



Department  
for Environment  
Food & Rural Affairs

## Rapid Pest Risk Analysis (PRA) for:

### *Ips hauseri*

June 2016

## Summary and conclusions of the rapid PRA

*Ips hauseri* is a bark beetle pest of spruce, pine and occasionally other conifers, which is native to mountainous regions of central Asia. Larvae and adults tunnel in the bark and, in high numbers, can kill their host trees. Like most bark beetles, they prefer to colonise stressed or dying trees, but in times of outbreak, healthy trees are also attacked.

### Risk of entry

All of the pathways assessed are covered by legislation in the EU Plant Health Directive, which prohibits some commodities and contains requirements designed to reduce the risk of entry of pests such as *I. hauseri* on others.

Entry was assessed as **unlikely** with **medium confidence** on **wood packaging material** (WPM). All WPM from outside the EU should have been treated for wood pests, and these measures will reduce the number of viable beetles able to travel on this commodity. Additionally, *I. hauseri* does not appear to be a species which is commonly moving in

trade. Entry on all the other pathways considered was **very unlikely**: on **wood as such**, this judgement was made with **medium confidence**. For the pathways of **cut branches** (including Christmas trees), **hitchhiking**, **wood chips/bark** and **plants for planting**, the judgements of **very unlikely** were made with **high confidence** as the likelihood of association of the pest with each pathway is considered very small.

## Risk of establishment

Establishment **outdoors** is considered **unlikely**, as the UK summer temperatures are considered too cool for optimal development when compared to the daytime summer temperatures which are likely to be experienced in the mountainous areas of this beetle's native range. However, this judgement is made with **low confidence** as climate data from mountainous regions are scarce, and some literature suggests that the UK would be suitable for the establishment of *I. hauseri*.

Establishment in **protected cultivation** is considered **very unlikely** with **high confidence**, as suitable hosts are not commonly grown in these areas.

## Economic, environmental and social impact

In the current area of distribution in central Asia, impacts are assessed as **large** because *I. hauseri* can be a primary pest of coniferous trees, as well as attacking trees stressed by factors such as drought, or those damaged by high winds. However the assessment is made with **low confidence**, as it is unclear how much of the impacts are due to *I. hauseri* alone and how much due to cumulative impacts with the stress factors and other tree pests.

All potential impacts (economic, environmental and social) in the UK are assessed as **small**, though with **low confidence**. This is because it is unclear how suitable the UK climate will be for the beetle to build up to damaging numbers, and precipitating factors for outbreaks such as large areas of wind-felled trees or severe drought seem less likely in this country than in the native range. One major cause of uncertainty over the potential impacts in the UK, in addition to the question of climatic suitability, is the suitability of European larch as a host: if *I. hauseri* is able to attack larch species grown in the UK, then trees affected by *Phytophthora ramorum* might enable *I. hauseri* to build up high population levels.

## Endangered area

It is unclear if any part of the UK is at risk from damaging populations, but if these were able to occur, then *Pinus sylvestris* plantations (and perhaps those of other conifers) susceptible to wind damage or other stresses are most at risk. If European larch is a suitable host, areas of woodland affected by *P. ramorum* may also be vulnerable.

## Risk management options

Continued exclusion is considered most appropriate for this pest. As *I. hauseri* is cryptic, largely living under the bark of trees, and would be present in the wider environment, outbreaks would be difficult to control. If it were to become established, chemical control options are limited and good plantation health and silvicultural practices are more likely to limit the impacts of this beetle.

## Key uncertainties and topics that would benefit from further investigation

The suitability of the UK climate for the establishment of damaging populations.

Whether *I. hauseri* has fungal associates, and if so, how effective these organism(s) are at colonising the bark of European conifer species. Additionally, if there are fungal associates and they are able to colonise European hosts, whether these fungi could transfer to other bark beetle species already present in the UK, and alter the pest/host dynamic.

Given *I. hauseri* has been able to increase its host range from *Picea schrenkiana* to other conifers including *Pinus sylvestris*, there are a number of other UK conifer species which might be suitable hosts and at risk of damage from this pest. The host status of European species of larch is a major uncertainty, as, if the pest is able to develop on these, then there is a possibility of cumulative impacts on trees attacked by *P. ramorum*.

How widely distributed this species is in China, and if it is present in Turkey.

Quantified details on impacts: much of the available literature is rather general, or quite dated.

## Images of the pest

Drawings of the larval tunnels and the adult are available in the datasheet by EPPO (2005) or in Kimoto and Duthie-Holt (2004). A photograph of the adult is available here <https://www.zin.ru/animalia/coleoptera/eng/ipshausk.htm>

**Is there a need for a detailed PRA or for a more detailed analysis of particular sections of the PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.**

No	<input checked="" type="checkbox"/>			
Yes	<input type="checkbox"/>	PRA area: UK or EU		PRA scheme: UK or EPPO

Though there are many uncertainties remaining in this PRA, these are due to the lack of data, such as details about much of the pest’s biology including the potential host range, and the difficulties of comparing temperatures in the native range, which consists of mountainous regions in continental climate (and for which few climate data are available) with the maritime climate of the UK. Therefore, a more detailed PRA will not help to resolve these uncertainties until such time as more primary research on this pest has been carried out.

**Given the information assembled within the time scale required, is statutory action considered appropriate / justified?**

Yes  Statutory action
                         
 No  Statutory action

Though the potential impacts in the UK have a great deal of uncertainty associated with the judgement, there is a potential for damage to coniferous trees. As *I. hauseri* can be a primary pest of conifers, and its impact has been compared to *Ips typographus* (EPPO, 2005) (which the UK has a protected zone against), statutory action against *I. hauseri* is considered appropriate, and indeed is required due to its listing in Annex IIAI in the EU Plant Health Directive 2000/29/EC (under the category of “non-European Scolytidae spp”).

# Stage 1: Initiation

## 1. What is the name of the pest?

*Ips hauseri* Reitter (Coleoptera: Cucurlionidae: Scolytinae).

English common names include Kyrgyz mountain engraver or Hauser's engraver.

*Ips ussuriensis* Reitter was synonymised with *I. hauseri* by Mandelshtam (2002).

Previously, the Scolytinae was considered to be a family in its own right (Scolytidae), but it has now been included as a specialised subfamily within the Cucurlionidae (weevils).

## 2. What initiated this rapid PRA?

*Ips hauseri* is a pest recommended for listing by EPPO (on the A2 list), and as such it fulfils the criteria for addition to the UK Plant Health Risk Register<sup>1</sup>. When the Risk Register entry was created, it suggested that parts of the UK could potentially be at risk from establishment of this pest, following information published in Vanhanen *et al.* (2008). This PRA was requested to further investigate the potential climatic suitability of parts of the UK for *I. hauseri*, and hence the potential impacts this beetle may have here.

## 3. What is the PRA area?

The PRA area is the United Kingdom of Great Britain and Northern Ireland.

# Stage 2: Risk Assessment

## 4. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC<sup>2</sup>) and in the lists of EPPO<sup>3</sup>?

While the distribution of *I. hauseri* includes a limited part of Russia, it is not present in the European part of Russia. As *I. hauseri* is associated with conifers, and is not found in Europe, it is therefore covered by the listing in Annex IIAI for "non-European Scolytidae spp." on conifer plants for planting over 3 m in height, conifer wood with bark and conifer bark alone.

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<sup>1</sup> <https://secure.fera.defra.gov.uk/phiw/riskRegister/>

<sup>2</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF>

<sup>3</sup> <https://www.eppo.int/QUARANTINE/quarantine.htm>

It is also on the EPPO A2 list of pests recommended for regulation.

## 5. What is the pest's current geographical distribution?

*Ips hauseri* is found in mountainous regions of central Asia.

Table 1: Distribution of <i>Ips hauseri</i> (unless otherwise stated, the source is EPPO, 2005)	
North America:	No records
Central America:	No records
South America:	No records
Europe:	No records
Africa:	No records
Asia:	Kazakhstan Kyrgyzstan Russia (south central Russia only) Tajikistan China (Ciesla, 2011; Cognato, 2015) (Xinjiang: Tien Shan mountains only (CABI, 2015))
Oceania:	No records

Two additional geographical records were found in the literature, but have not been included in Table 1. These were both found in reviews and not in primary literature. In these summaries of information, the two regions under discussion were included as part of a list with no further details. Cited references for the distribution lists were followed up as far as possible, but the original sources could not be found in the time available. Thus these two records are not included in Table 1, nor considered in the remainder of this PRA, though if the source information were to be located in future, elements of this PRA would need to be re-visited. In China, *I. hauseri* is reported to be in Jilin in the east by Cognato (2015). *Ips hauseri* is also reported to be in Turkey (region unspecified) (based on summary information provided in Ciesla (2011); Cognato (2015); and Kimoto and Duthie-Holt (2004)). However, these two records are clearly a source of uncertainty, as if *I. hauseri* is indeed found in eastern China and Turkey, this would expand its known range considerably and increase the risk of entry to the UK, especially if it were also present in provinces and countries between those listed in Table 1 and eastern China and/or Turkey.

Though the name of *I. ussuriensis* (now synonymised with *I. hauseri*) could suggest association with the Ussuri region in the far east of Russia, Mandelshtam (2002) states that the type locality of *I. ussuriensis* is in the Western Sayan region, in south central Siberia, and that it has never been collected in the Ussuri region.

## 6. Is the pest established or transient, or suspected to be established/transient in the UK/PRA Area?

There are no records of *I. hauseri* in the UK, either as interceptions or in the wider environment.

## 7. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK/PRA area?

*Ips hauseri* has been recorded on various species in the Pinaceae. Its main host is the Asian spruce *Picea schrenkiana* in Kyrgyzstan, but since other species of conifer started being grown there in the 1930s, it has also been recorded on *Pinus sylvestris* (Scots pine), *P. pallasiana* and *Larix sibirica* (Siberian larch) (EPPO, 2005).

Of the recorded hosts, *P. sylvestris* is very widely distributed in the UK (BSBI maps, 2016). It is grown as a forestry tree as well as being of environmental importance in native pinewoods, for example the Caledonian pine forest in Scotland. The other recorded hosts of *I. hauseri* are not commonly grown in the PRA area, but given it is able to feed on hosts in at least three coniferous genera, it is possible that other species, including conifers grown widely in the UK, are at risk.

## 8. What pathways provide opportunities for the pest to enter and transfer to a suitable host and what is the likelihood of entering the UK/PRA area?

All life stages of *I. hauseri* are found in galleries in the bark (Parfentev [Парфентьев], 1951). While adults may leave their original host to locate new trees, they spend much of their time feeding inside the bark of their hosts, and they typically overwinter under the bark (EPPO, 2005). No information could be found for *I. hauseri* feeding anywhere other than in the bark, and thus if hosts are imported completely without bark, the chances of this pest being associated with the commodity appear to be very small. There are a number of EU regulations covering conifer wood and bark. These include measures in Annex IIAI, which state that non-European wood and bark must be free from non-European Scolytinae, as well as requirements in Annex IV (which are fully detailed in the discussion of individual pathways below). As *P. sylvestris* is very widely distributed in the UK and *I. hauseri* can fly, location of a suitable host in this country is not considered a limiting factor. *Ips hauseri* does not appear to be commonly moving in trade: Haack and Rabaglia (2013) do not record it in their list of US Scolytinae interceptions from 1984 to 2008, and Kulinich and Orlinskii (1998) also did not record it as a species that has been intercepted by the USDA. There are no European interceptions of this species recorded on EUROPHYT (searched 3 May 2016).

## Wood packaging material

Brockerhoff *et al.* (2006) examined 1505 New Zealand interception records of Scolytinae between 1950 and 2000 (that is, before international measures were agreed for the treatment of wood packaging material (WPM)), and found that over 73% were associated with dunnage, crating and pallets. ISPM 15 was approved as an international standard in 2002, and individual countries adopted it in the years after that. In the USA, Haack *et al.* (2014) found that pre-ISPM 15, infestation rates of WPM were 0.17–0.25%, while post-ISPM 15, WPM infestation rates fell to 0.11–0.12% (as measured on WPM marked as compliant with the standard). One factor which may increase the probability of the association of *I. hauseri* with wood used for WPM is that the wood used for such purposes tends to be of poorer quality. If the tree has suffered severe damage from *I. hauseri* (or any other pest or pathogen), the wood may not be suitable for high-value end use, but instead be used for WPM.

All WPM (dunnage is now included within the definition of wood packaging material) entering the EU from third countries (except Switzerland) must be treated according to the International Standards for Phytosanitary Measures (ISPM) 15. According to ISPM 15, wood used in packaging must be free from bark (though small areas of bark are allowed to remain: either less than 3 cm in width but of any length; or more than 3 cm in width, but with a total surface area of less than 50 cm<sup>2</sup>), and must also have been either heat-treated or fumigated with methyl bromide. Thus, WPM from all parts of the range of *I. hauseri* should have been treated in a way designed to kill pests, including Scolytinae. The removal of most of the bark will also decrease the chances of *I. hauseri* being associated with WPM as there is no evidence that it tunnels into any part of the wood other than bark. However, as small areas of bark are permitted, the risk is not entirely eliminated: an egg or larva may not be able to complete its lifecycle, but a pupa may be able to complete development and the resultant adult, or adult associated with the bark, may be able to locate new hosts. This assumes that the heat or fumigation treatment did not kill the insects. There is also evidence that ISPM 15 does not fully remove the risk of live pests travelling on WPM, especially in cases of non-compliance, though it does reduce the likelihood (for example, Haack *et al.*, 2014; Zahid *et al.*, 2008).

EUROSTAT data (extracted 17 June 2016) does not show any import to the UK of wood packaging material (commodity code 4415) from Kyrgyzstan, Kazakhstan or Tajikistan between 2000 and 2015 inclusive. There were imports from Russia and China during this period, with large volumes from China, but *I. hauseri* is only present in a very limited area of both countries, and, additionally, not all WPM will be made up of host species of *I. hauseri*.

Overall, the pathway of wood packaging material is considered unlikely, with medium confidence. While Scolytinae as a subfamily are frequently recorded in association with WPM, requirements in ISPM 15 will reduce (but not eliminate) the risk of entry. However, there is some evidence of non-compliance with these standards in some WPM. Additionally, *I. hauseri* is not apparently a species that is commonly moving in trade.

## Wood (as such)

This pathway includes all forms of timber not used as packaging, including round wood, squared wood and even sawn planks, though the chances of any areas of bark remaining on the latter two examples are very small, and *I. hauseri* is not apparently associated with any part of the wood other than bark. Data from Brockerhoff *et al.* (2006) on New Zealand Scolytinae interceptions (pre-ISPM 15) over a 50-year time period suggest that sawn timber and logs are a less common source of entry than WPM, with sawn timber accounting for just over 17% of the interceptions, and logs just over 3%.

As well as the requirements against “non-European Scolytidae spp.” in Annex IIAI of the EU Plant Health directive 2000/29/EC, conifer wood from the native range of *I. hauseri* must meet requirements set out in Annex IV. Wood from Russia and Kazakhstan is listed separately from wood from Kyrgyzstan and Tajikistan, with wood from Russia or Kazakhstan having an additional option in the requirements, this being for wood to be from an area known to be free from specified pests, including “Scolytidae spp. (non-European)”. Options common to all four countries include various treatments for the wood, including kiln drying, heat treatment, fumigation or chemical impregnation. However, one of the requirements, which could be applied in isolation without the need for any other measure to wood from all origins of *I. hauseri*, is merely that the wood is bark free and free from *Monochamus* spp. grub holes, which are defined as holes greater than 3 mm across. The maximum width of an *I. hauseri* gallery is 3 mm (EPPO, 2005), with most being 2.5 mm (Parfentev [Парфентьев], 1951). While *I. hauseri* is very unlikely to be associated with completely bark-free wood, wood with emergence holes could be legally imported, as long as none of the holes exceeded 3 mm in diameter. Wood with active larvae which had not yet emerged (and thus was showing no emergence holes, of whatever size) could also be imported. Wood from China, if from an area where *Bursaphelenchus xylophilus* (pine wood nematode) is known to occur, must be treated according to one of three options; if from outside the area where *B. xylophilus* occurs, then the requirements are the same as those for Kyrgyzstan or Tajikistan.

Additionally, Annex IVB gives the UK, as a whole or in part, protected zone status against six other Scolytinae species in coniferous wood imports (summarised in Table 2), and these may also help to mitigate against the entry of *I. hauseri*. The requirements of these protected zones are that the wood must be without bark, or to have come from an area free of the species in question, or to have been kiln-dried. Four of the Scolytinae listed in the UK PZ requirements have been reported from areas where *I. hauseri* has also been recorded, but the finer details of the distribution are unclear and it might be possible for a country to declare an area of freedom from the Scolytinae listed in Annex IVB, and these areas of freedom might include locations where *I. hauseri* occurs. None of the six Scolytinae the UK has a protected zone against are reported to occur in Kyrgyzstan.

Debarking does not completely remove the risk, as isolated individuals may survive under fragments of bark, though it will reduce the number of beetles present, and thus significantly decrease the risk as eggs and larvae are unlikely to be able to complete development, and only pupae and adults present in bark fragments would be capable of

completing development and/or transfer to a new host. Squared wood will pose less of a risk than round wood, as the outer parts of the wood will largely have been removed under this treatment. Thus, squared wood is much less likely to contain the pest.

**Table 2.** Scolytinae included in the UK Protected Zones (PZ) in Annex IVB of the EC Plant Health Directive, and details of their distribution where it overlaps with *Ips hauseri*.

Species of Scolytinae listed in UK PZ requirements	Part of UK included in PZ	Countries where distribution potentially overlaps with <i>I. hauseri</i> (Source: EPPO GD <sup>4</sup> )	Status in named countries according to EPPO GD
<i>Dendroctonus micans</i>	Northern Ireland	Russia (Western Siberia, which includes the Altai Krai region)	Present, no details
<i>Ips amitinus</i>	All UK	None	–
<i>Ips cembrae</i>	Northern Ireland and Isle of Man	None	–
<i>Ips duplicatus</i>	All UK	Kazakhstan	Present, no details
		Russia (Western Siberia)	Present, no details
<i>Ips sexdentatus</i>	Northern Ireland and Isle of Man	Russia (Western Siberia)	Present, no details
<i>Ips typographus</i>	All UK	Tajikistan	Present, few occurrences
		Russia (Western Siberia)	Present, restricted distribution

Data from EUROSTAT (extracted 3 May 2016) indicate that, since 2000, the UK has not imported coniferous wood from Kazakhstan, Kyrgyzstan or Tajikistan. On average between 2000 and 2015, imports of various coniferous wood commodities from Russia to the UK have been around 300,000 tonnes, ranging from as little as 155,000 tonnes in 2012 to as much as 523,000 tonnes in 2005 (EUROSTAT data, extracted 3 May 2016). However, these data are for the Russian Federation as a whole, and *I. hauseri* is only present in a small part of the country. Additionally, many of the categories are for coniferous wood in general, or for species that are not the main hosts of *I. hauseri*, and thus these trade data will represent a substantial overestimate of the trade in wood from Russia that could potentially be infested with *I. hauseri*. As *I. hauseri* is likely only to be present in a very small, mountainous area in western China, data from China were not included in the analysis as only a very small fraction of the wood is likely to be from areas known to be infested with the pest.

<sup>4</sup> <https://gd.eppo.int/>

In summary, the volume of trade in coniferous wood that might carry *I. hauseri* is likely to be quite small, especially when no evidence was found that this species is found in parts of wood other than bark. But, while there are a number of requirements in the Plant Health Directive which apply to coniferous wood imports from countries where *I. hauseri* is known to occur, it is unclear if they will be fully effective in preventing entry. Overall, entry on wood is considered very unlikely but with medium confidence.

## Wood chips, bark and other wood parts

Wood chips are often composed of lower quality wood, and thus may be more likely to contain the pest. As the adult beetles are very small (less than 5 mm in length) (EPPO, 2005), they may survive the chipping process, as would other life stages such as pupae. Chipping is likely to reduce the viable population (for example, by increasing the surface area of the wood and so exposing the insects to increased desiccation), and if the wood chip consignment is composed of mixed species, then the viable numbers will be even fewer as the beetle will only be present in wood chips made of its host species.

Coniferous wood chips from the native range of *I. hauseri* are included in Annex IV requirements in the Plant Health Directive, which states that the wood must either be certified as being free from pests including “non-European Scolytidae spp.”, or have been produced from de-barked wood, or have undergone specified drying, heat or fumigation treatments. As well as the requirements against “non-European Scolytidae spp.” in Annex IIAI, bark from non-European conifers must either have been fumigated or heat-treated, as well as meeting requirements around the timing of the flight period of *Monochamus* spp., (longhorn beetles). Therefore, all woodchips or bark imports have requirements which are designed to reduce the risk of entry of non-European Scolytinae (including *I. hauseri*).

Twenty-three thousand tonnes of coniferous woodchips were imported to the UK in 2012 with a stated origin of the Netherlands, though there was a suspicion that these were large consignments from elsewhere that were merely split into smaller lots for onward shipment in the Netherlands (Hogan, 2013). Wood chips have been stored outside once at their destination, thus giving any surviving pests more time to complete their development and locate suitable hosts (Økland *et al.*, 2012). Coniferous wood chips are not currently imported into the UK in high volumes, but with the increasing use of biomass for power generation, this amount could increase in future years. One factor that may be helping to keep imports low is that exporters are apparently unwilling to use heat treatments on a product designed to be burnt at its destination. No data on bark imports were available, though it is apparently becoming increasingly common (at least in mainland Europe) for very large pieces of bark to be imported for use as mulches in amenity sites.

Based on the current import levels, consignments would need to originate from the pest’s current distribution, consist at least in part of a host species, contain bark, and consist of enough individuals to form a breeding population. Therefore, this pathway is given an overall rating of very unlikely, with high confidence, but if trade in coniferous wood chips were to increase, this rating would require revision.

## Plants for planting

*Ips hauseri* usually attacks trees over 5-6 cm in diameter, though in times of outbreak it may attack smaller trees (EPPO, 2005). Parfentev [Парфентьев] (1951) also states that *I. hauseri* is absent on young trees or smaller branches. Most trees moved in trade will be relatively young, and so seem less likely to be attractive to beetles. Young trees will also have fewer rough and loose pieces of bark which adults may hide under. Therefore, the likelihood of association of *I. hauseri* with young trees in the country of origin is considered to be very low.

As well as the requirements against “non-European Scolytidae spp.” in Annex IIAI (for trees over 3 m in height), Annex III prohibits the import of any plants of any species in the genera *Picea*, *Pinus* or *Larix*, other than seeds, from non-European countries. As *I. hauseri* is not known to be present in Europe, this legislation mitigates against entry. While there is a possibility of there being additional coniferous host genera, given *I. hauseri* has been able to utilise new hosts in the past, it should be noted that the Annex III listing does include a number of other potential hosts, such as *Abies* or *Pseudotsuga*. Additional measures are included in Annex IVAI, namely that all non-European conifer plants (other than seeds) must have been produced in nurseries and conifers over 3 m in height must be from a place of production that is free from “Scolytidae spp. (non-European)”. While some of the host genera may be grown as bonsai, no derogations are currently in place allowing the import of bonsai trees from any country where this pest is present. As *I. hauseri* is present in a part of Russia, there is a small risk that plants may be traded internally from the Altai Krai region to the European part of Russia, and thus would be allowed into the UK (or other EU member state) as “European” plants.

Overall, this pathway is considered very unlikely with high confidence, as trade in the known host genera is banned and the pathway via European Russia is not considered to be a significant source of risk.

## Cut branches (including Christmas trees)

As these will be imported with bark, all life stages of *I. hauseri* could potentially be associated with these commodities. Cut branches and Christmas trees will not be treated to eliminate insects in the wood, and thus populations of viable insects could arrive on these products. As these commodities have a limited lifespan, immature *I. hauseri*, unless development was almost complete, may not be able to finish developing if the original wood becomes unsuitable, and would not be able to locate a new host. However, if adults were present (or if adults emerged from pupae), they would be capable of flying off and potentially locating new hosts. However, the Annex III requirements which prohibit the import of any plants of any species in the genera *Picea*, *Pinus* or *Larix* from non-European countries, apply to cut branches and Christmas trees: as they retain their foliage, these are included under the definition of “plants” in the legislation. Therefore, this pathway is assessed as very unlikely with high confidence, as though there is a risk, the commodities are prohibited.

## Hitchhiking

Individual adults may survive transportation on assorted non-wood products, with their small size meaning that the beetles would be difficult to detect either pre-export or at entry. Upon arrival, either a gravid (mated) female will need to locate a suitable host in an appropriate timeframe, or several individuals will need to locate both a suitable host and each other in order to form a breeding population. Also, *I. hauseri* are usually found in association with their hosts. If they were associated with other commodities, due to their small size they would be vulnerable to desiccation during transport, and thus are less likely to survive. Overall, hitchhiking is considered very unlikely, with high confidence.

*Wood packaging material*      Very unlikely       Unlikely       Moderately likely       Likely       Very likely

*Confidence*      High Confidence       Medium Confidence       Low Confidence

*Wood as such*      Very unlikely       Unlikely       Moderately likely       Likely       Very likely

*Confidence*      High Confidence       Medium Confidence       Low Confidence

*Wood chips, bark, etc.*      Very unlikely       Unlikely       Moderately likely       Likely       Very likely

*Confidence*      High Confidence       Medium Confidence       Low Confidence

*Plants for planting*      Very unlikely       Unlikely       Moderately likely       Likely       Very likely

*Confidence*      High Confidence       Medium Confidence       Low Confidence

*Cut branches*      Very unlikely       Unlikely       Moderately likely       Likely       Very likely

*Confidence*      High Confidence       Medium Confidence       Low Confidence

*Hitchhiking*      Very unlikely       Unlikely       Moderately likely       Likely       Very likely

Confidence      High Confidence       Medium Confidence       Low Confidence

## 9. If the pest needs a vector, is it present in the UK/PRA area?

This is a free-living insect, and does not require a vector.

## 10. How likely is the pest to establish outdoors or under protection in the UK/PRA area?

Establishment outdoors is unlikely to be limited by host availability. While the native host, *P. schrenkiana*, is not commonly grown in the UK (there are no records of this species in BSBI maps (2016), and only one supplier on the Royal Horticultural Society's Plant Finder <https://www.rhs.org.uk/plants>), in Kazakhstan *I. hauseri* has successfully used *P. sylvestris*, a species of pine native to, and found throughout, the UK.

*Ips hauseri* is found in mountainous regions (at altitudes between about 1200 m and 3200 m (CABI, 2015; EPPO, 2005)), in countries which have a continental climate, i.e. hot summers and cold winters. Mountainous regions also have hotter day time temperatures but colder nights, than lower-altitude regions. Mountainous regions are very difficult to model climatically, due to the greater variation in temperatures combined with few climate monitoring stations in these types of locations. In its native range, *I. hauseri* is likely to experience extremes of both heat and cold, though living inside the bark will provide some buffering. In contrast, the UK has a maritime climate, which is overall mild and wet, with comparatively cool summers, warm winters and much less variation between maximum and minimum temperatures than countries in which *I. hauseri* is present.

Point data from the World Weather Information service (<http://worldweather.wmo.int/>) are available for selected locations, though the data between different countries may not be directly comparable. In Almaty, Kazakhstan (altitude around 800 m, thus lower than the altitude *I. hauseri* is found at), the mean maximum July temperature over a 30-year period (date range unknown) was 29.7°C (mean minimum 17.6°C). This contrasts with Ullapool (sea level in Scotland), which had mean maximum July temperatures of 17.2°C (mean minimum 9.1°C) between 1981 and 2010, while on the south coast of England, Southampton had mean maximum July temperatures of 22.4°C (mean minimum 13.7°C), again between 1981 and 2010. In January, Almaty had a mean maximum temperature in January of -1.3°C (mean minimum -11.1°C), Ullapool had a mean maximum of 5.1°C (mean minimum -1.2°C) and Southampton had a mean maximum of 8.4°C (mean minimum 2.9°C). Thus, even using average monthly values which do not show daily variation in temperature, the UK is cooler in summer and warmer in winter when compared to Almaty. Additionally, given that high-altitude areas such as those inhabited by *I. hauseri* typically have hot days and cool nights, the maximum daily temperatures experienced by

the beetle in its native range are likely to be higher than the values for Almaty given here. However, *I. hauseri* is very likely to be capable of overwintering in all parts of the UK.

Work by Vanhanen *et al.* (2008), using CLIMEX to analyse the potential distribution of *I. hauseri* in Europe, suggests that most parts of the UK are climatically suitable for the establishment of this pest. However, the analysis by Vanhanen *et al.* (2008) was not based on laboratory studies (for example, to determine the thermal requirements for development), as these are not available. Instead, bioclimatic matching was done from the existing species range, and even this was only done at a subnational level. For example, the whole of central Russia is included, right up to the Kara Sea in the north, instead of only the Altai Krai region. In the sensitivity analysis carried out on the CLIMEX model, *I. hauseri* was noted as very sensitive to changes in the diapause parameters (including both induction and termination temperatures, though not day length), with a small change in input parameters leading to a large change in the score for climatic suitability. It was also moderately sensitive to changes in the lower development temperature parameters used (Vanhanen *et al.*, 2008). This suggests that the maps showing that the UK is at risk from *I. hauseri* have a lot of uncertainty associated with them. In addition, Vanhanen *et al.* (2008) note that *I. hauseri* has relatively southerly in distribution within central Asia. Therefore, it is possible that the UK summers (or, at a minimum, the summers in much of Scotland where pine is grown) will not be warm enough for optimum development of this pest, especially given the caveats listed earlier around the differences in summer and winter temperatures between mountainous central Asia and the UK.

Establishment outdoors is rated unlikely. Confidence in this assessment is low, due to the uncertainties inherent in matching climatic variables between countries rather than working from thresholds determined from the insect itself, and the sensitivity of *I. hauseri* to several aspects of the CLIMEX modelling. Whether or not the species is present in Turkey or in a larger area of China also adds to the low confidence rating.

Establishment under protection is considered very unlikely with high confidence, as suitable hosts are not commonly grown in such conditions.

<i>Outdoors</i>	Very unlikely <input type="checkbox"/>	Unlikely <input checked="" type="checkbox"/>	Moderately likely <input type="checkbox"/>	Likely <input type="checkbox"/>	Very likely <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		
<i>Under Protection</i>	Very unlikely <input checked="" type="checkbox"/>	Unlikely <input type="checkbox"/>	Moderately likely <input type="checkbox"/>	Likely <input type="checkbox"/>	Very likely <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input checked="" type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input type="checkbox"/>		

## 11. How quickly could the pest spread in the UK/PRA area?

No data are available on the natural flight capacity of *I. hauseri*. EPPO (2005) states that only limited dispersal through adult flight is possible, but this is not quantified. However, as the adults, while able to fly, do spend much of their time feeding inside the bark of their hosts, the length of time they spend externally will be limited, and hence their opportunities to fly will also be limited. The rate of natural spread is assessed as slowly, with medium confidence.

Spread in trade could be much faster. All life stages are cryptic, and are found either entirely or partially in the bark. Movement of timber within the UK is not subject to controls and thus this pest could potentially be spread through internal trade in the timber of host trees, assuming they are not stripped of bark, though the timber would have to be transported in a way that allowed larvae to complete development (if applicable), and adults to fly off and find new hosts. Rate of spread with trade is assessed as 'quickly', with high confidence as all life stages are cryptic.

<i>Natural Spread</i>	Very slowly <input type="checkbox"/>	Slowly <input checked="" type="checkbox"/>	Moderate pace <input type="checkbox"/>	Quickly <input type="checkbox"/>	Very quickly <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input checked="" type="checkbox"/>	Low Confidence <input type="checkbox"/>		
<i>With trade</i>	Very slowly <input type="checkbox"/>	Slowly <input type="checkbox"/>	Moderate pace <input type="checkbox"/>	Quickly <input checked="" type="checkbox"/>	Very quickly <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input checked="" type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input type="checkbox"/>		

## 12. What is the pest's economic, environmental and social impact within its existing distribution?

While most Scolytinae attack stressed or dying trees, *I. hauseri* is considered to be a primary pest which will attack (apparently) healthy trees (Kulinich & Orlinskii, 1998; Parfentev [Парфентьев], 1951). It is considered one of the most important pests of *P. schrenkiana* in its native range and attacks can reduce the vigour of the host, enabling other species to colonise it (EPPO, 2005). *Ips hauseri* can have two generations per year in the lower-altitude parts of its range, though only one above 2200 m, and it is known to be capable of increasing its populations levels very rapidly if a large number of stressed trees are available for colonisation (EPPO, 2005). It is reported to have caused nearly 50% mortality in drought stressed trees on south-facing slopes, but when the drought ended, the populations of *I. hauseri* declined again (Prutenskii and Romanenko 1954, in Mukhamadiev *et al.*, 2014). However, while *I. hauseri* can attack healthy trees, the resin filling the galleries often kills the beetles (CABI, 2015). Even if trees survive, they may produce less seed and wood (EPPO, 2005), with resulting impacts on forest regeneration

and timber value. *I. hauseri* became a serious pest on *P. sylvestris*, after this conifer was introduced to Kyrgyzstan in the 1930s (EPPO, 2005).

In the early summer of 2011, large areas of forest (several thousand hectares) were damaged by high winds in the Tian Shan mountains in Kazakhstan (Mukhamadiev *et al.*, 2014). Subsequently, populations of bark beetles increased, including *I. hauseri*, which is a dominant species in this region, as they were able to feed on the dead and dying trees. Mukhamadiev *et al.* (2014) used tree rings to try and identify other bark beetle outbreaks in the forest over the past 200 years, by looking for a sudden increase in growth of surviving trees – attributed to the death of neighbouring tree(s) reducing the competition for resources and enabling the survivors to flourish. Only a few stands showed patterns attributed to bark beetle outbreaks, and the overall conclusion was that most tree damage in this region has been local and mechanical in origin (e.g. avalanches), and that bark beetles have been a secondary cause of tree death (Mukhamadiev *et al.*, 2014). *Ips hauseri* is mentioned as being one of the dominant species in areas of forest damaged by wind (Temreshev [Темрешев] *et al.*, 2012).

Overall, like many forest pests, the impact of *I. hauseri* appears to be very high in times of outbreak populations, but at other times it probably persists at a low level causing little damage. Outbreak populations can be triggered by external factors which kill or stress trees, and this allows *I. hauseri* populations to build up. In times of outbreak, when healthy trees may be attacked, impacts in the native range are assessed as large. However, it is unclear how much damage is due to the wind/drought etc., how much to *I. hauseri* and how much other bark beetle species add to the impact of *I. hauseri*. Thus the confidence in this judgement is low.

<i>Impacts</i>	Very small <input type="checkbox"/>	Small <input type="checkbox"/>	Medium <input type="checkbox"/>	Large <input checked="" type="checkbox"/>	Very large <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		

### 13. What is the pest’s potential to cause economic, environmental and social impacts in the UK/PRA area?

As establishment in the UK is subject to some uncertainty, all the judgements made here are made with low confidence: if the pest is not able to establish or persists only at a very low population level, impacts will be low, but if the UK climate is more suitable, damage could be a lot higher. It is also unclear which species of UK conifer may prove to be suitable hosts. *Pinus sylvestris* is a known host, but *I. hauseri* also attacks Asian species of *Picea* and *Larix*, and, if able to feed on species grown in the UK, the potential for damage would increase.

It is unclear if the UK will be suitable for the build-up of damaging populations. UK forests are less likely than the forests in the mountains of central Asia to have large areas of trees damaged by wind, rockfalls and avalanches, and though drought may be a problem in

some areas some years, in general this is not a major issue for the UK, with 102 cases in Scotland and northern England between 1972 and 2006 (Green & Ray, 2009). However, drought is predicted to become more important as climate change alters the seasonality of rainfall as well as increasing temperatures, resulting in drier, warmer summers (Ray *et al.*, 2010). Therefore, even if establishment is possible, it is considered unlikely that the UK will have large areas of damaged trees which would enable outbreak populations of *I. hauseri* to occur. However, if European *Larix* species are suitable hosts, areas of larch forest affected by *Phytophthora ramorum* might be suitable for large populations of *I. hauseri*. *Picea sitchensis* (Sitka spruce) stressed by aphid attack might also be at risk from *I. hauseri*. Overall, the potential economic impact in the UK is considered to be small because of the unsuitability of the UK climate, but with low confidence.

Potential environmental and social impacts are assessed together, as *Pinus sylvestris* (a known host, commonly planted throughout the UK) is an important component of ancient woodlands, such as the Caledonian pine forest, which are important both environmentally and for recreational use. The effects on tree regeneration through reduced production of seeds may have environmental consequences for the forest, but also for species which feed on the seeds, including iconic species such as red squirrels or crossbills. Environmental and social impacts are both assessed as small, but with low confidence as the many uncertainties affect these impacts, too.

<i>Economic Impacts</i>	Very small <input type="checkbox"/>	Small <input checked="" type="checkbox"/>	Medium <input type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		
<i>Environmental Impacts</i>	Very small <input type="checkbox"/>	Small <input checked="" type="checkbox"/>	Medium <input type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		
<i>Social Impacts</i>	Very small <input type="checkbox"/>	Small <input checked="" type="checkbox"/>	Medium <input type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		

## 14. What is the pest's potential as a vector of plant pathogens?

*Ips hauseri* has not been recorded as a vector of any plant pathogens.

However, it should be noted that a number of other species in the Scolytinae do act as vectors, with many *Ips* species recorded as having fungal associates. Some examples of fungal associates in the genus *Ips* are: the introduced species *I. cembrae* vectoring *Ceratocystis laricicola* (Redfern *et al.*, 1987); the European and north Asian *I. typographus*

which was associated with 9 different species of ophiostomatoid fungi from 2 genera in a study in France (Viiri & Lieutier, 2004); and the North American *I. pini*, which is a vector of the fungus *Sphaeropsis sapinea* (Whitehill *et al.*, 2007). Therefore, in line with other species in the genus *Ips*, it is possible that *I. hauseri* may have fungal associates, but until this pest is further studied, this will remain an area of further uncertainty.

## 15. What is the area endangered by the pest?

It is unclear how climatically suitable the UK is for the development of *I. hauseri*, and it is unlikely that parts of this country have warm enough summers for damaging populations to develop. However, if *I. hauseri* was able to establish at levels which caused damage, then areas of stressed trees (especially those of the known host, *P. sylvestris*), or parts of the country where there is a high risk of wind damage to tree plantations, would be most at risk from this beetle. If *I. hauseri* is able to feed on larch species grown in the UK, areas around larch stands affected by *Phytophthora ramorum* may be at risk as the beetles build up their populations on the dead and dying trees. However, there is no evidence that UK populations of the introduced species *Ips cembrae* (which is strongly associated with larch) have increased, despite the availability of larch affected by *P. ramorum* (J. Webber, pers. com., June 2016).

## Stage 3: Pest Risk Management

### 16. What are the risk management options for the UK/PRA area?

#### Exclusion

All wood packaging material from third countries should have been treated according to measures outlined in ISPM 15. There is some evidence that these requirements are not always fully met, such as continuing interceptions of live pests in WPM from third countries.

As a non-European Scolytinae, the potential pathways for *I. hauseri* are reduced by measures in Annexes II, III and IV of the Plant Health directive 2000/29/EC covering wood, wood chips, cut branches and growing plants. However, an option in the measures on wood in Annex IV (1.5 (b) for wood from Russia and Kazakhstan, and 1.6 (a) for wood from Kyrgyzstan, Tajikistan and parts of China free from *B. xylophilus*) is currently targeted against the cerambycid genus *Monochamus* and not Scolytinae. Under this option, while the wood must be free from bark (which would greatly reduce the chances of *I. hauseri* being associated with such wood), grub holes less than 3 mm across are permitted. The holes created by *I. hauseri* are 3 mm or less in diameter. The likelihood of live insects being present in the wood is, however, very small for *I. hauseri*, as no evidence of this species tunnelling in the wood could be found, and it appears to be restricted to the bark.

## Eradication and containment

The Forestry Commission already carries out regular surveys for other non-native *Ips* species, including *I. amitinus*, *I. duplicatus* and *I. typographus*, as part of the UK Protected Zone requirements. These surveys target a number of plots, with these plots being selected on a risk-based approach, such as being located close to ports, etc. (Poulsom, 2015). There is thus a chance that an outbreak of *I. hauseri* could be detected at a relatively early stage if it occurred at one of these high risk sites, and it might be possible to eradicate or contain the population using measures similar to those outlined in the *I. typographus* contingency plan, including removal and destruction of infested and newly dead trees (Poulsom, 2015).

However, there is also the possibility that *I. hauseri* would be found in the wider environment if introduced, and as it is very cryptic at most stages of its life cycle, eradication and containment would be very difficult to achieve if the pest became established. Low level infestations would be difficult to detect without a specific survey, due to the concealed life cycle and specialist skills required to accurately identify this species. Thus, high numbers of the pest could occur before the infestation was detected, making eradication much less feasible.

Given the difficulty associated with eradicating or containing this organism, attention should be focused on excluding this pest.

## Non-statutory controls

The chemical control of bark beetles has a long history, but reviews of research on the efficacy have found that human intervention is usually one step behind the pest population and the expense of treatments is not justified by the benefits. Insecticides are not generally an option for large infestations of bark beetles in forests, because the immature stages are in the subcortical part of the trees and the adults are only exposed during dispersal (Schowalter, 2012). The keys to managing bark beetles are maintaining healthy, site-adapted tree species and adequate spacing between host trees, but this is not always possible over large areas especially following severe drought or storms. However, appropriate tree selection and stand thinning minimise the probability of environmental stress (Schowalter, 2012). There is very little published information about the control of *I. hauseri*, however the control measures reported for its native area include silvicultural measures (planting more resistant trees, the removal of infested trees and the use of trap trees) and treatments with insecticides and biopesticides (EPPO, 2005). If *I. hauseri* were to become a damaging pest in the UK, research would be needed to investigate appropriate management strategies.

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