This text is an integral part of the *EPPO Study on bark and ambrosia beetles associated with imported non-coniferous wood* and should be read in conjunction with the study

**Pest information sheet**
**Bark beetle**

## *HYPOTHENEMUS ERUDITUS* (COLEOPTERA: SCOLYTINAE)

*EPPO Lists:* Not listed. The assessment of potential risks in this information sheet is not based on a full PRA for the EPPO region, but on an assessment of the limited information for that species used to prepare the information sheet.

## PEST OVERVIEW

### Taxonomy
*Hypothenemus eruditus* Westwood, 1836. *H. eruditus* currently has 71 recognized synonyms (Vega *et al.*, 2015). Recent molecular studies support the existence of many potential sibling species, and the authors support that many sequenced taxonomic units or current synonyms deserve species status (Kamberstad, 2011; Kamberstad *et al.*, 2017). The information here refers to *H. eruditus sensu lato*.

### Associated fungi
The following fungi were found associated with this species: *Ophiostoma pluriannulatum, O. quercus, Fusarium circinatum, F. culmorum, F. lateritium, Pesotum fragrans* (Lopez Romero *et al.*, 2007). *F. circinatum* is pathogenic on *Pinus*. No information was sought on the pathogenicity of other species.

### Morphology and biology
Adults measure ca. 1 mm long (Huang *et al.*, 2016, citing others; see this publication for details on the morphology of the different life stages). In addition to plants, *H. eruditus* has been recorded in various other material, such as fungal fruiting bodies, manufactured products, drawing boards, book bindings/covers (hence its species name) (Vega *et al.*, 2015; Browne, 1961; Karlshoven, 1958), and in the galleries of other beetles (Huang *et al.*, 2016 – Beaver, 1987, in old longhorn tunnels in dead stems of *Cajanus cajan*).

On plants, *H. eruditus* develops in the phloem of small branches (Lopez Romero *et al.*, 2007), but also in the bark of trunks or branches, in flowers, weeds, grasses and seeds (Wood, 1977). It is apparently especially associated with leaf petioles or twigs, but also seeds and fruits (Vega *et al.*, 2015; Huang *et al.*, 2016). Karlshoven (1958) includes an extensive list of findings in Java, that mention: bark, pods, withered plant parts, saplings and seedling stems, old fallen fruits (*Castanea*), dry fruits (several plant species) and coffee berries.

*H. eruditus* is an inbreeder. Females mate usually with males from the same brood/gallery (i.e. sibling-mating), or with non-sibling males when different galleries meet (Huang *et al.*, 2016). Dispersing mated females exit via the original entrance hole or through new exit holes (Huang *et al.*, 2016). In the field, development (egg to adult) takes approximately 28 days (Huang *et al.* 2016, citing Browne 1961). *H. eruditus* is 'unusually tolerant to low humidities' (Browne, 1961).

### Spread biology
Females of *H. eruditus* fly, but no details were found on their flight capacity. Males are flightless (Huang *et al.*, 2016).

### Nature of the damage
In small branches, *H. eruditus* tunnels irregular and shallow galleries, with the maternal gallery generally measuring 1-3 cm (Lopez Romero *et al.*, 2007).

### Detection and identification
*H. eruditus* is highly attracted to ethanol (Huang *et al.*, 2016). *H. eruditus* can be confused with *H. seriatus* and *H. birmanus.* Differences are detailed in Han *et al.* (2016). Its small size makes morphological

identification difficult, and there may also be a large number of cryptic species in the *H. eruditus* complex (see Taxonomy).

**Distribution (see Table 1)**
*H. eruditus* is present in all tropical and subtropical regions of the world and its distribution also extends to many temperate regions (Huang *et al.*, 2016). In the EPPO region, there are records from some Mediterranean countries, as well as Azerbaijan and Georgia. It is considered by some sources as the world's most common Scolytinae, because of its wide geographical distribution and host range (e.g. Kamberstad *et al.*, 2017). In California, its introduction is thought to have occurred over 100–150 years ago (Seybold *et al.*, 2016).

**Host plants (Table 2)**
*H. eruditus* is qualified as a "super generalist" since it can feed on a wide variety of phylogenetically diverse plants (Huang *et al.*, 2016). Its deciduous hosts include numerous tropical, subtropical and temperate species, including wild and cultivated forest and fruit species. A comprehensive list is provided in Atkinson (2018), and mentions hosts species in over 110 genera and 50 families. A few of the hosts that are present in the EPPO region are: *Ficus carica, Alnus, Castanea, Citrus, Diospyros kaki, Eucalyptus, Eriobotrya japonica, Fraxinus, Juglans, Malus, Morus, Pistacia, Prunus, Pyrus, Salix, Tilia* (hosts extracted from Lopez Romero *et al.*, 2007 and Atkinson, 2018). *H. eruditus* has also been recorded on conifers (*Pinus, Cryptomeria japonica, Abies balsamea*) and on non-woody plants such as *Saccharum officinarum.* Seybold *et al.* (2016) mention it was also recorded on weeds. Despite the already extensive host range and the fact that it has been documented for a long time, new host records are still published (e.g. *Alnus* and *Pterocarya fraxinifolia* in Iran, Amini *et al.*, 2017). It is probable that the list of host plants, at least with regards deciduous trees and bushes, is longer than currently documented. Some hosts are listed in Table 2.

**Known impacts and control in current distribution**
Lopez Romero *et al.* (2007) considers *H. eruditus* to be of potential economic importance, because of previous observations in various tropical countries showing that it is capable of killing transplants and seedlings (citing Beaver, 1987). Death of cocoa seedlings has been reported (Vega *et al.*, 2015, citing others; Browne, 1961). Beaver and Browne (1978) and Beaver (1987) refer in a general manner to damage to transplants and seedlings citing older publications; however, these could not be found, and it was not possible to determine on which other hosts mortality has been observed. Finally, Wood (1977) mentions that *H. eruditus* is frequently of economic importance in mature seeds or pods in the field and in storage.

More recent references from various countries do not indicate damage. Huang *et al.* (2016) note that, despite its prevalence, *H. eruditus* does not cause any significant economic damage and requires no management. It has been reported inside coffee berries, but does not consume the seeds and does not reproduce in them (Han *et al.*, 2016, citing others). In País Vasco (Spain), it has also presented a phoretic association with the pathogenic fungus *Fusarium circinatum* (Lopez Romero *et al.*, 2007). *H. eruditus* was the most abundant bark and ambrosia beetle species in a *Pinus taeda* and an *Eucalyptus grandis* stand in the state of Parana (Brazil), but it was not amongst the species found to be aggressive during this study (Flechtmann *et al.*, 2001). *H. eruditus* was common during a survey of Scolytinae in hazelnut orchards in Turkey (Tuncer *et al.*, 2017).

*Control:* No mention of control was found in the literature.

**POTENTIAL RISKS FOR THE EPPO REGION**
**Pathways**
*Entry*
When plants are attacked, life stages are in the bark. Wood commodities with bark may be a pathway. Regarding round wood and sawn wood, it is not clear if it is associated with large diameter trunks, as the information available appears to refer to small-size material, but it may be associated with commodities using small diameter material (e.g. possibly firewood as round wood). It has also been intercepted in the Korean Republic on 'logs and timber' of *Aralia elata* from China (Choi *et al.*, 2003), and round and sawn wood are therefore considered a pathway. Processes applied to produce wood commodities may destroy some individuals (even if *H. eruditus* is very small). The likelihood of entry on wood chips, hogwood and processing wood residues would be lower than on round wood, as individuals would have to survive processing and transport, and transfer to a suitable host is less likely. Finally, bark on its own could carry the pest. There has been one record on veneer, for which it is assumed that *H. eruditus* would have infested already processed

material, and processed wood commodities may therefore also be a pathway (which is an unusual case among bark beetles).
*H. eruditus* appears to attack mostly small-diameter plant material, including branches, seedlings, leaf petioles and twigs, and plants for planting could therefore be a main pathway. It could also be associated with cut branches of non-coniferous woody plants. It has been mentioned in association with fruits (including pods, coffee berries, chestnut etc., but this seems to relate to old fallen fruit) and various material (which it could contaminate).
Due to its large host range, and frequent new host records, all woody deciduous plants may be considered as potential hosts, as well as the known coniferous and herbaceous hosts.
Finally, *H. eruditus* is an inbreeder, which is favourable to entry and establishment.

*Summary of pathways (uncertain pathways are marked with '?'):*

- *wood (round or sawn, with bark, incl. firewood) of hosts*
- *bark of hosts*
- *wood chips, hogwood, processing wood residues (except sawdust and shavings)*
- *wood packaging material if not treated according to ISPM 15*
- *processed wood material (e.g. plywood, veneer)*
- *plants for planting (except seeds) of hosts*
- *cut branches of hosts*
- *host fruit?*
- *hitchhiking on various material?*

*Because of the large and uncertain host range, pathways may cover all non-coniferous species (as well as known coniferous and herbaceous hosts where relevant).*

*Spread* (following introduction, i.e. within EPPO region)
There is no specific information on natural spread, but females fly. *H. eruditus* may be associated with a wide variety of plant material exchanged between countries. Human-assisted pathways would contribute to spread.

**Establishment**
*H. eruditus* is already established in part of the EPPO region. The host range is not limiting as it may attack many species. *H. eruditus* appears overall to favour tropical and subtropical climates, although it thrives in the Mediterranean and in countries with hot summers and cold winters (North of Iran, Azerbaijan and Turkey). In the UK, it has not established outdoors. It may be that different cryptic species have different climatic requirements, but there are only few records from temperate areas to date. Therefore, establishment in the oceanic and temperate part of the EPPO region is considered less likely.

**Potential impact (including consideration of host plants)**
*H. eruditus* is highly polyphagous and may attack many plants and plant products in the EPPO region. There are references from the 1960s-80s on damage related to seedlings and transplants, i.e. implying a risk for nurseries and young plantations, and possibly hosts in the wild. However, the literature overall reflects little damage in its current distribution, including in EPPO countries. *H. eruditus* is now considered to be a complex of species, and it is not known if the death of seedlings and transplants reported from South-East Asia, may be due to one or several aggressive cryptic species (there is currently no evidence of this). Considering its wide host range, its abundance, wide distribution, and the fact that it attacks small material (seedlings, leaf petioles etc.), and may therefore be associated with plants for planting, *H. eruditus* may have already had numerous possible occasions to enter the EPPO region on plants for planting, which represents a huge trade. It is considered that impact may only occur if some aggressive cryptic species not yet present in the EPPO region are introduced from South-East Asia.

**Table 1. Distribution**
All records are from Atkinson (2018) except where a reference is given.

| | Reference |
|---|---|
| **EPPO region** | |
| Algeria | |
| France | |
| Georgia | |
| Israel | |
| Italy | Masutti, 1968 |
| Malta | Mifsud & Colonnelli, 2010 |
| Morocco | |
| Spain | |
| Turkey | Tuncer *et al.*, 2017 |
| UK | indoors, Turner and Beaver, 2015 |
| Uncertain: Azerbaijan | unpublished record |
| **Africa** | |
| Algeria | |
| Angola | |
| Azores | |
| Cameroon | |
| Canary Island | |
| Cote d'Ivoire | |
| Egypt | |
| Gabon | |
| Ghana | |
| Guinea | |
| Liberia | |
| Madagascar | |
| Morocco | |
| Nigeria | |
| South Africa | |
| Seychelles | |

| | Reference |
|---|---|
| Sierra Leone | |
| Tanzania | |
| Togo | |
| Uganda | |
| Zaire | |
| **Asia** | |
| Burma | |
| India | |
| Indonesia | |
| Iran | |
| Japan | |
| Malaysia | |
| Marquesas Isl. | |
| Philippines | |
| Sri Lanka | |
| Thailand | |
| Vietnam | |
| *Uncertain*: Taiwan | unpublished record |
| **North America** | |
| Canada (Ontario) | |
| Mexico | |
| USA (Alabama, California, Delaware, Dist. of Columbia, Florida, Georgia, Illinois, Indiana, Louisiana, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia, Hawaii).<br>*Uncertain*: Massachusetts, Nebraska | |

| | **Reference** |
|---|---|
| | unpublished records |
| **Central America** | |
| Costa Rica | |
| Guatemala | |
| Honduras | |
| Nicaragua | |
| Panamá | |
| *Uncertain*: El Salvador | unpublished records |
| **Caribbean** | |
| Cuba | |
| Dominica | |
| Guadeloupe | |
| Jamaica | |
| Nevis | |
| Puerto Rico | |
| Rep. Dominicana | |
| *Uncertain*: Bahamas, St. Vincent, Virgin Isl. | unpublished records |
| **South America** | |
| Argentina | |
| Brazil (Amapá, Bahia, Ceará, Goias, Mato Grosso do Sul, Paraiba, Pernambuco, Rio Grande do Sul, Santa Catarina, São Paulo) | Some states correspond to unpublished records in Atkinson, 2018 |
| Colombia | |
| Ecuador | |
| Peru | |
| Trinidad and Tobago | |
| Venezuela | |
| Uncertain: Guyana, Venezuela | unpublished records |
| **Oceania** | |
| Australia (New South Wales). *Uncertain*: Queensland | unpublished record |
| Cook Islands | |
| Fiji | |
| Micronesia | |
| New Caledonia | |

**Table 2.** Host genera in Atkinson (2018)

| Family | Genus | Family | Genus | Family | Genus |
|---|---|---|---|---|---|
| Acanthaceae | *Avicennia* | Cornaceae | *Cornus* | Lamiaceae | *Gmelina* |
| Altingiaceae | *Liquidambar* | Cucurbitaceae | *Lagenaria* | Lamiaceae | *Tectona* |
| Anacardiaceae | *Astronium* | Cucurbitaceae | *Luffa* | Lauraceae | *Persea* |
| Anacardiaceae | *Mangifera* | Cucurbitaceae | *Melothria* | Lecythidaceae | *Eschweilera* |
| Anacardiaceae | *Rhus* | Cucurbitaceae | *Schizocarpum* | Lecythidaceae | *Gustavia* |
| Anacardiaceae | *Spondias* | Ebenaceae | *Diospyros* | Magnoliaceae | *Liriodendron* |
| Anacardiaceae | *Toxicodendron* | Euphorbiaceae | *Croton* | Magnoliaceae | *Magnolia* |
| Annonaceae | *Annona* | Euphorbiaceae | *Hura* | Malpighiaceae | *Byrsonima* |
| Annonaceae | *Asimina* | Euphorbiaceae | *Jatropha* | Malvaceae | *Ceiba* |
| Apocynaceae | *Plumeria* | Euphorbiaceae | *Mabea* | Malvaceae | *Quararibea* |
| Apocynaceae | *Thevetia* | Euphorbiaceae | *Manihot* | Malvaceae | *Apeiba* |
| Apocynaceae | *Sarcostemma* | Euphorbiaceae | *Ricinus* | Malvaceae | *Gossypium* |
| Aquifoliaceae | *Ilex* | Fabaceae | *Caesalpinia* | Malvaceae | *Guazuma* |
| Arecaceae | *Cocos* | Fabaceae | *Delonix* | Malvaceae | *Luhea* |
| Asparagaceae | *Yucca* | Fabaceae | *Senna* | Malvaceae | *Theobroma* |
| Betulaceae | *Alnus* | Fabaceae | *Tamarindus* | Malvaceae | *Tilia* |
| Betulaceae | *Carpinus* | Fabaceae | *Copaifera* | Melastomataceae | *Miconia* |
| Bignoniaceae | *Jacaranda* | Fabaceae | *Acacia* | Meliaceae | *Swietenia* |
| Bignoniaceae | *Tabebuia* | Fabaceae | *Albizzia* | Moraceae | *Artocarpus* |
| Bixaceae | *Bixa* | Fabaceae | *Inga* | Moraceae | *Brosimum* |
| Boraginaceae | *Cordia* | Fabaceae | *Pentaclethra* | Moraceae | *Castilla* |
| Burseraceae | *Bursera* | Fabaceae | *Pithecellobium* | Moraceae | *Cecropia* |
| Burseraceae | *Protium* | Fabaceae | *Andira* | Moraceae | *Ficus* |
| Burseraceae | *Tetragastris* | Fabaceae | *Cercis* | Moraceae | *Morus* |
| Capparaceae | *Crateva* | Fabaceae | *Gleditsia* | Moraceae | *Trophis* |
| Capparaceae | *Capparis* | Fabaceae | *Lonchocarpus* | Moringaceae | *Moringa* |
| Caricaceae | *Carica* | Fagaceae | *Quercus* | Musaceae | *Musa* |
| Celastraceae | *Euonymus* | Hamamelidaceae | *Hamamelis* | Myristicaceae | *Myristica* |
| Combretaceae | *Terminalia* | Juglandaceae | *Carya* | Myrtaceae | *Psidium* |
| Convolvulaceae | *Calonyction* | Juglandaceae | *Juglans* | Olacaceae | *Ximenia* |
| Convolvulaceae | *Ipomoea* | Juglandaceae | *Pterocarya* | Pinaceae | *Abies* |

| **Family** | **Genus** |
|---|---|
| Poaceae | *Olmeca* |
| Poaceae | *Saccharum* |
| Pteridaceae | *Acrostichum* |
| Rhamnaceae | *Ziziphus* |
| Rhizophoraceae | *Rhizophora* |
| Rosaceae | *Malus* |
| Rosaceae | *Prunus* |
| Rutaceae | *Citrus* |
| Rutaceae | *Esenbeckia* |
| Salicaceae | *Salix* |
| Sapindaceae | *Acer* |
| Sapindaceae | *Cardiospermum* |
| Sapindaceae | *Cupania* |
| Sapindaceae | *Melicoccus* |
| Sapindaceae | *Serjania* |
| Sapotaceae | *Pouteria* |
| Solanaceae | *Cestrum* |
| Theaceae | *Camelia* |
| Ulmaceae | *Celtis* |
| Ulmaceae | *Ulmus* |
| Vitaceae | *Vitis* |

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