Department
for Environment,
Food & Rural Affairs

Rapid Pest Risk Analysis (PRA) for:

Orchidophilus spp. (orchid weevils)

March 2026

Summary and conclusions of the rapid PRA

This rapid PRA shows:

Orchidophilus is a genus of weevils (Family: Curculionidae; Subfamily: Baridinae) that currently contains 6 species: *O. aterrimus*, *O. epidendri, O. eburifer, O. insidiosus, O. peregrinator,* and *O. ran*. They only feed and develop on species of orchids primarily in the subfamily Epidendroideae, consequently they have acquired the common name of orchid weevils. They are native to southeast Asia, including Indonesia and the Philippines, and species such as *O. aterrimus* and *O. peregrinator* have spread to other countries such as Australia and Hawaii. These weevils can cause significant damage to orchid plants due to the feeding of adults and development of larvae within the plant.

Likelihood of entry

Pathways for entry are limited to trade of orchid material, including plants for planting and cut flowers, foliage and branches. The pathway of plants for planting is rated as unlikely with medium confidence. The association of these species with orchid plants is likely and there is strong evidence of pest movement with trade. However, the volume of trade from countries with pest presence is small and the likelihood of transfer to an area capable of sustaining a population is thought to be low. The pathway of cut flowers, foliage and branches of orchids is rated as very unlikely with medium confidence. This pathway experiences a higher volume of trade from countries with pest presence. However,

association of orchid weevils is less likely as the pseudobulb is preferred for larval development, and transfer is not expected as cut foliage would be used primarily for retail.

Likelihood of establishment

Outdoor establishment is rated as unlikely with medium confidence. Due to the pest's current distribution in tropical countries, the UK climate is unlikely to support development. It is unknown whether native UK orchid species would be suitable hosts, as they lack the pseudobulb which is the preferred oviposition/development site. Under protection is rated as likely with medium confidence. There are many sites within the UK that could sustain a population of orchid weevils such as botanical gardens, national plant collections, and specialist growers/retailers. These sites would contain suitable orchid species and conditions suitable for pest development. Additionally, previous reports of outbreaks in botanical collections and orchid cultivation facilities highlights pest ability to develop under protection. However, these sites would likely maintain high biosecurity measures such as quarantining and inspection of new plants, which would limit the likelihood of introduction.

Economic, environmental and social impact

Economic impact is rated as small with medium confidence. Damage caused by orchid weevils, such as necrosis or flower streaking, is likely to result in a loss of marketable plants or flowers. This is likely to affect nurseries, garden centres, wholesalers and private sellers. Although an overview of the orchid market in the UK is not available. Economic impact is also likely from the methods used to control the weevil. Previous cases of control involved destruction of orchid plants and extended pesticide spray programmes, which would be costly.

Environmental impacts in the UK are rated as very small with medium confidence. Due to the unsuitability of the UK climate and absence of known orchid host species in the wider environment, damage is expected to be limited or negligible. Additionally, no environmental impacts have been reported from the pest's current range.

Social impacts are rated as very small with medium confidence. No social impacts have been reported from the pest's current range and tropical orchids have limited cultural importance to the UK. However, establishment of a population within a botanical garden could lead to public concern where orchid collections may be damaged or removed from public display.

Endangered area

The area endangered by this pest group is any protected structure containing a large number of orchid plants, including botanical gardens, national plant collections and large-scale growers/nurseries.

Risk management options

Exclusion is the most effective risk management strategy for *Orchidophilus* spp. While all plants for planting must be inspected prior to export, there are no specific requirements for orchid plants. Cut flowers of *Orchidaceae* originating from a country where *Thrips palmi* is present must be inspected prior to export although it is unknown whether signs of orchid weevils would also be identified. Exclusion from sites within the UK can be obtained by quarantining and inspection of orchid plants before introduction.

Eradication of orchid weevils is often achieved by sanitation and use of pesticides. Infested orchids should be removed and destroyed to prevent emergence of new adults, although, identification of infested orchids can be difficult as oviposition sites may be hard to spot. In some cases, destruction of the entire plot may be necessary. Contact pesticides should then be sprayed on the remaining orchids and in the surrounding area. Pesticides target the adult, as the immature stages are protected within the pseudobulb, therefore sprays should be done every two weeks for at least four months.

Key uncertainties and topics that would benefit from further investigation

This PRA is primarily based on the data presented by Prena (2008), as the majority of information of these pest species is provided by this paper. This causes some uncertainty due to a lack of different views or contradictory data, resulting in possible bias that cannot be identified. These issues have been mitigated by including data from other papers to incorporate more findings, increase accuracy and fill in certain knowledge gaps. However, there are still sections where information is lacking and uncertainties remain.

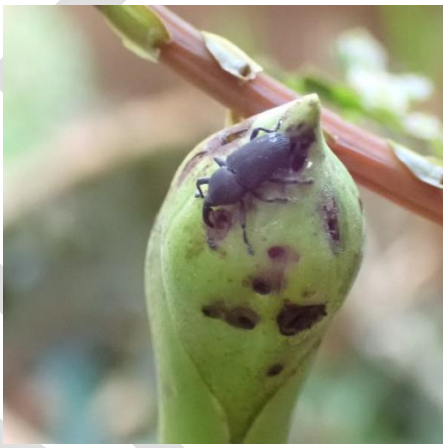
An area that would benefit from further investigation is the pest's capacity for natural spread. The introduction of orchid weevils to new areas is associated with movement of orchid plants, so their ability to spread naturally has not been explored. More information of flight capacity and rate of dispersal would be beneficial to predict potential spread within the UK.

As discussed in section 9 on pathways, it is difficult to estimate the volume of imported orchid material that may have been exposed to these pests. It is unknown how often orchids are moved through trading hubs and incorrectly labelled as EU origin. Additionally, internet trading of orchids is thought to be high-risk and relatively common. As this pathway is not properly regulated, the exact number of orchids being traded is unknown.

It is currently thought that UK species of orchids would be unsuitable as hosts due to the absence of a pseudobulb, which the weevils prefer for oviposition and development. However, this is not verified as no host studies have been conducted and it is unlikely the pest species would have come into contact with temperate orchid species. If orchid weevils could develop on UK orchid species, this may increase the likelihood of establishment.

Additionally, the suitability of the UK climate is also uncertain. While it can be suggested that a tropical weevil is very unlikely to develop in a temperate climate, there is limited information available on the weevil to support this. Previous papers looking at pest development focus on temperatures ranging from 20 to 30°C, and lower temperatures are not studied, meaning a lower developmental threshold has not been estimated. Therefore, it is difficult to accurately predict potential development in the UK.

Images of the pest

Photo 1 Orchidophilus adult	*Photo 2 Feeding damage by adult*
	
Copyright of Kevin Faccenda *(CC BY) https://www.inaturalist.org/photos/177513938*	Copyright of Claire Goiran (CC BY-NC) *https://www.inaturalist.org/observations/190707921*

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 EPPO) and the PRA scheme (UK or EPPO) to be used.

No	✓				
Yes		PRA area: UK or EPPO		PRA scheme: UK or EPPO	

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

Yes Statutory action		No Statutory action	✓

Statutory action is not recommended for this pest group. While considerable damage has been recorded from its native and introduced range, the likelihood of establishment in the UK is limited to protected structures that house a large number of tropical orchid plants. Introduction to these areas should be limited by biosecurity procedures such as quarantining of new material, especially for sites containing high value orchid plants.

Stage 1: Initiation

1. What is the name of the pest?

Orchidophilus (Insecta; Coleoptera; Family: Curculionidae; Subfamily: Baridinae)

There are currently six species recorded in the genus *Orchidophilus* (according to Prena (2008)):

Orchidophilus aterrimus (Waterhouse) (*aterrimus* is sometimes wrongly spelt *atterimus*)
Orchidophilus epidendri (Murray)
Orchidophilus eburifer (Pascoe)
Orchidophilus insidiosus Prena
Orchidophilus peregrinator Buchanan
Orchidophilus ran Morimoto

The genus of *Orchidophilus* was described by Buchanan in 1935 to describe the dull, black weevils that have been encountered in orchid cultures at various places in Asia, Australia, Europe, North America, and Hawaii. Species of the *Orchidophilus* genus can be differentiated by their morphology. A global species key is provided in Prena (2008).

This PRA applies to all six species of *Orchidophilus* but will be based primarily on published data for *O. aterrimus* as this species is considered a bigger threat to orchid cultivation and there is a lack of research for the other species. However, due to the similarity between some species, it is possible that some findings were misidentified and attributed to a different species.

2. What initiated this rapid PRA?

In August 2016, an *Orchidophilus* sp. (suspected to be *O. aterrimus* or *O. ran*) was intercepted on *Dendrobium* (orchids) hybrids from Singapore. As these weevils can be serious pests of orchids, statutory action was recommended at the time. Due to limited information on some of the species, it was appropriate to add these pests to the UK Risk Register at genus level. A full pest risk assessment is required to help decide whether statutory action against future interceptions and findings is justified.

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 plant health legislation, and in the lists of EPPO[1]?

Orchidophilus species are listed as provisional GB quarantine pests in the legislation for Great Britain (the Phytosanitary Conditions Regulation (assimilated regulation (EU) 2019/2072))[2].

None of the species within the *Orchidophilus* genus are listed in the EU plant health legislation (2019/2072[3] and 2016/2031) which applies to Northern Ireland, and none are recommended for regulation as quarantine pests by EPPO, nor are they on the EPPO Alert List.

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

The exact distribution of the *Orchidophilus* genus is uncertain. The majority of the species are thought to originate from south-east Asia, specifically Indonesia, Malaysia, the Philippines and Singapore, also possibly from Taiwan, Thailand, and Australia. Prena (2008) considers *Orchidophilus* species as being 'adventive' (entered into an area but not established) in multiple countries including: American Samoa, Brazil, Canada, the Cook Islands, Germany, Great Britain, Japan, the Netherlands, New Caledonia, Papua New Guinea, Solomon Islands, South Africa, South Korea, Sweden and the United States (including Hawaii). The pest status in these non-native countries is often uncertain, because reports often relate to interceptions or isolated populations collected from greenhouses. It is nearly impossible to determine whether individuals collected are from recently imported or older plants and for many of the countries, the weevils do not appear to have established. Table 1 displays the distributions for each pest including their native and introduced range, and where the species has been found but is not considered established. But there is generally a lack of reports concerning these pests, so it is difficult to generate an accurate and current distribution list. Figure 1 shows a distribution map of *Orchidophilus aterrimus* highlighting the native and introduced countries. Specific reports for each pest can be found in Prena (2008).

[1] https://www.eppo.int/ACTIVITIES/quarantine_activities

[2] https://www.legislation.gov.uk/eur/2019/2072 (link to latest consolidated version)

Table 1: Distribution of *Orchidophilus* spp.			
	Native range	**Introduced and established in**	**Found as a non-established adventive in**
O. aterrimus	Indonesia, Malaysia, Philippines, Singapore and possibly Taiwan	American Samoa, Australia, Hawaii and possibly the Cook Islands, New Caledonia and Papua New Guinea	Canada, Germany, Japan, the United States and possibly in Brazil, Great Britain, the Netherlands and Sweden
O. eburifer	Philippines		Great Britain and the United States (including Hawaii)
O. epidendri	Indonesia		Australia, Germany, Great Britain, South Africa and the United States
O. insidiosus	Australia (unconfirmed)		United States
O. peregrinator	Indonesia, Philippines	Soloman Islands	United States (incl. Hawaii)
O. ran	Philippines /Taiwan (unconfirmed)		Japan, South Korea and the United States

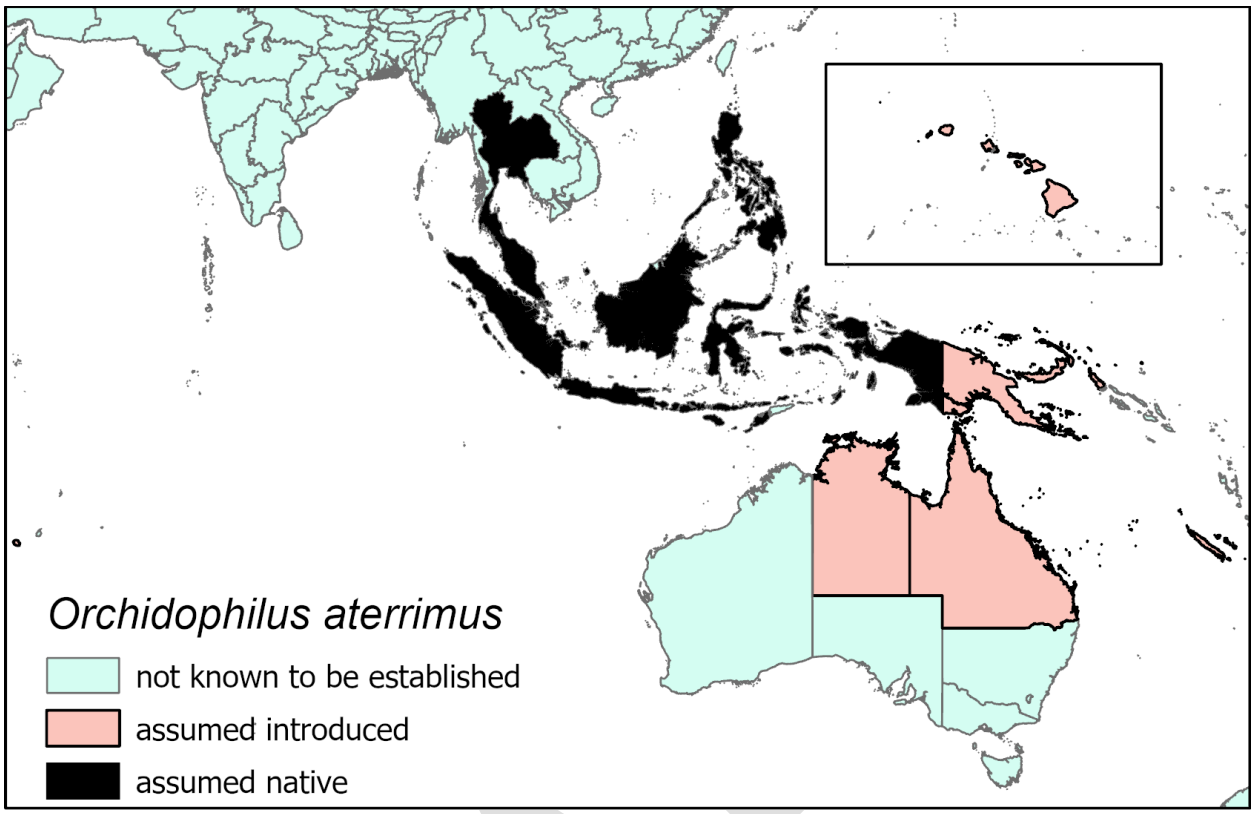


Figure 1. Distribution map of *Orchidophilus aterrimus*. Adapted ESRI World Administrative Divisions. Data & Maps for ArcGIS® 10 (ESRI).

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

No species of *Orchidophilus* are thought to be present in the UK. Prena (2008) lists records of pest findings in orchid collections from Kew, Torquay, and Tunbridge Wells. Some of these records are from the British Natural History museum archives but no further information could be found so the exact details of these findings is unknown. Champion (1913) recorded a single male of *O. aterrimus* found on an orchid, reported as *Catasetum splendens,* in an orchid house in Kew gardens. No further findings of *Orchidophilus* have been reported in recent years.

There has been only one interception of *Orchidophilus* reported recently. In 2016, an *O. aterrimus* or *O. ran* adult female was found on *Dendrobium* hybrids originating from Singapore in the quarantine unit of a botanic garden in England. This consignment was recommended for destruction and there were no further findings reported.

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?

Orchidophilus spp. only feed on plants from the Orchidaceae family, primarily on species within the subfamily of Epidendroideae. The paper by Prena (2008) compiled a list of plant associations for each species. *Orchidophilus aterrimus* has a longer list of recorded hosts than the other species. It is unknown whether *O. aterrimus* naturally has a wider host range or if it has been reported more as it is considered a more harmful and prevalent pest.

The Epidendroideae species associations recorded by Prena (2008) for all six weevils include: *Acanthephippium mantinianum, Aerides crassifolium, A. lawrenceae, Angraecum* sp., *Arachnis* sp., *Aranthera* sp., *Bulbophyllum leopardianum*, B. *mandibulare*, *Catasetum splendens*, *Cattleya* sp., *Coelogyne asperata*, *C. pandurata*, *C. xyrekes*, *Cymbidium* sp., *Dendrobium chameleon*, *D. canaliculatum*, *D. compactum*, *D. crassinode*, *D. crystallinum*, *D. findleyanum*, *D. guerreroi*, *D. nobile*, *D. phalaenopsis*, *D. pierardii*, *D. spectabile*, *D. superbum, D. taurinum*, *D. victoria*-reginae, *Epidendrum* sp., *Grammatophyllum multiflorum*, *G. speciosum*, *Liparis condylobulbon*, *Myrmecophila tibicinis*, *Oncidium sphacelatum*, *Paphiopedilum* sp., *Phalaenopsis amabilis*, *P. rimestadiana*, *P. sanderiana*, *P. schilleriana*, *P. stuartiana*, *Renanthera alba*, *Rhynchostylis retusa*, *Saccolabium* sp., *Sarcochilus hartmannii*, *Spathoglottis intermedia*, *Stauropsis lissochiloides*, *Trichoglottis brachiata*, *Vanda coerulea, V. luzonica*, *V. teres*, *Vanda* x Miss Joaquim (all species names are as they appear in Prena (2008)). It appears the majority of orchid species may serve as hosts, at least those in the subfamily of Epidendroideae.

Orchidophilus aterrimus has also been found associated with species from the subfamily Cypripedioideae including *Cypripedium curtisii*, *C. lawrenceanum*, and *Paphiopedilum* sp. Additionally, there is a report of a USDA interception of *O. aterrimus* on *Guzmania* sp. (a tufted air plant in the Bromeliaceae family) but this is most likely an incidental association.

There is currently limited information available on the susceptibility of different species as hosts. There is some evidence that host species experience different damage, for example *Vanda* continued to grow while infested with *O. aterrimus* but experienced colour break of flowers, while *Dendrobium* plants suffer stunted growth and flower production (Mau, 1983). Additionally, from an outbreak of *O. aterrimus* in Japan, particularly severe damage was noted for *Cymbidium goeringii* and *C. nariyanum*. Several other species of orchids such as *Dendrobium* spp. and *Phalaenopsis* spp. were present as hosts but damage was not recorded, suggesting any damage was limited (Ooishi *et al.*, 2007). These differences could suggest some variance in tolerance between orchid species, but there is not enough evidence to support this claim.

Some of the orchid species listed as hosts are of economic importance to the UK as they are often traded and kept as ornamental indoor plants. Orchid species of the subfamily Epidendriodeae are present in the UK and have environmental importance but are not

currently considered as hosts of *Orchidophilus* species. The role of native UK orchids as hosts is discussed more in section 11.

8. Summary of pest biology and/or lifecycle

The information presented in this section is primarily provided by two papers by Mau (1983) and Hirao *et al.* (2001), which studied the development of *Orchidophilus aterrimus* in Hawaii and the Philippines, respectively. The recorded developmental timings differ between these two studies and can be explained by difference in conditions (primarily temperature) and methodologies. Development timings are presented in table 2. No studies have been conducted on the other *Orchidophilus* species, so this section will focus on *O. aterrimus.* Due to the similarity between the distribution of the species, the biology and lifecycle are expected to be very alike.

Table 2. Developmental timings (days) for *Orchidophilus aterrimus* from 3 studies at different temperature ranges.

	Mau (1983)	Manoto *et al.* (1999)	Hirao *et al.* (2001)
Temperature	24 ± 4	25.06 ± 1.17 °C	28 – 35 °C
Egg	11.3 ± 0.54	7.2 ± 1.47	6.8 ± 1.62
Larvae	117	58.70 ± 11.24	47.6 to 75.3*
Pupae	15.9 ± 1.2	10.83 ± 1.54	10.33 ± 0.91
Total	144	70.15 ± 12.04	64.72 ± 12.30

*Total larvae development timing not provided in paper. First number calculated by subtracting mean incubation and pupae time from total time. Second number calculated by totalling the time measured for each individual larval stage.

Females chew cavities with their rostrum into the plant pseudobulb, the base of developing leaves, and in leaf axils where they deposit single eggs. These cavities do not differ in appearance or location from cavities without eggs. Eggs are small, about 0.7 – 0.8 mm in length and remain white for the first nine days before mandibles of developing larvae become visible as brown triangular spots, followed by the head capsule becoming visible. A day later the larvae hatch from the egg.

Larvae begin feeding immediately, tunnelling into the pseudobulb and producing a gallery. These galleries are oriented longitudinally, often downward, and filled with frass for a short distance behind the larvae. Larvae have also been reported to develop by feeding at the base of unopened *Dendrobium* leaves and in the terete (cylindrical) leaves of *Vanda*

orchids (Mau, 1983). It is also believed that larvae may develop within the stem. There are thought to be at least 5 larval instars, possibly 6, based on head capsule widths.

At the end of the larval stage, larvae begin to construct a pupal cell. Within the pseudobulb, larvae will seal their gallery with plant fibres and frass. If fed excised leaves, larvae construct a pupal cell made of food materials.

Adults emerge from the pupal cell by chewing a circular or oblong hole 2 – 3 mm across. Total development time from egg to adult is shown in table 2, where there is a noticeable difference between studies. This difference in development time may be due to difference in temperature as well as methodologies. Mau (1983) waited until the first adult emerged before checking other pseudobulbs for adults. This most likely skewed the data, where adults remain in the plant for several days after eclosion. Hirao *et al.* (2001) recognised this discrepancy where *O. aterrimus* reared on whole plants took an average of 17 days longer than those reared using leaves. Similarly, the method in the study by Manoto *et al.* (1999) differed, where larvae were placed in cut stems which were dissected daily to check life stage development.

Once adults emerge, they begin to feed on flowers, leaves, the pseudobulb, and exposed roots. Younger pseudobulbs are preferred but, if young growth is not present, adults will readily feed on older pseudobulbs. Similarly, adults prefer to feed on younger tissue and damage is most often recorded on apical growth. Adults are very long-lived. In the study by Mau (1983), half of the males and females lived for 34 and 37 weeks respectively, and there were adults still alive when the study was terminated at 52 weeks. After emergence, adults mate and females begin ovipositing eggs an average of 47 days after eclosion. In the Hirao *et al.* (2001) study, females laid an average of 2.4 eggs a week with approximately 89 eggs being laid in their lifespan.

9. 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?

Due to the *Orchidophilus* spp. close association with orchid plants, these pathways will focus on orchid material. Other pathways such as non-host plants for planting (e.g. previous interception on *Guzmania* sp.), hitchhiking, and natural spread are not thought to be significant and will not be discussed.

Plants for planting of orchids

Evidence for this genus being associated with this pathway is strong. There have been various interceptions recorded, primarily of *O. aterrimus* where its range has extended into the Indo-Pacific range from secondary dispersal with traded orchid cultivars (Prena, 2008). This species has been recorded moving into Hawaii in orchid plants from the Philippines and similar countries from as early as the 1900s (Fullaway, 1938). Other species are

occasionally intercepted with specific reports provided by Prena (2008). Additionally, there was one interception of this genus in the UK on *Dendrobium* hybrids originating from Singapore in 2016.

Likelihood of association with this pathway is high. All stages of the pests' lifecycles occur in or around the orchid plant. Eggs, larvae and pupae are often concealed within the pseudobulb, stems or leaves. It is believed that oviposition cavities containing eggs are difficult to see, and the first obvious evidence of infestation is adult emergence holes or necrotic spots on leaves caused by adult feeding. Adults may also be present on all parts of the plant, as they feed on flowers, leaves, the pseudobulb, and exposed roots. It is noted that adults, when disturbed, will immediately drop from the plants and play dead (Poeschko, 2004). Adults may still be present in containers or growing media, especially where orchids are often imported with moss type substrate.

Data on orchid plant material being imported into the UK for the last 5 years was provided by the IPAFFS and PEACH systems. Unfortunately, applications on PEACH were made to commodity type, and did not always include genus and species information. Therefore, this data is not considered comprehensive enough to include in full, and pathway rating is based primarily on IPAFFs data. While the IPAFFs applications provided a good overview of orchid imports, they only account for 2024.

From 2024, reports of plants for planting of orchids from countries with confirmed presence (e.g. Taiwan, Thailand, and the United States) identified 111 consignments with a net weight of 1464.4 kg (or 1.46 tonnes). PEACH data does not provide estimates of weights but did highlight a significant number of applications from Taiwan and Thailand, suggesting that trade from these counties has occurred at a similar rate for the last 5 years. This low trade volume suggests that entry of *Orchidophilus* spp. though this pathway is unlikely.

It is possible that *Orchidophilus* spp. may also enter the PRA area on orchid plants being imported from countries with no reported presence such as the Netherlands. While no *Orchidophilus* species are thought to be established in the Netherlands, this country does act as a trading hub where it is possible that orchid plants originating from countries such as the Philippines, Singapore or Indonesia are imported and then re-exported labelled as EU origin. Or where alternatively, the weevils may be introduced to a glasshouse and spread to orchid plants grown in countries where the pest is considered absent and later exported. In the paper by Prena (2008), there is a reported interception of *O. aterrimus* in Miami, Florida in 2005 on material originating from the Netherlands. The UK imports a large number of orchid plants for planting from the Netherlands. In 2024, approximately 2500 tonnes of orchid plants for planting were imported, primarily of the species in *Phalaenopsis*, *Dendrobium*, and *Cymbidium* (known hosts of *Orchidophilus* spp.). While movement of the orchid weevils through this pathway should be less likely compared to imports from countries with confirmed presence, the number of imports is significant.

Additionally, movement of orchid plants for planting may be facilitated by online/internet trading. A 2016 study of around 55,000 social media posts in orchid enthusiast forums and groups over a 12-week period found that 9% involved the sale of orchid plants, and 22-

46% of these plants were considered potentially wild sourced and of dubious legality (Lavorgna *et al.*, 2020). This poses a higher risk where orchid plants collected from the wild are more likely to be exposed to pests and diseases. It is unlikely that the proper phytosanitary measures are being applied to all orchids moved via internet trading and the number of plants being moved into the UK via this pathway is unknown.

It is also important to consider the likelihood of transfer from orchid plants for planting to other suitable hosts for establishment. It can be assumed that the majority of these orchid plants are being imported for retail and will be sold to the public. This would provide limited opportunity for the orchid weevil to establish, as it is not common for people to own a selection of orchids large enough to sustain a weevil population. There may be some cases where imported plants will be moved to protected structures such as glasshouses either to be kept as part of a collection or to be grown on for retail. These situations would allow transfer to new hosts and could lead to an established population. However, it is likely that these locations would have phytosanitary procedures, such as quarantining of new material, to prevent introduction of these weevils. This is demonstrated by the 2016 UK interception of *O. aterrimus* where an adult was found in the quarantine unit of a botanic garden in England. However, this is less certain for private collections where orchid enthusiasts purchasing or trading orchids through the internet are less likely to have the facilities to quarantine plants.

Due to the low trade volume of orchid plants for planting from countries where *Orchidophilus* spp. are known to occur and the belief that opportunity to transfer to other suitable hosts would be limited, the pathway of plants for planting of orchids is rated as unlikely with medium confidence.

Cut flowers, foliage and branches of orchids

Orchid material may also be imported into the PRA area as cut flowers, foliage or branches. Likelihood of association with this material is difficult to estimate. Similar to plants for planting it is possible that eggs, larvae and pupae may be associated. While adults are known to bore holes into stems and leaves for feeding and oviposition, it is unknown whether this is as common as oviposition and larval development within the pseudobulb. Adults will play dead and drop from plants when disturbed, therefore adults may be present in containers but unlikely to remain attached to plant material.

From IPAFFs data, in 2024, cut flowers and branches of orchids from Malaysia and Thailand measured 13125kg (13 tonnes) from 286 applications. These consignments mainly consisted of *Vanda* and *Dendrobium* orchid species, known hosts of *Orchidophilus* species. This is a larger amount than orchid plants for planting but still suggests a small volume of trade. However, as seen with plants for planting, the UK imports a much larger amount of cut material from the Netherlands, approximately 100 tonnes from 12997 applications. There is the concern that cut foliage of orchids is being imported to the Netherlands and re-exported to the UK labelled as EU origin, although it is unknown whether this is a significant risk.

There is limited opportunity for orchid weevils associated with cut flowers and branches to transfer to suitable hosts in the PRA area. Cut material is likely to be used for retail and

only for decorative purposes. Once the stems and flowers have died, the material would be disposed of. It is unlikely that cut foliage of orchids would come into contact with orchid plants that are being grown on or kept in a high-value collection.

Due to low volume of trade and the limited opportunity for transfer to new hosts, the pathway of cut flowers, foliage and branches is rated as very unlikely with medium confidence.

Plants for planting of Orchids	Very unlikely	☐	Unlikely	☑	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			
Cut foliage and branches of orchids	Very unlikely	☑	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			

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

The species belonging to the *Orchidophilus* genus are free-living organisms and do not require a vector.

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

This section will be based primarily on *O. aterrimus*, as more information is available for this species compared to the others. There is no evidence to suggest that the ratings would be significantly different for the other species.

Outdoor

The family of Orchidaceae is very large, and multiple species from this family are present in the UK as ornamentals and wild populations, including species within the Epidendroideae subfamily. However, the current recorded host list for the *Orchidophilus* spp. does not include any of the wild orchid species found in the UK (Prena, 2008). Orchid weevils primarily feed/develop on tropical orchid species and as no host studies have been conducted for these pests it is difficult to determine whether UK orchid species could be potential hosts. *Orchidophilus* species appear to prefer to oviposit and develop within the

pseudobulb of the orchid (Mau, 1983), which is a structure specific to tropical orchids, and is absent in temperate orchid species found in the UK. While feeding and development has been noted from leaves and stems, the frequency of this is unknown and might be less common. It is possible that UK orchid species which lack the pseudobulb may be unsuitable or less desirable hosts.

Regardless of hosts, orchid weevils are likely to be prevented from establishing outdoors by the UK climate. This genus is native to tropical countries such as the Philippines and Indonesia. Comparison of Koppen-Geiger climate maps shows significant difference between the pests' native/introduced range (Af for equatorial and fully humid) and the PRA area (Cfb for warm temperate, fully humid, and warm summer). Currently, no species from this pest genus are believed to be established outdoors in climates that significantly vary from the Af climate region. This suggests that the difference between the two climates would limit development of *Orchidophilus* species in the UK. However, these classifications are quite broad and hide a lot of variation, so there is significant uncertainty. The difference between the UK climate and that of the pest's current distribution is further demonstrated in Figure 2, where the pest is currently only found in areas with an annual degree day above 4,500, which is dramatically different than then UK annual DD of 250 to 1,000.

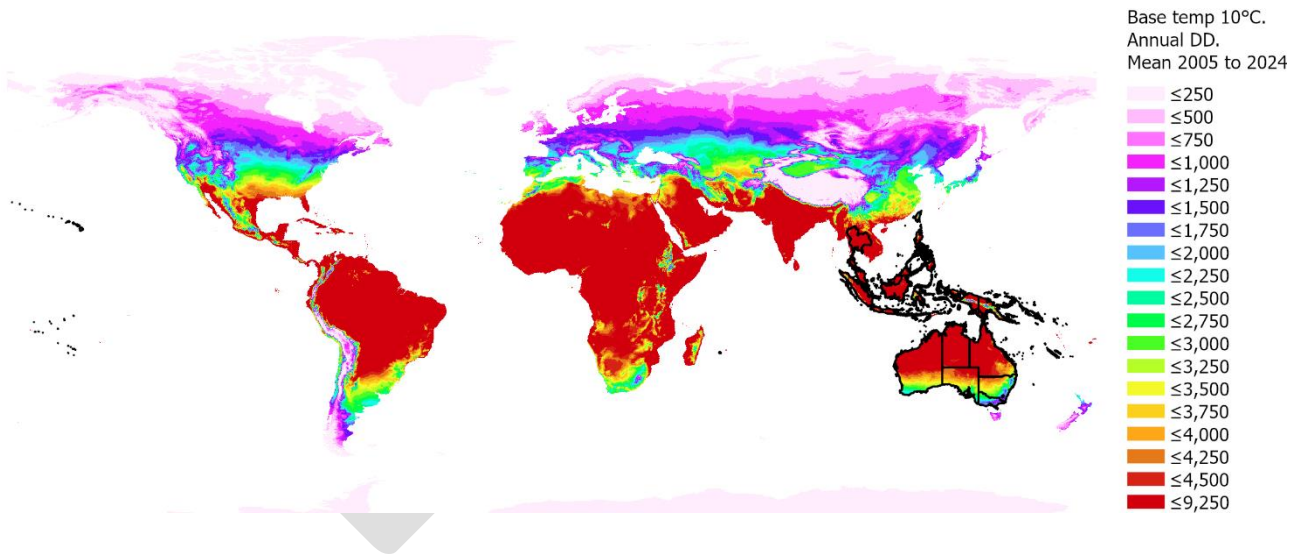


Figure 2. Map showing the distribution of all six *Orchidophilus* species over a layer of mean annual degree days with a base temperature of 10°C, data range 2005 to 2024. Global degree days were calculated by Neil Kaye (Senior Software Engineer, Climate and Nature team, Met Office) using temperature reanalyses data from ERA5-Land (ERA5-Land hourly data from 1950 to present). This work was part of the Met Office Hadley Centre Climate Programme (HCCP) funded by BEIS and Defra

Further analysis on climate suitability for *Orchidophilus* species is problematic. Primarily due to the lack of information available on the different species. The three developmental studies recorded for *O. aterrimus* were all conducted above 24°C, so any estimation of a

lower developmental threshold would likely be inaccurate. Incidence data for these species is either limited or not precise enough meaning any models produced would be inaccurate and unreliable. Sometimes other, better studied pest species are used as a comparison to estimate suitability, but weevils are a very diverse group and comparison between species is not useful. Further investigation into *Orchidophilus* biology would be necessary to make an accurate assessment of climate suitability.

As the UK climate is unlikely to be warm enough to support weevil development, establishment outdoors is rated as unlikely with medium confidence. It is unknown how well UK native/naturalised orchid species may act as hosts, but it is thought that tropical orchids would be the preferred host type due to the presence of a pseudobulb.

Under protection

The ability of *Orchidophilus* species to establish under protection is more likely. There are various 'protected' structures that house large numbers of orchids. These are primarily botanical gardens that have dedicated orchid collection, such as Royal Botanic Gardens, Kew (London), Royal Botanic Garden Edinburgh (Scotland), National Botanic Garden of Wales, and RHS Garden Wisley. This also includes National Plant Collections, such as the Mathers foundation, which are overseen by Plant Heritage. Additionally, there are growers and retailers that specialise in orchids. At these sites, it is likely that biosecurity procedures such as quarantining of new material would be in place to prevent introduction of pests and diseases. Quarantine timing varies between sites, but multiple months are recommended to ensure freedom from pests. Additionally, while initial damage such as oviposition tunnels may be difficult to spot, orchids are likely to be thoroughly inspected prior to introduction to main collections. Smaller collections are likely to be present throughout the UK owned by hobbyists and collectors. Although these are unlikely to play a significant role in establishment or spread of *Orchidophilus* populations.

While the environment for growing and maintaining orchids may vary between sites, the typical conditions maintained for glasshouses with tropical orchids is 16 to 27°C and 60 – 80% relative humidity. These conditions would be suitable for development of *Orchidophilus*, as shown by the life studies from Mau (1983) and Hirao *et al.* (2001). Additionally, it is likely that wherever tropical orchids can grow, the orchid weevil would also be able to develop.

There is also considerable evidence to indicate that *Orchidophilus* species can establish under protection. Prena (2008) provides four reports of findings of *O. aterrimus* and *O. epidendri* in botanical gardens from Australia and Germany. Further information is not provided so it is unknown if these findings were under protection or if they were breeding populations. Outbreaks have been reported from the Cairns botanic garden in Queensland (Australia) (Richardson, 2024), and in 'orchid cultivation facilities' in Uruma City (Okinawa, Japan) (Ooishi *et al.*, 2007). Although, the details of these outbreaks are lacking and may not fit the expectation of 'under protection'. For example, in Smith and Neal (1998), an outbreak in a nursery discusses the use of a 'shade house' which can vary from a

semipermanent structure to protect orchids from intense sunlight, to a structure similar to a glasshouse.

Due to orchid collections being under protection in the UK, the suitable conditions for the pest species, and the previous reports of outbreaks in botanical gardens and nurseries, establishment under protection is rated as likely with medium confidence.

Outdoors	Very unlikely	☐	Unlikely	☑	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			
Under Protection	Very unlikely	☐	Unlikely	☐	Moderately likely	☐	Likely	☑	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			

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

Natural spread

The speed of natural spread of *Orchidophilus* species is difficult to estimate. While these species have wings and are capable of flight, no studies have been conducted to measure flight capacity or dispersal ability. Additionally, the weevil family is diverse, and include numerous flightless species that lack wings, therefore it would be unreliable to compare dispersal distance of *Orchidophilus* species with others. Even where development and morphology are similar, some species may travel long distances and others may prefer to stay close to the plant they emerged from.

Information about *Orchidophilus* spp. can be inferred from a reported outbreak of *O. aterrimus* in a shadehouse structure in the Northern Territory, Australia. *Orchidophilus aterrimus* was likely introduced in 1986 on *Phalaenopsis* orchids from Queensland (where the pest is established) and then noticed in 1988. Pesticides were used to control the population. Low numbers persisted and the pest was still present in April 1992. Following surveys in the surrounding area, *O. aterrimus* was not recorded in any nearby nurseries, and the weevil was suspected to have a limited distribution in the Northern Territory. Therefore, the weevil was introduced to a new area with a suitable climate and was present for 6 years but did not spread to any other sites, suggesting a low rate of natural spread. Although it is noted that the infested property was considered relatively isolated (Smith & Neal, 1998), and spread was potentially limited by the structure or the abundance of hosts.

In the UK, due to the unsuitable climate, it is unlikely that any *Orchidophilus* spp. will be able to spread quickly unless facilitated by humans. Insect adults often require warm

temperatures for flight. In the UK, if development is possible, it would likely be limited to later in the year, which suggests that temperatures will be too cold to allow flight. As UK climate is unsuitable, adult weevils would need to spread to another protected site with a large number of orchids to establish a further population. It is unclear whether the pest would be able to enter these collections. Often, as a part of an IPM strategy, physical barriers are used to prevent the introduction of pests, including the use of netting on windows, which prevents entry of larger insects such as weevils. However, this would vary between sites.

Natural spread is rated as very slowly with high confidence. While the pest species are capable of flight, they do not appear to disperse long distances, and the UK climate would make weevil spread difficult.

With trade

Spread of *Orchidophilus* spp. to new countries and areas has been highly associated with orchid plants for planting with multiple reports of interceptions and outbreaks resulting from movement of orchid plants. Therefore, trade is the more likely form of spread.

Trade of plants from garden centres and similar businesses to the general public is unlikely to pose a biosecurity risk. With exception of specialist collectors, it is not likely that members of the public would have a large enough collection of orchids to allow the establishment of a weevil population or would regularly trade orchid plants.

The movement of infested orchid plants to small collections belonging to hobbyists could facilitate further spread of the pest, but the beetle presence should be more obvious and easier to control in smaller collections. Additionally, it is uncertain whether a hobbyist would knowingly sell or trade an infested plant.

Trade of orchids between commercial growers and large orchid collections (such as botanical gardens) is higher risk as the plant will likely come into contact with a large number of orchid plants to which the orchid weevil could transfer and produce a new population. It is difficult to estimate how often orchid plants are moved between growers and orchid collections, but it is not thought to be common. Even where orchids are commercially traded, they should be inspected prior to movement to allow the issue of a plant passport, and individual sites would most likely have phytosanitary measures such as quarantining of new material, which would limit the likelihood of pest entry to a new area.

Spread with trade is rated as slowly but with low confidence as there is a lack of information regarding the volume of orchid plant movement within the UK and the potential for transfer and establishment in larger collections of host plants.

Natural Spread	Very slowly	☑	Slowly	☐	Moderate pace	☐	Quickly	☐	Very quickly	☐

Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐			
With trade	Very slowly	☐	Slowly	☑	Moderate pace	☐	Quickly	☐	Very quickly ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

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

Economic

Orchidophilus species, particularly *O. aterrimus* and *O. peregrinator*, pose significant economic risks to orchid cultivation, especially in regions where orchids are a major horticultural commodity. For example, in Hawaii, infestations have led to severe reductions in flower quality and marketability. Hara and Mau (1986) looked at insecticidal control of *O. aterrimus* and found that untreated orchids produced only 40.7 marketable flowers compared to 133.7 flowers on chlorpyrifos-treated plants, and 27.5% of untreated flowers showed streaking compared to 0.0-0.9% on treated plants. This streaking makes flowers unmarketable and directly impacts grower's revenue. In commercial gardens such as those in Nuuanu Valley (Hawaii), *O. peregrinator* infestation led to a reduction in *Vanda* orchid bloom production, which is a high-value ornamental crop (Swezey, 1945).

Despite these examples, there is a notable lack of comprehensive data on monetary losses, making it difficult to estimate the full economic impact. Even with reports of *Orchidophilus* outbreaks causing severe damage and plant death, there is a lack of detail on the potential impacts. In Okinawa (Japan), while weakening and death of orchids is recorded, it is also noted that no damage was found on domestic fields, suggesting that outbreaks are primarily limited to orchid collections under protection (Ooishi *et al.*, 2007).

Fullaway (1938) suggests for growers that pay close attention to their collection, this beetle can be relatively easy to deal with by removing the beetle from the plants manually and using bait plants with exposed roots. This has not been verified by clinical trials but appears a possible solution. Issues are more likely in large collections where attention cannot be made to each plant, and weevil populations can grow to a significant size before detection.

The control of *Orchidophilus* spp. can also lead to economic damage where sanitation and insecticides are used to control infestations. During the Roratonga Cook Islands outbreak, after the infestation of *O. aterrimus* was identified, approximately 3,500 *Dendrobium* orchids were destroyed and the surrounding area (~1000 m^2) was treated with insecticides, followed by remaining orchids within the property being treated with another insecticide on a fortnightly basis for eight months. After this spraying programme was completed, weevils were then found on two plots of *Vanda* and *Epidendrum* orchids within

the treatment area, suggesting the programme was not effective. Even with further pesticide application, there were further finds and the spraying programme was ongoing at the time of the report (Poeschko, 2004). While the cost of these measures is not discussed, the loss of plants by destruction and the pesticides used were likely expensive. This is similar to the outbreak of *O. aterrimus* in the Cairns botanic gardens, Queensland, Australia where many plants had to be destroyed and pesticides were applied. Additionally, rare or valuable orchids were quarantined, which may have additional costs associated where more space is required (Richardson, 2024).

Environmental

The environmental impacts of *Orchidophilus* spp. infestations have not been fully studied but are likely to occur in two ways. First, the damage caused by larvae and adults, such as feeding on pseudobulbs, stems, leaves and exposed roots, will likely weaken any infested plant and could lead to mortality. In Japan, infestations on species like *Cymbidium goeringii* and *Spahoglottis* have resulted in pseudobulbs being almost entirely consumed, with all life stages of the weevil present (Ooishi *et al.*, 2007). This level of destruction may threaten both cultivated and wild orchid populations. Although as previously stated, no damage has been reported from domestic fields. This may be due to presence of natural enemies and parasitoids in the environment which act as natural control, preventing populations rising to damaging levels. In environments where wild host orchids grow, mortality of these orchids might reduce biodiversity and have impacts to the ecosystem, due to their symbiotic relationship with fungi (for nutrient absorption) and their role as food sources for pollinators. Secondly, the use of chemical controls, such as pyrethroids and organophosphates, may have negative impacts due to pesticide residues, non-target effects, and environmental contamination. Currently, no biological or integrated pest management strategies are widely documented for these species, leaving growers dependent on chemical interventions.

No environmental impacts have been specifically reported from the pests' current distribution. It is difficult to assess whether this is due to a lack of research into the ecological impact or because the orchid weevils do not actually cause considerable damage in the wider environment. It is possible that damage is only seen in orchid collections where large numbers of suitable hosts are grown in proximity to each other and conditions are optimised for plant and pest development.

Social

Information regarding the social impact of orchid weevils is lacking. Orchids are both popular ornamentals and symbols of tradition and prestige in multiple Asian countries, with many species holding high monetary and social value. Damage to orchids in countries such as Indonesia, Japan, and the Philippines where orchids are important to horticultural heritage, may have led to losses for growers, impacting livelihoods and local groups, as well as disrupting cultural practices tied to orchid displays and festivals. As current control of orchid weevils is inefficient and there are no standardised management strategies,

damage to growers could be exacerbated and create uncertainty in maintaining crop quality and meeting market demands. However, there is limited evidence to support the claim that orchid growers are being seriously affected by the *Orchidophilus* pest species.

Due to the recorded damage made by orchid weevils, particularly *O. aterrimus* and *O. peregrinator*, to orchid plants resulting in stunted growth and irregular flower production, the overall impact of *Orchidophilus* spp. in its current range is rated as medium with medium confidence.

Impacts	Very small	☐	Small	☐	Medium	☑	Large	☐	Very large ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			

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

Economic

The UK imports large volumes of orchids for retail and floristry, a portion of which are grown on in glasshouses for later sale. Introduction of an *Orchidophilus* species and infestations of orchids could lead to the loss of marketable plants, where damage from larval boring and adult feeding could result in poor growth and undesirable flowers. Orchids are a high-value ornamental, where even minor cosmetic damage such as holes or flower streaking, can make plants unmarketable potentially affecting nurseries, garden centres, wholesalers, or private sellers. Although it is difficult to estimate the orchid market in the UK.

The presence of *Orchidophilus* species would result in higher management costs at infested sites. In collections containing high-value orchids, phytosanitary measures would be put in place to limit spread of the pest. These measures would most likely include sanitation, application of pesticides, and increased quarantine procedures. All of which can be expensive. Sanitation requires the destruction of orchids and could range from hundreds to thousands of orchids being destroyed (e.g. ~3,500 *Dendrobium* orchids in Rorotonga, Cook Islands outbreak). Due to the pests' long lifecycle, spraying programmes must be completed every 2 weeks for more than four months, resulting in high costs from buying and application of pesticides. Particularly valuable orchids may be quarantined to prevent weevil damage, but this requires space capable of meeting the requirements for orchid growth, leading to further costs.

Where a glasshouse becomes infested, damage could be significant and even put an individual small company out of business. However, as discussed in the establishment and spread sections, outbreaks are likely to be localised where it would be difficult for the

weevil species to transfer to a new site. For this reason, the potential economic impact in the UK is rated as small with medium confidence.

Environmental

Potential impacts of this pest to the environment appear unlikely. Orchids in the UK are important to the environment as they support pollinators, act as biodiversity indicators (due to their high sensitivity to soil chemistry and fungal presence), and play a role in nutrient cycling. However, it is unlikely that *Orchidophilus* spp. will be able to establish outdoors in the UK. In the case of adults escaping to the wider environment in the summer months, adults may feed on flowers, leaves, and stems, potentially allowing entry of disease, but damage is expected to be negligible, as larval development would be unlikely due to absence of pseudobulbs in UK orchids and the unsuitable climate. Additionally, no reports have been made of environment damage caused by *Orchidophilus* spp. in its current range.

Environmental impacts are rated as very small with medium confidence.

Social

While orchids are important to countries where *Orchidophilus* spp. are currently present and hold high value, no social impacts have been reported. If there was a large outbreak in particular orchid collections in the UK, some social impacts could be expected. Outbreaks would likely lead to orchid damage and potential loss of plants, either from mortality or though sanitation to prevent further spread. Many orchids are valuable and are prized in botanical gardens and by hobbyists. Damage to these orchids may diminish their availability and beauty. This may also result in public concern where damage to orchids in a botanical garden would be troubling, or whole collections may be removed or quarantined, limiting public interaction.

Social impacts are rated as very small with medium confidence.

Economic Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				
Environ - mental Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				
Social Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large	☐

Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐

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

No species of the *Orchidophilus* genus are known to act as a vector of any plant pathogens.

16. What is the area endangered by the pest?

The area endangered by this pest group is any protected structure containing a large number of orchid plants, including botanical gardens, national plant collections and large-scale growers/nurseries.

Stage 3: Pest Risk Management

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

Exclusion

The import of orchid plants from third countries is not subject to any specific restrictions but all plants for planting from third countries must be grown in a place of production which is registered and supervised by the exporting NPPO and must be inspected prior to export to confirm they are free from signs or symptoms of any pests. The only regulation that applies specifically to orchid material is for cut flowers of Orchidaceae. When imported from any third country these commodities must be accompanied by a phytosanitary certificate with an additional declaration that they originate in a country free from *Thrips palmi* or have been inspected prior to export and are free of *Thrips palmi*. As *T. palmi* is present in multiple southeast Asian countries including Indonesia, Malaysia and the Philippines, any consignment of orchid cut flowers should be inspected prior to export, although the frequency of pre-export inspections or whether signs of *Orchidophilus* spp. would be identified is unknown. Additionally, internet trading of orchid plants remains a concern. As plants moving on this trade pathway are less likely to be compliant, there is a higher risk of pests being associated with the material.

Exclusion of *Orchidophilus* spp. from specific sites such as botanical gardens and nurseries can be achieved by quarantining and rigorously inspecting any orchid material being imported.

Containment

The containment of an orchid weevil population should be straightforward as adults are unlikely to spread far from the outbreak site by natural spread and the weevils are unlikely to establish outdoors. Quarantining of infested orchid plots and limiting movement of orchids would allow proper containment of a population. However, signs of oviposition are difficult to spot, so initial delimiting surveys in larger collections would need to be meticulous.

Eradication

Sanitation involves the removal and destruction of infested plant material to prevent further spread. This is the most effective method of control for the orchid weevils but can result in the destruction of many orchid plants resulting in high losses. Additionally, early identification of infested plants may be difficult where the first obvious signs are adult exit holes or adult feeding. Careful inspection of plants for tunnels produced by adult boring is necessary to identify plants that may contain eggs.

Chemical control primarily targets adult weevils, as eggs and larval stages are found within the pseudobulb, leaves, or stems, and would be protected from contact pesticides. Systemic pesticides have shown limited effectiveness against immature stages and are not used for control. A post-harvest pyrethroid dip is thought to help eliminate adults harboured in leaf axils but is unlikely to affect eggs, larvae and pupae. Control in the weevils' current distribution is primarily through the use of pesticide sprays. As these insecticides only affect adults, applications are made every 2 to 3 weeks for 4 to 5 months to cover the full lifecycle. Synthetic pesticides with good residual activity are preferred and have shown good efficacy against weevil populations. Previously used pesticides included pyrethroids such as bifenthrin and organophosphates such as chlorpyrifos and acephate (Hara & Mau, 1986). However, chemical use differs between countries and guidance on approved pesticides should be sought from the relevant authority.

Hara and Mau (1986) assessed the efficacy of acephate, bendiocarb, chlorpyrifos, and microencapsulated methyl parathion (none of which are authorised for use in the UK) on *Vanda* orchids. The orchids were sprayed 12 times at 21-day intervals from October 12th, 1982, to May 31st, 1983. After 6 sprays the number of adults observed from the pesticide treated orchid plots was lower than untreated, going from a severe infestation of >14 adults a week to a minimum level of <4 a week. From this reduction the amount of marketable *Vanda* flowers (with no streaking) was much higher in the treated plots, although it is not mentioned whether the weevil population was completely removed.

A similar spray programme was conducted in a nursery in Rarotonga, Cook Islands. The insecticide bifenthrin (not authorised in UK) was applied on a fortnightly basis for 8 months. Adults were found continuously, and it was suggested that the weevil was resistant to bifenthrin and spraying was continued with a pesticide containing chlorpyrifos. After 8 months without any further findings or adult weevils, the programme was stopped, only for newly emerged adult weevils to be detected 5 months later (Poeschko, 2004). This

suggests that complete removal of orchid weevils may be difficult and there are knowledge gaps for effective control with pesticides. Additionally, the Cairns botanic gardens, Queensland, Australia also reported difficulty in control weevil populations with pesticides and relied more on sanitation with removal of infested plants (Richardson, 2024).

For smaller collections of orchids, it is suggested that weevil populations can be removed by paying close attention to plant care, checking for signs of boring and manually excising the weevil from infested orchids, and then treating the wound with fungicides, alcohol, or sulphur dust. It is also claimed that adults can be captured by using orchids with exposed roots as trap plants, as they are attracted to the tender tissue at the root tips (Fullaway, 1938). However, there have been no studies to evaluate the efficacy of these methods.

Other than sanitation and pesticide programmes, no other control methods are recommended in the literature. Generalist predators are a possible form of biocontrol, but they cannot be targeted and their impact is inconsistent. Currently, no specialised agents such as parasites or parasitoids have been identified. Recent research on the entomopathogenic fungus *Beauveria bassiana* displayed a high level of mortality (86.9%), suggesting usage as a biopesticide (Hutapea *et al.*, 2024). However, the use of *B. bassiana* in an integrated pest management strategy for this pest has not been fully explored.

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