetle, Smaller Japanese cedar longhorned beetle, etc.

Biology

The biology of *Callidiellum rufipenne* is only briefly described here and further information, including pictures, can be found in Maier and Lemmon (2000), Humphreys and Allen (2000) and in Hoebeke (1999). Notice, however, that there are some inconsistencies in the sources, i.e. according to Humphreys and Allen (2000) the elliptical exit holes are 6-10 mm in diameter and according to Hoebeke (1999) they are 4 x 2 mm.

The beetle is 5-13 mm long (Maier and Lemmon, 2000). Adults emerge in spring after having overwintered as adults within the host (Maier and Lemmon, 2000). The female lays the eggs in bark crevices of stressed or dead trees (Maier and Lemmon, 2000). Larvae feed and tunnel first in the phloem under the tree bark and later into the xylem to pupate (CABI, 2019). The life cycle is reported to be 1 year in Connecticut, USA (Maier, 2008), but 2 years may be required in some northern areas of Japan (Maier and Lemmon (2000) citing Y. Soma in litt.). The life cycle can also be prolonged for 2–3 years if the host trees or logs are too dry (Ueda and Shibata (2007) citing Makihara (1994)). The beetles required about 20 accumulated day-degrees above 8 °C to first emerge in Connecticut, USA. (Maier, 2008).

Hosts

The main host genera of *Callidiellum rufipenne* are conifers in the family Cupressaceae including *Chamaecyparis*, *Cryptomeria*, *Cupressus*, *Juniperus*, and *Thuja* (Haack 2017). Within its native range it is frequently reported from *Cryptomeria japonica* and *Chamaecyparis obtusa* (CABI 2019). In USA it has infested *Chamaecyparis obtusa Chamaecyparis thyoides, Chamaecyparis pisifera, Chamaecyparis nootkatensis Cryptomeria japonica, Juniperus communis, Juniperus scopulorum, Juniperus virginiana*, and *Thuja occidentalis* (Maier and Lemmon, 2000; Maier, 2007). In Europe it has been reported on *Cupressus macrocarpa*, *Juniperus communis* and *Thuja* cultivars (CABI 2019; Glavendekic, 2014). Since other species has been infested in Europe and North America than in the native range it appears likely that other species within the family Cupressaceae than those currently listed as hosts are at risk.

Some sources also list conifers within the Pinaceae genera, i.e. *Abies* and *Pinus*, as hosts based on records from Japan (e.g. CABI, 2019). However, in a review of the evidence Maier (2007) found that the records of Pinaceae are doubtful. Further, experimental data showed that no beetles were produced in the following species: *Aies balsamea, A. fraseri, Larix decidua, L. laricina, Picea abies, Picea glauca, Picea rubens, Pinus banksiana, Pinus resinosa, Pinus rigida, Pinus strobus, Pinus sylvestris, Pinus thunbergii, Pseudotsuga menziesii*, and *Tsuga canadensis* (Maier 2007). Maier (2007) therefore concluded that only species of Cupressaceae seem to be suitable for the development of *C. rufipenne*. This conclusion is supported by a recent review in which it is stated that in North America, no Pinaceae have yet been documented as hosts (Haack 2017).

Climate suitability

The most northern locations of *Callidiellum rufipenne* has been recorded from the state of New York, USA and on Sakhalin Island in Russia (Far East) (EPPO, 2019). These areas have warm temperate and boreal (Snow) Köppen-Geiger climate types which are also found in Sweden (Kottek et al. 2006). It is however not clear whether the pest is established in areas on the Sakhalin Island which according to Kottek et al. (2006) has the same boreal climate type which covers the northern parts of Sweden (Köppen-Geiger climate classification Dfc).

Regulatory status and previous risk assessments

Callidiellum rufipenne is not regulated as a quarantine pest in the EU (Council Directive 2000/29/EC). The species was formerly on the EPPO alert list. It was added in 1999 as a response to the introduction of *C. rufipenne* to USA where eradication measures were being taken (EPPO 1999). It was deleted from the EPPO alert list in 2004 since no particular international action was requested by the EPPO member countries during this period and the EPPO Panels considered that sufficient alert had been given to this species (EPPO, 2004).

In USA *C. rufipenne* currently appear to be regulated in some states (Invasive.org, 2019). According to references in Maier and Lemmon (2000) the quarantine status changed from actionable to a non-reportable pest in 1982 and back to actionable pest again in 1998. According to Eyre and Haack (2017) the species is currently not under any eradication or containment programs in Europe or North America.

Łos and Plewa (2011) state that *C. rufipenne* has a status as a quarantine species in Japan (but without supporting any references to support that).

No previous PRA on *C. rufipenne* for Europe was found. The risks associated with this species has however been assessed for the United Kingdom (UK Plant Health Risk Register, 2019). They assessed, on a scale to five, the likelihood of entry to four, the likelihood of establishment to five, the spread to three, and the impact to two. *Callidiellum rufipenne* obtained a UK Relative Risk Rating value of 32 on a scale to 125. *Callidiellum rufipenne* was also included in a horizon scanning assessment of the environmental risk of new non-native animals in England and the environmental risk associated with a potential introduction of *C. rufipenne* were assessed to be low (Parrott et al., 2009).

A pest risk assessment of the species has been performed for Australia Biosecurity Australia 2006).

Current area of distribution

The native range of *Callidiellum rufipenne* is stated to be the eastern part of Asia (CABI, 2019). In Asia the species is reported from China, Japan, Taiwan, Korea Dem. People's Republic, Korea, Republic and Russia, far east (EPPO, 2019). The

species has spread from the native range to other parts of the world and is reported as present in USA and Argentina, and in several countries in Europe (EPPO, 2019). The first record in Europe was made already in 1906 (Cocquempot and Lindelöw 2010). The EPPO global database reports that the pest species is present in Belgium, Croatia, France, Italy, Southern Russia (e.g. in Sochi) and Spain (EPPO, 2019). At least in some countries in Europe it is considered as established, e.g. in Belgium where it has been found in 13 different locations (Drumont et al. 2015).

Additional observations have been made in the following countries:

- Denmark: In 1978 a dead specimen was found in Skagen, the most northern tip of Jutland, Denmark (Hansen et al. 1992).

- Serbia: The species is reported as present in two locations in Serbia (Glavendekic, 2014). High mortality of plants in production of *Thuja* cultivars was observed in 2012-2013 and *Callidiellum rufipenne,* together with another secondary pest (*Lamprodila festiva L.; Coleoptera, Buprestidae*), was reared from dead trees (Glavendekic, 2014).

- The Netherlands: An online database reports that the first observation of the species was done in Limburg in 2018 (Colijn 2019 citing Geraeds 2019).

In addition, the online database "Catalogue of Life: 2019 Annual Checklist" also includes the following countries and regions in the species distribution: Canada, Caucasus, Georgia, Iran, New Caledonia, New Zealand and Siberia (Tavakilian and Chevillotte, 2019).

EPPO (2019) reports the pest as 'Absent, intercepted only' in Canada and New Zealand.

Sweden

Callidiellum rufipenne was observed for the first time in Sweden in 2017 in Halland, southern Sweden (Artdatabanken SLU, 2019). Additional observations were made of adult specimens in both 2018 and 2019 (Artdatabanken SLU, 2019). The observations were made of several adult individuals, both male and female (and possibly a larvae (but not verified)) (Artdatabanken SLU, 2019). The observations have all been made in one gravel pit and associated with *Juniperus* spp., presumably alive or cut trees and branches, and branches of some unknown conifers (*Taxus* spp. and *Thuja* spp. mentioned but not verified) according to the information provided by the observers reporting the species (Artdatabanken SLU, 2019). These observations of in total about 30 specimen indicate that there may currently be a reproducing population of *C. rufipenne* in Sweden. However, since only a restricted number of specimen has been found in a single site it should not be considered established according to the ISPM5 definition of establishment, i.e.

"Perpetuation, for the foreseeable future, of a pest within an area after entry" (FAO 2019).

Pathways and interceptions

Several pathways have been associated with *C. rufipenne.* According to Cocquempot and Lindelöw (2010) importation of plants for planting in nurseries led to the introduction and establishment of *C. rufipenne* to Europe. Other authors emphasize the pathways with wood products (solid wood packaging and dunnage) since empirical data show that all life stages of this beetle can be present on such material and that host species of *C. rufipenne* are used in the manufacture of wood packaging material (Biosecurity Australia 2006; Humphreys and Allen 2000; Maier, 2018). Haack (2017) conclude that given the species life history traits it can easily move in barked logs, wood packaging material, cut branches, and live plants.

The risk that *C. rufipenne* can be transported with ISPM 15 compliant wood packaging material has been assessed to be low (Biosecurity Australia 2006). *Callidiellum rufipenne* has been found both in small dimensional material, in living nursery stock, as well as in branches and trunks larger than 25 mm in diameter (according to references in Biosecurity Australia 2006).

EPPO reports the pest to have been intercepted in Canada, Puerto Rico and New Zealand (EPPO, 2019). In addition, interceptions are mentioned from Australia (11 interception between 1975-2003 on wood packaging material before the implementation of ISPM15; Biosecurity Australia 2006) and USA (frequently intercepted on wood packaging material between 1984-2008; Eyre and Haack, 2017). No interceptions were found in the European Union Notification System for Plant Health Interceptions (EUROPHYT, 2019). It should however be noticed that *C. rufipenne* is not a quarantine species in Europe and EUROPHYT mainly report interceptions of plants or plant products that do not comply with EU legislation.

Impact

Callidiellum rufipenne is generally considered to be a secondary pest, i.e. it cannot attack or complete normal development in healthy trees and so attack weakened or dead trees (Haack 2017). However, a study by Maier and Lemmon (2000) is sometimes cited as support for that *C. rufipenne* can attack "healthy" plants (e.g. EPPO 2004; Biosecurity Australia 2006) or "apparently healthy" plants (e.g. CABI 2019; Haack 2006). It should though be emphasised that Maier and Lemmon (2000) state that even though most infested plants appeared healthy they had previously been grown for a period of time before they were dug up with a ball of soil. Thus the trees may have been stressed and susceptible to attack because of root and branch breakage and possibly inadequate watering before, during, and after shipment to Connecticut (Maier and Lemmon 2000). Furthermore, these plants were occasionally infested by bark beetles (Scolytidae). In later work the main author refer to the plants in that study as "apparently stressed" (Maier 2009).

Further, there are both field studies and experimental studies which indicates that only stressed or dead trees are attacked (Ueda and Shibata, 2007, Maier, 2007). Thus, in conclusion, there does not seem to be any support for that *C. rufipenne* is a threat to healthy plants.

Callidiellum rufipenne may however be a concern for stressed trees. In Connecticut, USA, 101 apparently stressed *Thuja occidentalis* in garden centers, nurseries, landscaped areas, and the wild were infested (Maier and Lemmon, 2000; Maier, 2009). Heavy infestations of live hosts can cause tree or branch death, but more typically, economic impact results from lowering the quality of the wood due to larval feeding (Haack, 2017). On the contrary, Humphreys and Allen (2000) claim that the degradation of the log value is minimal since tunneling is restricted to the outer sapwood. Regardless, a decrease in wood value is of less concern for Sweden since, to our knowledge, Cupressaceae is not grown for timber production in Sweden. In Serbia thousands of *Thuja* cultivars died and *C. rufipenne*, together with other secondary pests, were reared from dead trees (Glavendekic, 2014). It is however not stated whether the trees were healthy or stressed when they were infested. Ueda and Shibata (2007) provides support for that trees that are under water stress might be attacked by *C. rufipenne*.

A concern is also that *C. rufipenne* can become prevalent in the areas it invades, e.g. in southern Connecticut, USA, it was found in 157 of 165 towns that were surveyed (Maier 2018). In England the environmental risk associated with a potential introduction of *C. rufipenne* were assessed to be low (Parrot et al. 2009). In a risk assessment for Australia they anticipated that an introduction of *C. rufipenne* would not have "…any consequences for healthy plants and the ecosystems they are part of…" (Biosecurity Australia 2006).

Sweden

The only native species of Cupressaceae in Sweden is ***Juniper communis*** (Anderberg, 2017). However, several other species are however commonly grown in Sweden such as ***Thuja occidentalis***, *Th. plicata, Th. Dolabrata, Microbiota decussate, Chamaecyparis lawsoniana,* ***C. nootkatensis***, ***C. pisifera*** and ***C. obtusa*** (Anderberg, 2017). All tree species highlighted in bold text above have been found to be hosts for *C. rufipenne* but since other host species than in the native area has been attacked in the invaded regions there is a risk that also other species within the family Cupressaceae may be infested.

Thus the expected damage of *C. rufipenne* on native host trees in Sweden is expected to be restricted to stressed or dead *Juniper communis*. The presence of such hosts is assessed to be frequent enough to allow it to become common in Sweden. Further, since several other host species are frequently grown in Sweden in private gardens as well as in parks etc. stressed trees of these species is expected to be susceptible to attacks. Thus, this is a concern especially for trees growing on marginal sites.

The impact on the environment in Sweden is expected to be small if *C. rufipenne* establishes in Sweden since only stressed and dead trees are susceptible. Further it is not expected to outcompete any native species since there are no native species in Sweden that has a similar lifestyle as *C. rufipenne* in *Juniper communis* (Åke Lindelöw, personal communication).

Experience of management

In USA the suggested control options for nursery stock are insecticidal treatment, inspection, and certification programs whereas for logs and wood products control may be achieved by rapid utilization, debarking, and heat treatment or fumigation (Haack 2017; Maier 2007). Others have claimed that the most effective control is to focus on maintaining healthy trees and to destroy infested material by chipping, burning, or burying logs at least 30 cm deep (Humphreys and Allen, 2000; Invasive.org, 2019).

Cerambycidae, to which *C. rufipenne* belongs, have some biological and ecological properties, especially their relatively slow spread, which provides a realistic chance of eradication (Eyre and Haack, 2017). It is well known from previous experience that the success of an eradication program to a large extent depends on how fast it is initiated after introduction. For *C. rufipenne* we could only find information from one eradication programme, which however failed (Kean et al. 2019). That eradication programme was initiated in 1998 in southern Connecticut, USA (Kean et al. 2019). In that case *C. rufipenne* was already present in at least four garden centers and in nearby residential areas in which in total more than 100 infested plants were found (Maier and Lemmon 2000). Further, an unknown number of plants that may have been infested by *C. rufipenne* at the four garden centers had already been sold and probably planted in the region (Maier and Lemmon, 2000). There are however at least 22 examples of successful eradication campaigns of other Cerambycidae species (Kean et al. 2019).

The detectability of the pest and the size of the infested area when an eradication attempt is initiated has been shown to be important for whether it will be successful (Brockerhoff et al., 2010; Tobin et al., 2014). The detectability of *C. rufipenne* is currently high since effective lures have been developed which are commercially available (Maier 2018). It is however currently unknown whether the infestation is restricted to the small area from which the currently available observations has been made or whether *C. rufipenne* has a wide distribution (Artdatabanken SLU, 2019).

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