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Rapid Pest Risk Analysis (PRA) for *Phlyctinus callosus*

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Phlyctinus callosus adult. Pest and Diseases Image Library. Bugwood.org

Executive Summary

Phlyctinus callosus is a polyphagous pest commonly referred to as banded fruit weevil in its native South Africa and as garden weevil in countries Australia and New Zealand.

Impacts on a number of economically important hosts have been recorded in each of these countries. Many of these hosts are also important to industry in Ireland in the nursery sector (various ornamental hosts), in field vegetables production (carrot, onion) and in protected crop sectors (strawberry, blueberries). Additionally, the hosts grapevine, apple and peach/nectarines are of high economic importance in the wider EU and EPPO regions.

Phlyctinus callosus is a regulated pest in a number of countries; therefore it is also of phytosanitary importance. *Phlyctinus callosus* has been intercepted on fresh fruit consignments in particular on grapes and apples. One such interception on apples from South Africa for import into Ireland initiated this PRA.

With only around 5% of fresh apples consumed in Ireland actually produced domestically, Ireland imports significant quantities of fresh apples from South Africa and New Zealand, with an upward trend as volumes have been increasing in recent years. For this PRA this pathway was assessed as part of **entry on fruits pathway and this pathway was judged as moderate likely with medium uncertainty**. As identified recently in the EU project DROPSA, *P. callosus* is among a number of economic pests that is likely to transfer with the fruit trade. This potential pathway for entry has been demonstrated for Ireland with the recent interception of live *P. callosus*. However, the pest may have difficulty transferring from fruit produce to a suitable host, lowering the risk of entry on this pathway.

The **trade in plants in planting** is recognised as one of the most risky pathways for the entry of pests into new areas. As *P. callosus* is found in nurseries and as a pest with large periods of its cryptic life cycle in the soil or near the roots of plants, the trade in live plants poses a risk for entry of this pest. Following trade analysis, trade in various plants for planting commodities between Ireland and countries where *P. callosus* is present was found to occur at low levels. Current regulations also help to lower the risk for this pest entering on plants for planting commodities. Therefore, likelihood of entry for this pathway **was judged as unlikely with medium uncertainty.**

A factor in assessing the subsequent areas of the PRA process for this pest is recent taxonomic changes. *Phlyctinus callosus* is no longer recognised as the only species in the genus *Phlyctinus*. Five new species have been described. The species subject to this PRA, *Phlyctinus callosus* still remains by far the most extensively distributed species and the only species found in the specimens outside of South Africa including the recent interception in Ireland.

With this taken into account for the analysis on establishment in the PRA, the **likelihood of establishment outdoors is judged as likely with high uncertainty.** Climatic conditions and the availability of host plants in Ireland provide conditions to support establishment. The pest's current distribution in New Zealand and in the Australian states Victoria and Tasmania presents evidence for establishment in Ireland. However no detailed climatic suitability studies were performed as part of this PRA. Based on the literature, **Ireland is marginal for establishment of high numbers of *P. callosus* outside** due to the higher abundance of *P. callosus* in and preference for warmer climates**.**

Evidence would support the establishment of *P. callosus* **in protected production** in the PRA area. **Establishment of *P. callosus* under protection is likely with low uncertainty**. The climatic conditions provided by protected crops and the cultivation of hosts such as strawberries would lead to successful establishment of *P. callosus*, as has been the situation in Australia. Similarities with the pest vine weevil (*Otiorhynchus sulcatus*) currently a serious pest in Ireland, are discussed in the PRA.

The polyphagus *P. callosus* has caused large economic impacts on a number of hosts in particular on apples and grapes in its native region in South Africa. There is evidence of significant damage caused to wine grapes in Australia. In general it may be causing lower impacts in the horticulture and agricultural sectors in Australia and New Zealand but is still a pest that requires management and can cause damaging localised impacts for growers.

Phlyctinus callosus meets the abiotic (climate) and biotic (host plants) criteria to establish and spread in the PRA area and it is likely to cause economic impacts in the PRA area, however these are more likely to be localised and sporadic than widespread. As a regulated pest in important export countries for Ireland, even if transient population were to establish, this could impact trade. **Statutory action against interceptions and outbreaks of the pest is technically justified**.

Risk management options are outlined in this PRA with exclusion of *P. callosus* the best strategy through phytosanitary measures. This is because the pest could prove difficult to eradicate due to its cryptic lifecycle and a lack of effective control measures. In addition, phytosanitary measures on trade should be considered as trade is likely to be the main cause for movement of this pest's spread rather than the pest's limited natural spread.

A key recommendation from this PRA, is that *P. callosus* is subject to a PRA at EU or EPPO level, to further investigate the risk to the EU and EPPO region as a whole and identify appropriate risk management measures for the EU. The evidence to date suggests that other EU and EPPO countries are at a higher risk from establishment and impacts caused by *P. callosus.*

Contents

Stage 1: Initiation

1.1 What is the name of the pest?

Phlyctinus callosus (Schoenherr, 1826) (Curculionidae: Curculionidae).

EPPO code: PHLYCA (Phlyctinus callosus)

The genus *Phlyctinus* was first described by Schoenherr (1826) as a subgenus of the genus *Peritelus*. Subsequently a number of species were added and removed until 1843, from then, until very recently, *P. callosus* remained the only species in the *Phlyctinus* genus.

In the literature the authority for this pest name is also sometimes associated with a later description by Boheman 1834 (CABI 2020; Magagula 2019).

In South Africa *P. callosus* is commonly called banded fruit weevil while in Australia and New Zealand it is referred to as garden weevil (CABI 2020).

1.1.2 Special notes on taxonomy

Based on a recent study *P. callosus* was shown to be among a complex of several closely-related species. Published in the European Journal of Taxonomy (EJT), Haran et al (2020) describes five new species in the genus *Phlyctinus* Schoenherr. Printed versions have been deposited in the libraries of national museums and types specimens have been deposited in reference collections. These new species are recognized by the International Code of Zoological Nomenclature (ICZN) (J.Haran pers. comm. Jun 2020).

The six recognised species of genus *Phlyctinus* are *P. callosus* and the new species *P. grootbosensis* Haran sp. nov., *P. xerophilus* Haran sp. nov., *P. planithorax* Haran sp. nov., *P. littoralis* Haran sp. nov., *P. aloevorus* Haran sp. nov.

While *P. xerophilus* Haran sp. nov. may include several more species, stable morphological features could not be identified yet (Haran et al 2020).

This leads to uncertainty when analysing previous studies on *P. callosus* host plants and geographical distribution. *Phlyctinus callosus* remains as a distinct species in the Haran study and is regarded as the most extensively distributed of the 6 species recognised in the genus, being the only species found in the specimens outside of South Africa. Currently, only *P. callosus* and *P. xerophilus* are considered as pests in orchards and vineyards in South Africa.

1.2 What initiated this rapid PRA?

Live Curculionidae weevils confirmed to be *Phlyctinus callosus* (Schöenherr) were intercepted on *Malus domestica* fruit for consumption from South Africa during Irish border plant health inspections in May 2020. This rapid PRA has been initiated in order to assess if phytosanitary regulations are justified against this pest.

1.3 What is the PRA area?

The PRA area is Ireland.

1.4 Are there any previous PRAs on the pest(s)?

A previous PRA was performed by the UK in 2004 (Smith 2004). That PRA was initiated following a finding of a single adult in a public market in March 2004 on a potted azalea plant. In the time since that PRA, new information on this pest has emerged on the pest taxonomy and on the pest distribution. In addition, the EU/EPPO EU study DROPSA (Suffert et al 2018) identified *P. callosus* as a pest of high economic importance and one that is likely to transfer with the fruit trade. This pathway has been demonstrated by the interception in Ireland and the risks of establishment and impacts needs to be assessed.

Stage 2: Pest Risk Assessment

2.1 Is the pest present in the PRA area?

There are no records of *P. callosus* in the PRA area. There are no records of interceptions in the PRA area other than the one previously mentioned in 1.2.

2.2 What is the pest's current geographical distribution?

Phlyctinus callosus is indigenous to Western Cape, South Africa (Barnes and Pringle 1989) and has a limited distribution throughout the world. The weevil has been recorded in South Africa (native), Australia (introduced), New Zealand (introduced), Norfolk Island (introduced), Reunion Island (introduced) and St Helena (introduced) (CABI 2020; Dlamini et al 2019; EPPO 2020; Haran et al 2020).

Table 1: Distribution for *Phlyctinus callosus*	
Africa	Reunion Island, South Africa (indigenous to Western Cape), St Helena.
Asia	No records.
Europe	No records.
North America	No records.
South America	No records.
Central America and the Caribbean	No records.
Oceania	Australia, New Zealand, Norfolk Island

2.3 What is the regulatory status of the pest?

This pest is not listed in EU plant health legislation. Recently as of August 2020 *P. callosus* has been added to the European and Mediterranean Plant Protection Organisation (EPPO) Alert list. It has not yet been added to either EPPO A1 or A2 lists.

Phlyctinus callosus is a quarantine pest in the USA where it has often been intercepted. In addition to *P. callosus* as a result of new species identified in the Phlyctinus genus, *P. callosus* sp. are now also regulated (USDA 2020) (CABI 2020). *Phlyctinus callosus* is also regulated in Israel (CABI 2020), Chile (EPPO 2020; MPI NZ 2020), Korea, Mozambique, Thailand and Vietnam (MPI NZ 2020).

2.4 What are the pest's host plants?

While *P. callosus* adults and larvae are key pests in apple orchards (*Malus domestica*) and vineyards (*Vitis vinifera*), this weevil is known to be a highly polyphagous species. Taking account of recent taxonomic changes in South Africa, verified hosts have been reported (Haran et al 2020) for this particular species on a wide range of plant families including:

Aizoaceae (ornamental *Lampranthus* sp.)
Amaryllidaceae (ornamental *Tulbaghia* spp.)
Asteraceae (*Osteospermum moniliferum L.*, ornamental *Gazania* sp.)

Apiaceae (*Daucus carota L*.)
Crassulaceae (*Cotyledon orbiculata L*., *Cotyledon* spp.)
Geraniaceae (ornamental *Pelargonium* sp.)
Plantaginaceae (*Plantago lanceolata* L.)
Plumbaginaceae (ornamental *Plumbago auriculata* Lam.)
and the aforementioned Rosaceae (*Malus domestica*) and Vitaceae (*Vitis vinifera*) families.

Vaccinium corymbosum (blueberry) has also recently been recognised as a host, with native insects such as *P. callosus* reaching pest status on this relatively newly introduced and understudied fruit crop in South Africa after cultivation was first started in the early 1990s (Bredenhand et al 2010; Ferreira 2010; Ferreira and A.P. Malan 2014; Suffert 2018).

This highlights the extensive host range and potential host range of the highly polyphagous pest *P. callosus*. As a result, this section cannot be considered as a fully comprehensive host list.

In addition, when analysing previous records of hosts, recent changes to the taxonomy of *P. callosus* as mentioned in 1.1.2, need to be taken in account adding uncertainty to the current host list. Also, useful to note are the following hosts for the other described species in the *Phlyctinus* genus, from Haran et al, 2020:

- *Phlyctinus grootbosensis* sp. nov. species was found on plants *Osteospermum moniliferum*, Senecio halimifolius L. and *S. burchellii* , only found at Grootbos Private Nature Reserve, South Africa.
- *Phlyctinus xerophilus* sp. nov. found in table grape vineyards (*Vitis vinifera*) and on *Plantago lanceolata* plants in these vineyards.
- *Phlyctinus planithorax* sp. nov. found on *Hymenolepis crithmifolia* (Asteraceae) and *Carpobrotus edulis* (Aizoaceae) plants on Kogelberg Mountain, South Africa.
- *Phlyctinus littoralis* sp. nov. found on host plants *Arctotis angustifolia* (Asteraceae) plants in Kogel Bay beach, South Africa.
- *Phlyctinus aloevorus* sp. nov. found largely on host *Aloe arborescens* (Asphodelaceae). Located at limited areas on the Cape coast between Betty’s Bay and Hermanus, South Africa.

For this PRA, the new species *Phlyctinus xerophilus* sp. nov is potentially significant as it is also found as a pest in orchards and vineyards. Although similar, it can readily be distinguished from *P. callosus* morphologically (Haran et al 2020).

The following (Table 2) outlines previously recorded host plants for *P. callosus*. These are still deemed to be likely hosts of *P. callosus* as this is a species with an extensive distribution and the only species from the *Phlyctinus* genus confirmed to have has been introduced into new areas and other countries.

EPPO major hosts and/or CABI main hosts are highlighted in Table 2. Included also are host plant records from New Zealand's PPIN (Plant Pest Information Network Database) (PPIN 2020) if they were noted to be of economic significance in that database.

Table 2: Host Plants	Reference	Present in PRA Area
Allium cepa (onion)	(PPIN 2020) (EPPO 2020)	Yes
Asparagus officinalis (asparagus)	(CABI 2020)(Prestidge & Willoughby 1990)	Yes
Beta vulgaris (beet)	(PPIN 2020)	Yes
Capsicum sp.	(PPIN 2020)	Yes
Chrysanthemum sp.	(PPIN 2020)	Yes (Ornamental)
Citrus	(PPIN 2020)	No (Yes-ornamental)
Cotyledon sp (succulents)	(Haran et al 2020)(EPPO 2020)	No (Yes-ornamental)
***Daucus carota* (carrot)**	**(CABI 2020) (EPPO 2020) (PPIN 2020)**	**Yes**
Fragaria ananassa (strawberry)	(CABI 2020)	Yes
Gazania sp	(Haran et al 2020)(EPPO 2020)	Yes (Ornamental)
Juglans regia (walnut)	(CABI 2020)	Yes
Lampranthus sp	(Haran et al 2020) (EPPO 2020)	Yes(Ornamental)
Lolium perenne (perennial ryegrass)	(CABI 2020)	Yes
Malus domestica (apple)	**(CABI 2020) (EPPO 2020)**	**Yes**
Papaver nudicaule (Iceland poppy)	(CABI 2020)	Yes
***Pastinaca sativa* (parsnip)**	**(CABI 2020)**	**Yes**
Pelargonium sp. (pelargoniums)	(CABI 2020)(Haran et al 2020)(EPPO 2020)	Yes(Ornamental)
Plantago lanceolata L. (ribwort plantain)	(Haran e t al 2020) EPPO 2020)	Yes (Wild-widespread)
Plumbago auriculata Lam.	(Haran et al 2020) (EPPO 2020)	No (Yes -ornamental)
Prunus domestica (plum)	(CABI 2020)	Yes
***Prunus persica* (peach)**	**(CABI 2020) (EPPO 2020) (PPIN 2020)**	**No**
***Prunus persica* var. *nucipersica* (nectarine)**	**(EPPO 2020)**	**No**
Prunus salicina (Japanese plum)	(CABI 2020)	No
Pyrus communis (European pear)	(CABI 2020)	Yes
Osteospermum moniliferum L.,	(Haran et al 2020)	No
Rheum rhabarbarum (rhubarb)	(PPIN 2020)	Yes
Rosa sp.	(PPIN 2020)	Yes
Rumex acetosa (sour dock)	(CABI 2020)	Yes(Wild- widespread)
Solanum tuberosum (potato)	(CABI 2020) (PPIN 2020)	Yes
Taraxacum officinale (dandelion)	(CABI 2020)	Yes (Wild-widespread)
Tulbaghia spp	(Haran et al 2020) (EPPO 2020)	No
Vaccinium corymbosum (blueberry)	(Bredenhand et al 2010)(EPPO 2020)	Yes

Table 2: Host Plants	Reference	Present in PRA Area
***Vitis vinifera* (grapevine)**	**(CABI 2020) (EPPO 2020) (PPIN 2020)**	**No (Negligible area)**
Zantedeschia sp.	(PPIN 2020)	Yes

In Australia, *P. callosus* is a significant pest of crops such as young and mature *Vitis vinifera* (grapevines), *Malus domestica* (apples) and *Prunus persica* var. *nucipersica* (nectarines). *Phlyctinus callosus* can also be a problem in Australian nurseries with larval stages being the most damaging (Horne 1997; Learmonth et al 2005; CABI 2020).

In New Zealand, *Asparagus officinalis* (asparagus), *Daucus carota* (carrots) and glasshouse crops of *Vitis vinifera* (grapes) are preferred hosts, in addition to some ornamental plants (Butcher 1984; PPIN 2020). A full list of recorded hosts in New Zealand is provided in Annex 1 Table 3 which includes minor and incidental hosts.

2.4.1 What host plants are of economic or environmental importance in the PRA area?

A number of the hosts recorded (listed in Table 2) for *P. callosus* are of economical and environmental importance in Ireland including on the economic side field crops (*Solanum tuberosum, Allium cepa, Pastinaca sativa*), soft fruit (*Fragaria ananassa, Vaccinium corymbosum*) and ornamentals (*Pelargonium, Chrysanthemum*) agricultural (*Lolium perenne, Beta vulgaris*) and in the wider environment (*Plantago lanceolata L., Taraxacum officinale* complex).

Of those currently identified as major hosts*, Daucus carota* subsp. *sativus* (carrot), *Pastinaca sativa* (parsnip) and *Malus domestica* (apple) are the most important crops, albeit covering small areas in Ireland. In DAFM national surveys, carrots are the most important field vegetable in terms of production area and in terms of farmgate value (potato production is excluded in the surveys). There was 716 hectares of carrots grown in 2014 with a farmgate value of €15.4 million (DAFM 2015). Parsnips are also among the main crops produced in the Irish field vegetable sector, 377 hectares with farmgate value of €8.3 million was produced in 2014 (DAFM 2015).

For the Irish apple industry, total apple production area in 2017 was 713 hectares with the farmgate value of Irish apples harvested in 2016 of €5.94 million (DAFM 2017). This includes dessert apples (eating apples), culinary orchard (cooking apples) and cider apples (for cider industry). Only around 5% of fresh apples consumed in Ireland are produced here (Irish Apple Growers Association 2015).

Analysis of the economic or environmental importance of other hosts for *P. callosus* in the PRA area is described in Section 2.12.1. Particularly focus is given to any recorded impacts on hosts present in climatically similar areas to Ireland, e.g. *Fragaria x ananassa* (strawberry) and *Solanum tuberosum* (potato) on which impacts have been recorded in New Zealand and the Australian states of Victoria and Tasmania.

2.5 What is the lifecycle of the pest?

The biology of *P. callosus* has been studied in South Africa and Australia (Annecke & Moran 1982 cited in CABI 2020; Walker 1981). Studies show it is accustomed to dry, hot summers and wet winters of the south-western parts of South Africa. Although Barnes (1989) found *P. callosus* adjusted its life cycle based on different cultural practices (e.g. irrigation) in deciduous fruit orchards that created different microclimates.

Most evidence indicates that this species reproduces sexually. Eggs are laid on or near the soil surface in late summer or early autumn. Depending on temperature, eggs can be laid in batches of 20 (Dlamini et al 2019) and hatch in about 10-14 days. In term of survival, Walker (1981) showed that larval survival was four times greater at 20.0°C than at 15.0°C. Although the author did express caution in extrapolating this data from the laboratory to the field. The theoretical minimum threshold temperature for egg development was deemed to be 6°C (CABI 2020).

In contrast, the current pest distribution, such as the presence of the weevil in areas that experience cold and frost in New Zealand, would indicate the ability of the weevil to survive temperatures lower than those stated above.

After hatching, first instar larvae burrow into the soil, where they feed on the roots of host plants such as carrots and parsnips, or tubers such as potatoes (Miller 1979). Most larvae are found in the top 10 cm of soil (Barnes 1989). The larvae over-winter in the soil and progress through a variable number of instars (CABI 2020).

Adults emerge in the late spring and early summer, feed during the night on hosts, and seek shelter during the day (CABI 2020). Therefore, locating adults can also be difficult in addition to the other cryptic soil-based life stages for this pest. In term of survivability, adults performed better than larvae at 15ºC, with 15% mortality in the first 100 days after emergence compared to 70% mortality at 20ºC (Walker 1981) (CABI 2020).

Phlyctinus callosus has one generation per year, except in summer irrigated fruit orchards in South Africa, where conditions were found to be suitable for a second generation (Barnes 1989; Dalmini 2019; CABI 2020).

2.6 What pathways provide an opportunity for the pest to enter the PRA area and transfer to a suitable host, and what is the likelihood of the pest entering the PRA area?

2.6.1 Fruit

The various factors that affect the risk of *P. callosus* entering on the fruit pathway are discussed below. For this pathway, only major fruit hosts *Malus*, *Prunus persica*, *Vaccinium corymbosum* (considered important hosts in some recent literature sources) and *Vitis vinifera* for this pest were analysed.

Current Regulations

Phlyctinus callosus is not an EU regulated pest. Current EU phytosanitary measures (EU 2019/2072)[1] are in place on the imports of fruit under the genus name *Malus* Mill. from third countries. However, these are for other pests including another Curculionidae *Anthonomus quadrigibbus* and also for *Botryosphaeria kuwatsukai*, *Grapholita inopinata*, *Grapholita prunivora* and *Rhagoletis pomonella*. These pests occur in North America and Asia, none are found in Africa and Oceania where significant amounts of this trade to the EU originate and where *P. callosus* is located.

Fruits of *Prunus* L. are regulated from third countries for Tephritidae (non-European) and fruits of *Prunus persica* (L.) from countries of the African continent, Saint Helena and La Reunion for the pest *Thaumatotibia leucotreta* (false codling moth).

In addition, as all fruits can only be imported into the EU if accompanied by a phytosanitary certificate (exception only for pineapples, coconuts, durians, bananas and dates) they are subject to inspection at export and import ensuring their compliance with this EU legislation.

Phlyctinus callosus is a regulated pest in a number of countries (e.g USA, Israel) this could affect the likelihood of entry on the pathway to the PRA area, as growers will be taking measures to actively avoid the pest being associated with harvested fruits.

Trade

The interception of live *Phlyctinus callosus* weevils indicates the trade in *Malus domestica* from South Africa as a viable pathway for entry of this pest into Ireland. This would not be unusual as *P. callosus* is often found on commodities packed for export (Opatowski 2001). UK PHSI (Plant Health and Seeds Inspectorate) have also intercepted this pest on previous occasions in association with imported produce from South Africa, so the pathway has been well demonstrated (Fera pers. comm. May 2020).

Ireland imports significant quantities of apples (*Malus*) from South Africa, one of our biggest import partners for fruit and vegetables. Data was extracted from Eurostat on trade in fruits under various commodities over a five-year period from 2015 to 2019, this is summarised in Annex 2, Table 4. Total imports for the commodity fresh apples from South Africa were 10,750 tonnes. A five-year period was selected to take account of variable trade patterns, although for this particular trade, the trend has been steadily increasing every year from 1,700 tonnes in 2015 to 2,500 tonnes in 2019. South Africa is the third largest

[1] http://data.europa.eu/eli/reg_impl/2019/2072/oj

importing partner for fresh apples in the EU after New Zealand and Chile (EU 2020).

Ireland imported a total of 7,350 tonnes of fresh apples from New Zealand over the period 2015-2019. Therefore, these two export countries contribute markedly to the total Irish apple imports, the second largest fruit we import (CSO 2018). Trade data for imports into the UK was also included as some of this is destined for Northern Ireland although it's not known exactly how much (Annex 2, Table 4).

Interceptions of *P. callosus* have also been recorded on the trade in table grapes. In the USA *P. callosus* has been intercepted on table grapes since at least the 1960s on consignments from South Africa (CABI 2020). Ireland also imports table grapes from South Africa; in the last five year some 5,200 tonnes have been imported as seen in Annex 2.

Phlyctinus callosus has been intercepted on grapes imported into New Zealand presumably in this case from Australia as interception data was analysed only on grape imports from Australia, Chile, Mexico and USA from 1987 to 2008 (Verhagen et al 2009). There was no trade data found for imports of fresh grapes from Australia to Ireland or the UK.

A search on Europhyt for trade interceptions of *P. callosus* (PHLYCA) on fruit or any commodity from the period 01-01-1994 to 24-05-2020 did not yield any results. This suggests that the pest is not regularly intercepted in Europe, although known findings in Ireland and the UK were not reported on this platform.

The fact that adult weevils have demonstrated an ability to survive transit for this particular trading route of apples from South Africa to Ireland is important to note when assessing likelihood of entry.

Transfer & Life stages associated with the pathway

This pathway (pest associated with table ready produce) is less risky than plants for planting as adults are required to make an additional step in escaping outdoors onto host plants in order to establish. Although the wide host range and ability of this pest to hitchhike makes this more of a possibility than other fruit pests.

The timing of trade and the life stages associated with this pathway would appear to be important factors to consider. The trade of apples from South Africa to Ireland occurs most years from Mar/April to October. The life cycle (Section 2.5) for *P. callosus* suggests adults emerge at spring/summer (September onwards for Southern Hemisphere). Therefore, the interception of adult *P. callosus* at the Irish port of entry in May suggests the pest could occur in counter season trade. Although significantly, Barnes & Pringle (1989) did note that adult

P. callosus could be collected at any time of the year in deciduous fruit orchards in Grabouw, Western Cape, with findings on the weed host *Plantago lanceolata* L. (ribwort plantain). In addition there is evidence that *P. callosus* can have two generations per year in optimal conditions, in these instances adults emerge in the autumn (March in Southern Hemisphere) (Barnes 1989) which then coincides with the start of the trading period to Ireland.

The trade in table grapes from South Africa to Ireland starts in December and continues until April/May. As above, the adult life stages could be associated with this pathway. Research in this area and into the source of insect contaminants in export consignments of South African table grapes was performed by Pryke (2005). Of particular relevance was studies and monitoring of packhouses to establish whether phytosanitary pests such as *P. callosus* infested the grapes via packhouses. *Phlyctinus callosus* was not found in any packhouses monitored, thus the source for *P. callosus* as contaminants was likely from the field.

Related to trade in fruits, vegetable commodities were also considered such as trade in asparagus as this host is an important host of *P. callosus* in New Zealand. Ireland imported asparagus only from Australia and in recent years only in 2016 with small quantities (100kg).

Conclusion

Likelihood of entry on fruits is moderately likely with medium uncertainty. This pathway for entry has been demonstrated for Ireland with the recent interception of live *P. callosus*. There is medium uncertainty due to the fact that the pest has not been intercepted regularly in the EU. In addition, the pest may have difficulty transferring from fruit produce to a suitable host, lowering the risk of entry on this pathway.

Likelihood

Negligible		Very unlikely		Unlikely		Moderately likely		Likely		Very likely	
							✓				

Uncertainty

Low		Medium		High	
			✓		

2.6.2 Plants for planting

Current Regulations

The trade in plants for planting is recognised as one of the most risky pathways for the entry of pests into new areas and therefore is subject to many current phytosanitary regulations. The vast host range *of P. callosus* includes many commonly traded plants and would indicate that this is a potentially viable pathway for entry of this pest. A number of prohibitions and phytosanitary measures exist against known hosts of *P. callosus* in EU legislation (2019/2072)[2]. This includes prohibited plants such as plants of *Vitis* (a major host) from third countries. While the Commission Implementing Regulation (EU) 2018/2019[3], which establishes a list of high risk plants for planting that are provisionally prohibited from entering the EU pending a full risk assessment, includes major hosts from genus *Malus* Mill. and *Prunus* L.

Soil is also prohibited from entry into Ireland and into the EU from third countries (Commission Implementing Regulation (EU) 2019/2072), although in some instances plant commodities associated with planting (bulbs for planting) can contain very small amounts of soil, 1% or less of total weight of consignment or lot.

Trade

As stated in the previous pathway, there has been no Europhyt notifications for *P. callosus* for interceptions, this includes traded plants into the EU or any outbreaks recorded in the EU. However, there was a report of a finding of a single *P. callosus* adult in England from 2004 (Brown 2004), this was assessed in a UK PRA for this pest (Smith 2004). This finding in a public market was discovered on a potted azalea plant. While the precise details of that finding are not available, the trade in ornamental plants is suspected as the most likely way of introduction (Smith 2004).

For this PRA, trade analysis on the number, the nature and the size of various plants for planting commodities between Ireland and either South Africa, New Zealand or Australia was performed to determine the risk of introduction. Data on this trade was extracted from Eurostat and is summarised in Annex 2 Table 5. Overall, trade in plants for planting between these countries and Ireland occurs at relatively low levels and is sporadic. In recent years, no single plants for planting commodity were traded continuously every year. As a result, data was gathered for the previous five years and covers a range of plants for planting commodities.

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2 http://data.europa.eu/eli/reg_impl/2019/2072/oj
3 https://eur-lex.europa.eu/eli/reg_impl/2019/2072/oj

The largest five-year total of these commodities was for trade in *Unrooted cuttings and slips (excl. Vines)* from Australia with 58 tonnes imported. As *P. callosus* is especially a problem in Australian nurseries with larvae the most damaging (Horne 1997) and this particular stage of this pest lifecycle is one most likely to go undetected in trade, a risk of entry does potentially exist. However, given the commodity in question is unrooted cuttings and slips, this would be considered a low risk pathway for a weevil pest that lives mostly in soil/roots. The only other plants for planting commodity traded between Ireland and Australia is *Live outdoor plants, incl. their roots*. There were 0.2 tonnes of this commodity traded, all in the year 2016. The UK imported significantly more quantities at over 56 tonnes, but it is not known how much of this trade was destined for Northern Ireland. Phytosanitary measures related to soil accompanying plants from third countries within EU plant health legislation would help reduce the risk of the pest being associated with this particular trade. This commodity was also traded in very small amounts (<100kg) with New Zealand and South Africa, the only other countries where *Phlyctinus callosus* is known to be present and where trade occurs with Ireland.

The remaining commodities which yielded any trade data were all traded in relatively small amounts and all traded with New Zealand. In that country *P. callosus* has been found to have a geographical wide distribution as outlined in Annex 1 Table 3 which includes a pest record for *P. callosus* found in nursery soil. The pest however does not appear to be a significant problem in New Zealand nurseries as outlined in this PRA in section 2.11.1 Economic impacts in pest current distribution. The sporadic and localised nature of the pest as oppose to a significant, widespread problem would lower the probability of entry. The risk of *P. callosus* entering on this pathway is therefore considered low.

In addition to the trade in live plants commodities, other commodities that fall under the general plants for planting category were considered. For example as Butcher (1984) and May (1966) state, *P. callosus* attacks the bulbs and corms of plants, therefore the following traded products were considered:

Bulbs, tubers, tuberous roots, corms, crowns and rhizomes, dormant, in growth or in flower; chicory plants and roots other than roots of heading

However, no trade data was found between Ireland and either South Africa, New Zealand and Australia for this commodity. While there is trade between New Zealand and Ireland for commodities within:

Onions, shallots, garlic, leeks and other alliaceous vegetables, fresh or chilled

these included commodities for consumption and did not include any plants for planting commodities or onion sets.

Transfer & Life stages associated with the pathway

A transfer step to a suitable host would not be necessary with the movement of *P. callosus* in the plant trade for the pest to enter the PRA area. The association with a suitable host is already made in many instances. Adults and eggs which are laid near the surface are most likely to be detected than the soil borne larval stages. The larvae as root feeders are therefore the life stage most likely to be associated with this pathway, in particular on rooted plants for planting.

Conclusion

Likelihood of entry on plants for planting is unlikely with medium uncertainty. There a number of reports in the literature of *P. callosus* in nurseries. The finding in the UK of a single *P. callosus* would indicate that the trade in ornamental plants poses a risk. The potential presence of eggs, larvae, pupae or adults in soil means there is a risk of the pest going undetected and entering the PRA area.

However, trade occurs at low levels between Ireland and countries where *Phlyctinus callosus* is present. Current phytosanitary regulations between the EU and third countries on soil and on plants for planting for a range of *P. callosus'*s hosts would also reduce the chances of the *P. callosus* entering.

Uncertainty is medium, as it is not known what proportion of imported plants for planting would include known hosts of the pest, this information is not detailed in trade data for plants for planting commodities.

Likelihood

Negligible		Very unlikely		Unlikely	✓	Moderately likely		Likely		Very likely	

Uncertainty

Low		Medium	✓	High	

2.6.3 Cut Flowers

Current Regulations

All cut flowers from third countries including those where *P. callosus* is currently distributed require a phytosanitary certificate when imported into the EU. This document certifying that the produce is free from quarantine pests should also reduce the chances of the unregulated *P. callosus* being associated with this trade.

Trade

While imports of cut flowers from South Africa were in high quantities to the UK (around 1,800 tonnes in 2018) it is not clear how much of this trade was destined for Northern Ireland. Trade to Ireland was in much lower volumes, again only from South Africa with <100kg in 2016, 8 tonnes in 2018 and 0.9 tonnes in 2019.

Transfer & Life stages associated with the pathway

Cut flowers usually have very high quality standards, with this commodity all life stages would likely be detected. Additionally, it is very unlikely that the damage caused by *P. callosus* would be tolerated.

There is also low risk of transfer of *P. callosus* from cut flowers to a suitable living host. This can only occur when cut flowers are kept outdoor or disposed of outdoors in close proximity to suitable host plants.

Conclusion

Entry on plant parts and plants products were considered in particular on cut foliage such as cut flowers. However, the cut flowers pathway was deemed to pose a very unlikely to negligible risk.

Likelihood

Negligible		Very unlikely	✓	Unlikely		Moderately likely		Likely		Very likely	

Uncertainty

Low	✓	Medium		High	

2.7 Does the pest require a vector and is that vector present in the PRA area?

Phlyctinus callosus does not require a vector, it is a free living organism.

2.8 How likely is the pest to establish outdoors or under protection in the PRA area?

2.8.1 Establishment outdoors

Several different factors affect the likelihood of *P. callosus* establishing in the PRA area, and these are discussed below.

Climate

A comparison of the climate from the known global distribution of *P. callosus* and the climate in the PRA area is essential in the judgement for potential establishment of the pest in Ireland. By means of the Köppen–Geiger climate classification system (Kottiek et al 2006) which describes climate zone in terms of average minimum winter temperature and summer maxima and amount of precipitation and seasonality, Ireland is a 100% match for the climate type Cfb (temperate oceanic climate). Outside of Europe this climate type is not common in other individual countries except for New Zealand (MacLeod and Korycinska, 2019).

While most records in the literature on pest distribution in New Zealand surround how *P. callo*sus was first reported as a sporadic occurrence in gardens and small areas in Auckland (Kuschel 1990), reports then provide evidence for *P. callosus* establishment in further parts of North Island and also in Nelson in the South Island (Butcher 1984). However, a lack of data on the pest distribution in New Zealand was noted in the UK PRA (Smith 2004).

Therefore, for this PRA, pest distribution records were requested and supplied by New Zealand NPPO, these are outlined in Annex 1 Table 3. These records reveal that the distribution of the pest was found to cover much of New Zealand apart from the far south. This would suggest that this weevil can establish in areas that get cold, in more unfavourable conditions than previous studies indicated (Section 2.5 Life cycle of the pest). This may provide evidence of an even greater capacity of the pest to adapt to a wide range of habitats than data from its native range would indicate. This adaptability would increase the potential for *P. callosus* to establish in the PRA area. There is also the possibility that other *Phlyctinus* species are in fact also in abundance in New Zealand. In the Haran study, all specimens outside of South Africa were identified as *P. callosus* but just one single specimen from New Zealand was analysed.

The most southerly records from the New Zealand is Invermay, which is outside Mosgiel (city of Dunedin). However, it is noted that this particular record is described as nursery soil which may not present direct evidence for outdoor establishment. The next most southerly records are from Christchurch, in Mid Canterbury. While detailed climate suitability studies were not performed for this PRA, basic climate matching tools (CLIMATCH) found these areas to be very similar to Ireland's climate.

Further evidence exists through public submitted records on online biodiversity databases (GBIF 2020), although they should be treated as less reliable than the NPPO data. These records would indicate that the pest is still found in these southern areas mentioned above, such as Mid Canterbury. This resource also highlights that the pest is still most abundant in the warmer areas of New Zealand.

In other countries where *P. callosus* is distributed, the only similar climate zones to Ireland are found in the Australian state Victoria (predominantly a Cfb climate zone) and the state of Tasmania (fully Cfb climate zone). Both states have records of *P. callosus* and in fact *P. callosus* first established in Tasmania, from where it spread to other areas in Australia (CABI 2020).

Host plants and suitable habitats

For *P. callosus* to establish, it needs to find host plants or suitable habitats in the PRA area.

Evidence for the presence of hosts in Ireland listed in Table 2 were found for 29 of the 34 named hosts here. While technically present in Ireland they are of varying levels of abundance and importance. They appear mainly in nurseries, vegetable production, fruit production and in the wider environment. The hosts mostly likely to aid establishment are discussed below.

Away from a cultivated environment, *P. callosus* is likely to occur in the wider natural or unmanaged environment (CABI 2020).

In South Africa an important wild weed host is *Plantago lanceolata* L. (Ribwort Plantain), this plant is very widespread in Ireland (NBDC 2020). While other common plants in Ireland such as dock and dandelion (NBDC 2020) play an important role in Australian vineyards in supporting large numbers of garden weevil and influence the distribution of larvae (Fisher and Learmonth 2003). These could also play a role in sustaining populations in Ireland. While with carrot listed as a host, given that there are several wild type apaciae in Irish hedgerows and field margins, this could also be a reservoir for survival and persistence of *P. callosus.*

In New Zealand, vegetable crops such as carrots and onions are listed as hosts (Annex 1 Table 3). These two crops are important in terms of vegetable production in Ireland. It is worth noting that the largest production areas are generally in the East of the country. For carrots the largest production areas are in Counties Wexford, Louth, Kilkenny, Meath and Laois (DAFM 2020). For onion, their production has fluctuated in recent years, but they are still the most important alliums crop grown in Ireland. Current crop area data shows largest areas are in Cork, Dublin and Kilkenny (DAFM 2015; DAFM 2020). The major port of entry for the fruit pathway which requires a transfer to a suitable host (as discussed Section 2.6.1) is located in the East (Dublin Port).

Similarly, the largest areas for hosts parsnips and orchard fruit are located in the East, in County Dublin (DAFM 2020).

Natural enemies

There is limited evidence of control of *P. callosus* using natural enemies in its native region (Barnes 2014; Thorpe 2015). With Barnes (1987) noting that natural enemies appear to be ineffective albeit it is difficult to assess. As a result, a search for presence or absence of natural enemies in the PRA area was not performed (Witt et al. 1995).

Conclusion

Overall the likelihood of establishment is likely with high uncertainty. The evidence for establishment of *P. callosus* populations in Ireland is based on pest distribution data in particular in New Zealand but also in the Australian states Victoria and Tasmania. Comparable climatic conditions and the availability of host plants in Ireland provide conditions to support establishment.

However, no detailed climate suitability studies were performed as part of this PRA. The literature refers to a preference generally for *P. callosus* for regions with a mediterranean or warm temperate climate (CABI 2020). For *P. callosus*, Pryke and Samways (2007) noted that the abundance of weevils went up in South African vineyards when temperatures increased. **The PRA area may be marginal for establishment of damaging levels of *P. callosus*.**

High uncertainty exists due to the possibility that other Phlyctinus species are in fact also in abundance in New Zealand.

Likelihood

Negligible		Very unlikely		Unlikely		Moderately likely		Likely	✓	Very likely	

Uncertainty

Low		Medium		High	✓

2.8.2 Establishment under protection

Phlyctinus callosus can establish in protected cultivation. In New Zealand, *P. callosus* occurs in glasshouses where it is a pest of grapevines (Lo et al 1990).

In Australia, *P. callosus* is a pest of strawberries where the larvae feed on the roots of strawberries and adults on the foliage, in field and greenhouse grown strawberries (Curran and Patel 1988; Fisher and Learmonth 2003).

In Ireland, the protected crop sector accounts for 20% of total horticulture output of which 15% is food crops and 5% is ornamental crops. There has been recent growth in this sector driven by strawberries, with protected strawberries now the mainstay of the soft fruit industry in Ireland. Other soft fruit such as raspberries and blueberries are also important. The other main crops grown are tomatoes, lettuce, cucumbers and peppers (Bord Bia 2020; Teagasc 2020b)

While blueberries and peppers are listed as hosts of *P. callosus*, the most likely host to lead to establishment of *P. callosus* in protected cultivation in Ireland is strawberry. This is due to the larger area under production and also due to the continuous problem posed by vine weevil (*Otiorhynchus sulcatus*) in Irish strawberries, a weevil with a similar biology to *P. callosus*.

In Australia, both vine weevil (*Otiorhynchus sulcatus*) and *P. callosus* are known to feed on strawberry, stunting plants and reducing vigour (Curran and Patel 1988).

In Irish nurseries and in particular in Irish strawberry production, problems with vine weevil control is continuing, driven by the move to protected cultivation and the loss of pesticides (Gaffney 2014). These changing cultivation practices may also aid the establishment of *P. callosus*. For instance, the increased temperatures under protection have allowed vine weevil (*Otiorhynchus sulcatus*) to expand its period of activity. Outdoors in Ireland vine weevil populations are found largely at the same stage, small larvae in autumn, larger larvae in spring, emerging adults in early summer, frass feeding and egg laying from August to October. In contrast under protection you can observe adults surviving the winter and even some large egg clusters being laid in winter. The same issue could arise with *P. callosus*, as previously noted, abundance increased as temperature increased, albeit outdoors in South African vineyards (Pryke and Samways 2007) (Gaffney 2014) (Gaffney per comm. Sept 2020).

When drawing comparisons with Australia it is important to note that strawberry production is similar in Australia. Some production is still outdoors and in the ground, but many more growers now use artificial substrates, on table tops under plastic (P.Horne pers. comm. Aug 2020).

When comparing *P. callosus* and vine weevil it is worth noting the differences in sexual reproduction which could affect the probability of establishing new populations of *P. callosus*. For vine weevil only females are known so it only takes a single individual (egg, larva or adult) to begin an infestation. In contrast, *P. callosus* has both males and females (Horne 1997) and the majority of the literature states that *P. callosus* reproduces sexually. A new population in a new area would need at least a mated female, or a male and a female, in order to establish a population (Smith 2004; Ferreira 2010; CABI 2020)

One reference was found noting that in Tasmania only females were present (Miller 1979). Which implies that reproduction takes place parthenogenetically. It is unclear if this is a misidentification or if any similarities could be drawn to the Irish weevil species *Liophloeus tessulatus* which can reproduce both parthenogenically and sexually depending on altitudes.

Different control options may be required for *P. callosus* than for vine weevil. In Australia the insecticide Avatar® (indoxacarb) is approved for use on for control of *P. callosus* on strawberries. This insecticide is not approved for use on strawberries in Ireland although it is approved for other crops. In an application for its minor use permit in Australia, it states that a permit is required as there is currently no agrochemical product registered for use on strawberries for the control of *P. callosus* and that chemical control is the only effective and efficient method of control (Lean 2013; APVMA 2018).

It is not clear if biological control currently used for vine weevil would also be effective for *P. callosus*. Curran and Patel (1988) state that there are differences in how effective different entomopathogenic nematodes are for vine weevil and *P. callosus,* depending on the species of nematodes used.

Conclusion

Overall the likelihood of establishment of is likely with low uncertainty. The climatic conditions provided by protected crops and the cultivation of hosts such as strawberries would lead to successful establishment of *P. callosus*, as has been the situation in Australia. The production systems in Australia seem to be of a similar nature providing evidence that *Phlyctinus callosus* could establish alongside vine weevil (*Otiorhynchus sulcatus*) in Ireland.

Likelihood

Negligible		Very unlikely		Unlikely		Moderately likely		Likely	✓	Very likely	

Uncertainty

Low	✓	Medium		High	

2.9 How quickly could the pest spread in the PRA area?

2.9.1 Natural spread

While adults are mobile in that they can climb up to the canopy of hosts, natural spread of adults is limited, as adults do not fly since their elytra are fused together (Annecke and Moran (1982) cited in CABI 2020). Adults are more likely to spread by human assisted means, Haran et al (2020) stating that prediction of their natural range is challenging due to this human influence.

As an introduced species in Australia, *P. callosus* has spread to a number of southern states such Tasmania, Victoria, South Australia and also to Western Australia (EPPO 2020; Haran et al 2020; Horne 1997; Learmonth 2011; Miller 1979) *Phlyctinus callosus* is widely dispersed in Australia, where localised severe problems are noted in each state, while no problems are observed in many areas (Horne 1997).

Phlyctinus callosus has spread throughout New Zealand apart from the very South (MPI NZ pers. comm. Jun 2020) as outlined in Annex 1 Table 3. Prestidge and Willoughby (1990) stated that, while it quickly assumed the status as a major pest on asparagus in New Zealand, it did not spread widely with only localised areas in the North Island affected. The role of natural spread in this history of *P. callosus* pest distribution is not likely to have been a major factor.

With the larvae and pupae of *P. callosus* inhabiting soil, Barnes (1987), asserted that the larvae do not disperse much in the soil (Magagula 2019). These particular life stages of the weevil are likely only to spread to new areas through movement of infested plants or soil (Horne 1997; Dlamini et al. 2020).

Within nurseries, Horne (1997) notes that infection and damage may be noticed in patches and localised rather than widespread as the flightless weevils move quite slowly.

Barnes and Capatos (1989) did suggest *P. callosus* has aggregation pheromones. It is suggested that the pheromone is secreted to indicate to other *P. callosus* adults the presence of a palatable host plant. No further studies on *P. callous* and aggregation pheromones including in terms of potential control were found.

Conclusion

As *P. callosus* does not have an ability to fly and no evidence in the literature suggests long natural dispersal, the **rate of natural spread is judged to occur very slowly with medium uncertainty**. There is uncertainty over the role aggregation pheromones due to a lack of studies in this area due to difficulties of rearing it in the laboratory (Thorpe et al 2016).

Rate

Negligible		Very slowly	✓	Slowly		Moderately pace		Quickly		Very quickly	

Uncertainty

Low		Medium	✓	High	

2.9.2 Spread with trade

If *P. callosus* establishes in Ireland, there is potential for *P. callosus* to spread with the plant trade, as (i) it is a polyphagous pest that has been recorded on a wide range of plant taxa present here and (ii) it is a known root feeder.

While occasionally adults, in particular emerging adults, are found in the soil, the recognised soil stages of *P. callosus*'s life cycle are the larvae and pupae. These can remain in the soil for a long time (Ferreira and Malan 2014) increasing the likelihood of this pest moving passively in the trade of rooted plants.

Given the association of the pest with a range of ornamental plants, there is a risk of the pest moving around the country through buyers of plants (i.e members of the public).

In Ireland, there is also trade between nurseries and garden centres in addition to inter trade between nurseries in Ireland.

Gourlay (1955) uses the occurrence of *P. callosus* in Nelson, New Zealand as an example for the necessity to have regulation on moving trade in nursery stock from areas known to have the pest to areas which are free from this pest.

Another factor that could enable spread is detection of the pest, for example as both vine weevil (*Otiorhynchus sulcatus*) and *P. callosus* occur together in Australia in plant nurseries (Horne 1992) and in strawberries (Curran and Patel 1988), larvae are easily confused with each other (Horne 1992; Miller 1979). Given vine weevil is a serious established pest in Ireland, even if *P. callosus* damage is detected, it may be misidentified as vine weevil damage. There are morphological differences between the species particularly in adult form, although the *P. callosus* nocturnal behaviour may allow them to go unrecognised for a period of time.

Vine weevil (*Otiorhynchus sulcatus*) continues to move within the plant trade in Ireland, although, not as much as it used to, due to better control in this area (D. Flanagan pers. comm. Aug 2020). For the fruit and vegetable sectors they are unlikely to facilitate to the same degree the movement of this pest although any movement of infested soil could lead to new outbreaks.

The potential for *P. callosus* to spread to new areas as a hitchhiker is also a risk. This is potentially through movement of people but also as a contaminant on trade (i.e. intercepted in consignments involving non-host plants).

Conclusion

***P. callosus* has great potential to move passively in the plant trade, the rate of spread is judged to occur quickly** particularly if the pest establishes in Ireland and within the EU, as the plant trade could facilitate the rapid spread of the pest.

There is medium uncertainty as clear evidence of the role of trade and other factors has played in the pests current distribution is not clear.

Rate

Negligible		Very slowly		Slowly		Moderately pace		Quickly	✓	Very quickly	

Uncertainty

Low		Medium	✓	High	

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

There is no evidence that that *P. callosus* is a vector of plant pathogens.

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

2.11.1 Economic impacts

In its native South Africa, *P. callous* is an important economic pest of grapevine and of deciduous fruits in particular apples (Dlamini et al 2019).

There are few estimates of the financial impact of damage caused by *P. callosus*, except for apples in South Africa. Witt et al (1995) cites sources that estimate 40% of all damage to apples in the 1970s in the Elgin area of Western Cape, South Africa was caused by *P. callosus*. Later in 1981 in this region, crop losses and fruit damage were estimated to cost an annual loss of US$ 100 000 and in 1987 losses of US$ 550 000.

Also, in the Elgin area, a study examined crop loss in apple orchards with cv. Granny Smith, where damage was monitored on two farms during the period 1981-86. Fruit damage was variable between trees, from less than 1% to 66% where populations of *P. callosus* were not controlled. The average crop loss between seasons varied from 5% to 29% (Barnes & Giliomee 1992).

In South Africa, the pest is also of phytosanitary importance as fruit consignments are rejected by importing countries where *P. callosus* is regulated. For example, in Hex River Valley, South Africa's main table grape producing area, *P. callosus* is one of the main phytosanitary pests and is responsible for the most rejections (Pryke 2005).

The direct damage on the grapes may not always be of economic importance but applying effective postharvest treatments is needed to reduce trade rejections and to prevent trade related economic impacts (de Villiers & Pringle 2008).

Phlyctinus callosus has also been reported recently as pest of blueberries in South Africa. This is still considered a new and understudied fruit crop in South Africa (Ferreira 2010; Dlamini 2018). The extent of impacts is not well documented. The adult weevil causes damage to fruit by chewing the skin as well as the underlying flesh. Monitoring in blueberry orchards found infestations of *P. callosus* in these orchards and identified its potential as a serious pest for this host (Ferreira and Malan 2014; Bredenhand et al 2010).

Phlyctinus callosus is a key insect pest of wine grapes in Western Australia, a study found untreated plots yielded 4.1t/ha less than sprayed plots (Learmonth 2011). Also noted was damage caused to growing tips of vines affecting the structure of vines and the number of buds for the following season. In addition, damage seen on individual berries could lead to bunch diseases such as the ones caused by *Botrytis* (Learmonth 2011). As quoted in an article by Smith (2006) Learmonth states that adults can kill newly-planted vines and reduce yields of mature vines by up to 70%.

In a study on managing weevils in Australian apple fruit orchards, Learmonth (2005) suggests that since the arrival of *P. callosus* in Western Australia in the 1970s its pest status has changed, with apple weevil (*Otiorhynchus cribricollis*) now more important in apple orchards which previously had problems with *P. callosus*. However, no such situation exists with affected vineyards, these vineyards continue to have problems with *P. callosus*.

In analysis of Western Australia grape pest reports from 2015-2017, *P. callosus* was the most reported beetle (Hammond and McCarthy 2018). The report outlined how *P. callosus* will damage grapevines by skeletonising leaves and chewing the bark of new shoots and bunch stalks, with damage particularly noted on young vines.

In addition to vineyards and orchards in Australia, the nursery sector is also affected. Horne (1997) notes that, amongst weevils most likely to cause problems, vine weevil (*Otiorynchus sulcatus*) is the most serious problem in nurseries, as its larva can ringbark plants. This is followed by the next most economic damaging weevil *P. callosus*, mainly due to larval damage caused to roots. Fuller's rose weevil (*Asynonychus cervinus*), whitefringed weevil (*Graphognathus leucoloma*) and vegetable weevil (*Listroderes difficilus*) are considered less serious pests.

Although *P. callosus* may not be considered a major pest in Australian nurseries and in strawberry crops, it is still a problem that needs to be dealt with fairly regularly (P.Horne pers. comm. Aug 2020). In a report for a pesticide permit application Lean (2013) states that *P. callosus* is a significant pest of strawberries, while it is sporadic, it can cause significant crop damage particularly when high numbers develop. In one recent case, adult weevils were found to cause large damage in the leaves and crowns of strawberries after peat bags were re-used from the previous season (A.Mathews per comm. Aug 2020).

Phlyctinus callosus can also occasionally be a problem in root crops such as carrots and potatoes in Australia (per comm. Horne 2020). A more recent work has been looking at *P. callosus* as a pest of olives trees (*Olea europaea* L.) and truffle (*Tuber melanosporum*) host trees with leaf and fruit feeding by the adults an issue but predominately research on this pest is continuing on grape vines (A.Mathews pers. comm. Aug 2020).

In New Zealand, adult *P. callosus* have been reported as a major pest of asparagus. In the Waikato, Bay of Plenty, Manawatu and Taranaki regions of the North island of New Zealand adults feed on emerging asparagus spears during peak harvest period leading to product quality downgrades (Prestidge and Willoughby 1989; Prestidge and Willoughby 1990).

Phlyctinus callosus is also a pest on glasshouse grapes in New Zealand with adult weevils feeding on leaves, young shoots and fruit stalks as opposed to the fruit (Lo et al 1990). Damage is not noted on individual berries as mentioned on studies on the pest in Australia (Learmomth 2011), although in New Zealand it has been observed that frass deposited can cause spoiling of the fruit. It can again be considered a phytosanitary pest potentially affecting exports. Lo et al (1990) suggest while these weevils are a minor pest in horticultural crops in New Zealand and in the glasshouse grape industry overall, they are a major problem for some individual growers. Their research also highlights the difficulty in controlling *P. callosus* with insecticides in glasshouses due to the extended period of emergence of adults in this type of cultivation.

No other records on impacts were found in the published literature. Other sources, such as pest records from the New Zealand surveillance database PPIN, were consulted (PPIN 2020). In this particular database, each record of *P. callosus* includes information on the host it was found on and if this association is of economic significance. This is outlined in Annex 1.

The lack of recent publications reporting on impacts suggests that the weevil may presently not be causing any major impacts in New Zealand.

Conclusion

The polyphagus weevil *P. callosus* has caused large economic impacts with medium uncertainty, on a number of hosts, in particular on apples and grapes in its native region in South Africa. There is evidence of significant damage caused to wine grapes in Australia. It may be causing lower impacts in the horticulture and agricultural sectors in Australia and New Zealand but is still a pest that requires management and can cause damaging localised impacts for growers.

There is medium uncertainty due to a lack of current studies on economic impacts that include monetary values or yield losses.

Economic Impacts

Negligible		Very small		Small		Moderate		Large		Very large	
									✓		

Uncertainty

Low		Medium		High	
			✓		

2.11.2 Environmental impacts

There is little published evidence on the level of damage caused by *P. callosus* in the wider environment. *Phlyctinus callosus* is not known to have any significant ecological impact on indigenous plants in New Zealand (Brockerhoff and Bain 2000). As *P. callosus* has been recorded on a wide variety of plant taxa, feeding directly on native plants is possible and there may be some environmental damage.

There could be indirect environmental effects due to an increased use of insecticides. For instance, there were recent concerns expressed by wine producers in Western Australia about the over reliance and ongoing use of one insecticide active Indoxacarb (Avatar®) for the control of *P. callosus* (Anon 2017). This presents a risk of development of undesirable changes to the pest such as insecticide resistance with consequences for the environment.

The environmental impacts are rated as small although there is medium uncertainty due to the lack of studies in this area.

Environmental Impacts

Negligible	☐	Very small	☐	Small	✓	Moderate	☐	Large	☐	Very large	☐

Uncertainty

Low	☐	Medium	✓	High	☐

2.11.3 Social impacts

Social impacts may be affecting members of the public in the pest current distribution. *Phlyctinus callosus* is often found in private gardens on ornamentals (Haran et al 2020) and is commonly called garden weevil in Australia and New Zealand. It also is known to impact vegetable and fruit trees which may be grown in private gardens (Kushel 1990).

Other social impacts are related to the economic impact. Localised outbreaks can have damaging impacts on individual growers. However overall social impacts are rated as small.

Social Impacts

Negligible		Very small		Small	✓	Moderate		Large		Very large	

Uncertainty

Low		Medium	✓	High	

2.12 What is the pest's potential to cause economic, environmental and social impacts in the PRA area?

2.12.1 Economic impacts

Phlyctinus callosus has potential to cause economic impacts in the PRA area. Of the major hosts in the pest's native region, *Malus* Mill. (apples) would be the most significant in Ireland. However, the economic importance of apple production in Ireland is currently of a low level, about 5% of fresh apples consumed here are produced here in a retail market of 100 million euros annually. While there is scope to increase the Irish area of production (Irish Apple Growers Association 2015) the small area currently under production combined with the uncertainty about establishment to high levels (Section 2.8.1) would mean economic impacts seem to be unlikely, although if the environmental conditions were favourable to the pest impacts on individual growers could be seen.The use of insecticides with active ingredient Indoxacarb currently used for *P. callosus* control on apples in Australia, is also registered in Ireland for use on apples which should help to manage economic losses on this crop.

Likely to be of greater economic significance are those hosts where there have been reported impacts in the current pest distribution that share similar climatic zones to Ireland, such as root vegetables in Tasmania and New Zealand (PPIN 2020; CABI 2020). As mentioned in Section 2.4.1, 716 hectares of carrots were grown in Ireland in 2014, making it the most important field vegetable in terms of production area and in terms of farmgate value. In addition, the hosts onions and parsnip are also important field vegetable crops grown in Ireland (DAFM 2015). While *P. callosus* can also be a pest of potato in New Zealand, it is regarded as a minor pest (Matthiessen and Learmonth 1994; Ferreira 2010; PPIN 2020). Ireland planted area of 8,600ha this year for potatoes and this is a crop of high value and economic importance to Ireland (DAFM 2020).

In the PRA area, the economic impacts are likely to be small to moderate on these vegetable crops, given in Australia *P. callosus* is regarded as an occasional and minor pest on these crops and given there are no reports outlining significant damage in New Zealand (Ferreira 2010; P.Horne pers. comm. Aug 2020).

As outlined in section 2.8.2 establishment under protection is judged likely given the suitable climatic conditions and the likely difficulties in control based on experiences here with vine weevil control and based on experiences in New Zealand & Australia with *P. callosus* control under protected cultivation. The crop at most economic risk in protected cultivation in the PRA area is strawberry production.

Strawberries are Ireland's largest protected crop, with the sector continuing to grow in line with strong market demand. Ireland's growers produce around 8000 tonnes of fresh strawberries per year worth an estimated 43 million Euro. (Bord Bia 2020; Teagasc 2020b)

In recent years in Ireland vine weevil has become a significant problem on soft fruit due to increased use of peat-based composts combined with the withdrawal of persistent soil insecticides (Murchie 2020). The challenge in controlling vine weevil could be an indicator for difficulties and cost associated with *P. callosus* control. The control of *P. callosus* may require different chemical or biological control inputs as discussed in Section 2.8.2 which may lead to higher input costs for growers. While as a pest *P. callosus* is more likely to occur more sporadically than vine weevil, it can cause significant damage to strawberry crops when high numbers develop (Lean 2013).

Another potential soft fruit crop affected in the PRA area is host blueberries. The market for fresh blueberries in Ireland is increasing over recent years, although in 2012 it only accounted for 2% of total Irish farmgate fruit value with strawberries occupying 89% (DAFM 2013).

Phlyctinus callosus may also cause economic impacts to other areas of the wider horticultural sector by causing localised but damaging problems for nurseries including the protected ornamental sector. Damage would mainly be associated with larvae feeding on roots. As often with soil pests, growers may only become aware of *P. callosus* when plants start to suffer but by then damage will have been done. Cosmetic damage can also be caused by adults on these crops which can cause economic impact as the value of these crops is based on appearance and quality.

Listed in New Zealand as a host on the PPIN database is *Eucalyptus* (Annex 1, Table 3) which is an important crop in Ireland's cut foliage sector. Current area of production for the cut foliage sector is 220ha with the area dedicated to Eucalyptus currently at 100ha (Teagasc 2020a). Demand in export markets for this product is increasing and prospects for continued expansion are promising. Climatic conditions in the south of Ireland give growers a clear advantage over foliage producers in much of Europe.

However, the details on this single record in New Zealand suggest the association with this host may be incidental or casual. There were no further records found for Eucalyptus and this pest has not been found on eucalyptus in Australia (P.Horne pers. comm. Aug 2020).

Other economic impacts may be caused due to the status of *P. callosus* as a phytosanitary pest. Even if transient populations were to establish in Ireland this could impact exports. Ireland exports plants and plant products to approximately 40 third countries including those where *P. callosus* is a regulated pest. Export commodities such as potatoes, fruit, vegetables, peat, daffodils and live plants could harbour *P. callosus*.

Conclusion

Phlyctinus callosus damages a wide range of crops in each country it has established in. ***Phlyctinus callosus* is likely to cause economic damage in the PRA area. This is likely to be moderate and localised in nature rather that widespread damage. Economic damage to protected crops is more likely.** There is uncertainty on the extent of the impact given the number of host plants which are widely cultivated and distributed in the PRA area.

Economic Impacts

Negligible		Very small		Small		Moderate		Large		Very large	
							✓				

Uncertainty

Low		Medium		High	
			✓		

2.12.2 Environmental impacts

For this PRA, a detailed analysis of the potential impacts on biodiversity caused by *P. callosus* could not be performed due to a lack of data, in particular on the impacts on those hosts that are grown in the wider environment in Ireland. Most evidence for impacts by *P. callosus* are on cultivated crops. As some recognised hosts wild hosts (*Plantago lanceolata* L., *Rumex acetosa*, *Taraxacum officinale* complex) are widespread in Ireland, potential for some impacts or alteration of ecosystems is possible.

With no documented evidence of any significant environmental impacts in similar climatic areas in the *P. callosus*'s current distribution, including as an exotic pest in introduced areas, **environmental impacts are rated as small, with medium uncertainty.**

While *P. callosus* as a polyphagous pest would likely cause direct impacts on some native and wild plants in Ireland, there is uncertainty on the level of impacts caused by the presence of *P. callosus* in the wider environment.

Environmental Impacts

Negligible		Very small		Small		Moderate		Large		Very large	
					✓						

Uncertainty

Low		Medium		High	
			✓		

2.12.3 Social impacts

There may be public concern with the presence of the non-native invasive *P. callosus* in private gardens. Social impacts may be in the form of damage caused to garden fruit trees and vegetables or through loss of aesthetic/cultural/historic value of ornamental plants. *Phlyctinus callosus* has occurred in these settings in New Zealand and areas with similar climatic zones with Ireland.

Social impacts could also be linked to economic impacts. The soft fruit, vegetable production and nurseries sectors in Ireland consists of predominantly family-run businesses mainly for sale in the Irish retail market.

As there is no evidence of other significant social impacts in the pest's current distribution, **the social impacts in the PRA are likely to be small to moderate.** There is uncertainty due to the fact that studies on the social impact of this pest or similar pests were not found.

Social Impacts

Negligible		Very small		Small		Moderate		Large		Very large	
					✓						

Uncertainty

Low		Medium		High	
			✓		

2.13 What is the area endangered by the pest?

The pest could potentially affect nurseries (approx 180) distributed throughout Ireland, likely only causing localised problems where it establishes. For field vegetables, if *P. callosus* establishes here, the east of the country is at most risk given the greater areas under vegetable production there. Protected crop production in which there is more certainty that suitable climatic conditions for high population numbers will be met are mostly located in the East and South. For example, strawberry production sites are now mostly found right across counties in Leinster.

Stage 3: Pest Risk Management

3.1 What are the risk management options for the PRA area?

3.1.1 Exclusion

For this pest exclusion is the best management strategy as the pest would likely be difficult to eradicate. It has successfully spread in those countries where it has been introduced and is also not known to have been successfully eradicated beyond the finding of a single adult in the UK.

Phlyctinus callosus is a quarantine pest in a number of countries as outlined in section 2.3. A number of these countries also have phytosanitary measures in place for this pest on fruit commodities from South Africa.

It is useful to consider these prior to making recommendation for phytosanitary measures for this PRA.

The USA has a Deciduous Fruit Designated for Export Programme with South Africa. This includes measures such as sampling, inspection and treatments. *Phlyctinus callosus* is listed in this programme as an actionable pest, in particular apple and grape consignments are mentioned.

Israel has specific requirements for *P. callosus* on table grapes from the Hex River area, South Africa's main table grape producing area. These measures involve the use of PLANTEX® sticky stem barriers with the requirement that all vines in the vineyard should be treated. The presence of untreated vines will disqualify a vineyard for export to Israel. Additionally, during the growing season if *P. callous* adults are detected in the canopy, a treatment with a suitable insecticide is required. Israel has approved Lambda-cyhalothrin (KARATE®).

This management approach is also outlined in research (Pryke 2005; Pyrke and Samways 2007). Phytosanitary control of *P. callosus* was found to be more effective using the aforementioned Plantex® barriers rather than pesticides. Similarly, in apple orchards, untreated stem barriers proved to be as effective as sprays or treated barriers in reducing apple damage (Barnes et al 1996).

For control of *P. callosus* on grapes, research (de Villiers & Pringle 2008) determined that action control (when to begin control) would be a bunch level infestation of 1%. It should be noted that this study assumed an economic threshold was 5% damage and states this should only be applicable if the grape crop is to be exported to markets where *P. callosus* is not of phytosanitary concern. Where grapes are exported to markets like the USA or Israel where phytosanitary restrictions are imposed, there should be a zero tolerance target. If this or similar approach is in practice it does highlight a potential risk that grapes with some levels of infestation could be sent to markets where *P. callosus* is unregulated, such as the EU. Although if there was a regular occurrence of infestation numerous interceptions would be expected and these have not been recorded for Europe to date.

Therefore, this PRA recommends:
Ireland takes measures against *P. callosus* pursuant to Article 29 of Regulation (EU) 2016/2031. In accordance with this article, a Member State shall take the necessary measures to prevent the entry and establishment of a pest if it considers that that pest may fulfil the criteria of a Union quarantine pest based on assessment. This PRA provides evidence and justification for taking those measures. This includes taking necessary measures where the pest is officially confirmed in a consignment of plants, plant products or other objects as per Article 29(1).

As this pest poses a threat not only to the PRA area but potentially across the EU, listing in Commission Implementing Regulation (EU) 2019/2072 Annex II *Part A: Pests not known to occur in the Union*, should be considered.

Additional phytosanitary measures should be considered for key hosts of *P. calllosus* on the main pathways identified in this PRA. For Fruits of *Malus* Mill., and Fruits of *Vitis* L. from countries where the pest is known to occur, these measures could be listed in Commission Implementing Regulation (EU) 2019/2072 Annex VII
List of plants, plant products and other objects, originating from third countries and the corresponding special requirements for their introduction into the Union territory.

Appropriate special requirements include:
- Options at the place of production including visual inspection and specific treatment of crop (insecticide) or physical (barriers on vines/trunks).
- Options after harvest, at pre-clearance or during transport including visual inspection of consignment or treatment

3.1.2 Eradication and containment

Successful eradication is likely to be difficult in the case where *P. callosus* has established, although eradication is conceivable with an early detection. As *P. callosus* has a slow rate of natural spread, an initial outbreak could be localised, giving opportunities for the pest to be eradicated. Difficulty arises in detecting this cryptic pest, in particular its life cycle stages in the soil. *Phlyctinus callosus* larvae and indeed damage caused may be misidentified as vine weevil. This pest also has a history of easily spreading to new areas once introduced due to human mediated means such as trade.

Adults are nocturnal but are more likely to be detected and controlled as seen with the finding in the UK. Eradication control options exist in the form of insecticide application in order to remove the pest quickly. While Australia has a number of actives currently registered for *P. callosus* on a range of crops, only one of these actives (Indoxacarb) is registered in Ireland. Although another active Alpha-Cypermethrin, approved in Australia for *P. callosus* is also approved in a number of EU countries for other crops. Another synthetic pyrethroid insecticide, Lambda-cyhalothrin is approved by Israel for *P. callosus* and is registered in Ireland for a number of crops, including on carrots, parsnips and potatoes. These insecticides will only be effective and authorised for control of adults.

Eradication relying on biological and cultural control may not be successful as these options have not proved totally effective to date for *P. callosus* control. These control measures discussed below in 3.1.3 may be sufficient in containing the pest and suppressing populations.

3.1.3 Non-statutory controls

The first step in control of *P. callosus* is monitoring, to check for the presence of the weevil and the abundance of weevil to better inform management of the pest. Good hygiene is probably the most important aspect in controlling *P. callosus*. The aim is to prevent *P. callosus* moving from an infested area to non-infested area. For example avoidance of re-using infested growing media/soil or avoidance of moving soil, fruit, pruning's, machinery or other equipment from an infested areas (Horne 1997; Fisher and Learmonth 2003; Anon 2020).

For biological control in orchards and vineyards, the use of turkeys, chickens and guinea fowl at densities around 50 per hectare can reduce weevil numbers as in Australian vineyards (Fisher and Learmonth 2003; Anon 2020). However, they are not a very effective or selective control option.

More familiar in Ireland, would be biological control options using entomopathogenic nematodes (EPN) which has proven useful for the control of the soil borne stage of other weevil species. Trials for *P. callosus* control have proved unsuccessful in Australia with research continuing in South Africa (Anon 2020). Recent research reveals promising experimental results for entomopathogenic fungi (Dlamini et al 2020).

Physical control options again in orchards, is the use of trunk or exclusion barriers which can be very successful preventing the flightless *P. callosus* adults from climbing up the canopy. However, this is labour-intensive, particularly in large orchards and vineyards (Fisher & Learmonth 2003; Dlamini et al 2020).

Cultural controls exist in the form of removing of weeds (such as dandelion and dock) that are an important food source to *P. callosus*. Their removal should reduce the abundance and survivability of *P. callosus* (Anon 2020). There is some evidence that appropriate choice of cover crops, ones that will discourage *P. callosus* could help to control the pest in orchards and vineyards (Smith 2006).

As most programmes for *P. callosus* control should follow an IPM (Integrated Pest Management) strategy, chemical foliar sprays should be the last option but are still the most effective tool for controlling *P. callosus*. Those likely to be used and approved for emergency use in the PRA area are products with active ingredients Indoxacarb and Lambda-cyhalothrin.

Conclusion and Summary

4.1 Is statutory action against the pest technically justified?

Phlyctinus callosus is polyphagous pest of economically important crops in South Africa and in both Australia and New Zealand where it has established. This weevil meets the abiotic (climate) and biotic (host plants) criteria to establish in the PRA area and it has potential to cause impacts in the PRA area, as well as other EU Member States. Statutory action against interceptions and outbreaks of the pest is technically justified.

4.2 Is a more detailed PRA required?

Yes, other EU and EPPO countries are at potentially at a higher risk from establishment and impacts caused by *P. callosus*. It is recommended that *P. callosus* is subject to a PRA at EU or EPPO level, to further investigate the risk to the EU and EPPO region as a whole and identify appropriate risk management measures for the EU.

4.3 What are the key uncertainties or areas that could benefit from additional research?

In light of recent changes on taxonomy, further specimens in introduced regions, should be analysed to confirm they are *P. callosus* or to assign another species from the genus *Phlyctinus*. This could address uncertainty on current pest distribution and host plants. In South Africa, further research would be beneficial to determine each of the new *Phlyctinus* species exact distribution ranges, host plants and climatic niches, because they could have been confused in previous studies (Haran et al 2020).

To reduce uncertainty around establishment, analysis of the climatic suitability of the PRA area for pest establishment using models and mapping software could be performed.

The area of biocontrol of *P. callosus* could benefit from further research, building on promising recent results using entomopathogenic nematodes and fungi (Dlamini et al 2019; Dlamini et al 2020). Further applied research in this area could benefit plant health biosecurity, more effective control would lead to a reduction in *P. callosus* populations in exporting countries and increase chances of eradicating the weevil following introduction into new areas.

Future research could explore potential of attract and kill control methods as *P. callosus* has aggregation pheromones (Thorpe et al 2016).

Similarly, continuing research (Johnson and Neven 2011; Smit et al 2018) in the area of postharvest treatments such as using chemical free technology incorporating heat and atmospheric stress e.g. CATTS (controlled atmosphere temperature treatment system) would be beneficial for preventing further introductions of *P. callosus*.

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Annex I: Pest Records

Table 3 –New Zealand pest records for *Phlyctinus callosus*. Data Sources: (PPIN NZ 2020) (Auckland Museum New Zealand Online 2020) (May 1993) (MPI NZ pers. comm. Jun 2020)

Island/Area/Locality	Host description	Of economic significance on host?	Collection date(s)	Source of record
North Island/Bay of Plenty	*Prunus persica* var. *nucipersica*	Yes	11/03/1981	PPIN
North Island/Taranaki	*Malus sylvestris* var. *domestica*	Minor	25/02/1980	PPIN
North Island/Auckland	*Vitis vinifera rootstock Harmony*	Yes	Multiple	PPIN
North Island/Auckland	*Vitis vinifera*	Yes	Multiple	PPIN
North Island/Gisborne	*Vitis vinifera*	Yes	21/12/1977	PPIN
North Island/Bay of Plenty	*Vitis vinifera*	Yes	19/11/1969	PPIN
North Island/Auckland	*Vitis vinifera* Italia	Yes	09/04/1985	PPIN
North Island/Auckland	*Phaseolus* sp.	Minor		PPIN
North Island/Northland	*Citrus sp.*	Yes	01/12/1997	PPIN
North Island/Auckland	*Citrus limon*	Yes	25/04/1949	PPIN
North Island/Auckland	*Citrus sinensis*	Yes	17/11/1955	PPIN
North Island/Wellington	*Rosa sp.*	Yes	01/12/1986	PPIN
North Island/Gisborne	*Rosa sp.*	Yes	10/05/1984	PPIN
North Island/Auckland	*Chrysanthemum* sp.	Yes	02/12/1974	PPIN
North Island/Auckland	*Allium cepa*	Yes	Multiple	PPIN
North Island/Bay of Plenty	*Zantedeschia* sp.	Cosmetic, quality affected	08/02/1995	PPIN
North Island/Taranaki	*Zantedeschia* sp.	Cosmetic, quality affected	25/05/1995	PPIN
North Island/Taranaki	*Solanum tuberosum*	Minor	23/10/1980	PPIN
North Island/Bay of Plenty	*Daucus carota* ssp. *sativus*	Yes	27/05/1978	PPIN
North Island/Wairarapa	*Daucus carota* ssp. *sativus*	Yes	04/09/1984	PPIN
North Island/Auckland	*Daucus carota* ssp. *sativus*	Yes	Multiple	PPIN
North Island/Taranaki	*Daucus carota* ssp. *sativus*	Yes	29/07/1977	PPIN
North Island/Auckland	*Eucalyptus viminalis*	Of no known significance	08/02/1994	PPIN
North Island/Bay of Plenty	*Beta vulgaris*	Yes	12/12/2001	PPIN
North Island/Bay of Plenty	*Rheum rhabarbarum*	Yes	12/12/2001	PPIN
North Island/Bay of Plenty	*Capsicum* sp.	Yes	12/12/2001	PPIN
South Island/Central Otago/Invermay	nursery soil		01/06/1967	May-93
North Island/Auckland/Mt Albert	under clover		28/06/1967	May-93
North Island/Bay of Plenty/Whangaparoa Beach			26/01/1993	AMNZ44359
North Island/Taranaki/New Plymouth			29/11/1948	AMNZ20662
North Island/Coromandel/Pauanui			24/11/1984	AMNZ45039

Island/Area/Locality	Host description	Of economic significance on host?	Collection date(s)	Source of record
North Island/Northland/Kaiwaka			01/01/1949	AMNZ20765
North Island/Auckland/Waiheke Island			09/04/1944	AMNZ99976
North Island/Northland/Houhora			20/11/1975	AMNZ99988
North Island/Bay of Plenty/Mt Maunganiu			04/01/1968	AMNZ99971
South Island/Mid Canterbury/Christchurch			01/01/1922	AMNZ99963
North Island/Northland/Whangarei			29/01/1927	AMNZ99974
North Island/Taranaki/Fitzroy			06/11/1986	AMNZ99983

Annex II – Detailed Trade Statistics

Table 4 –Imports of host plants under various fruit commodity codes from Australia, New Zealand and South Africa into Ireland and the UK. Commodities which yielded no data for both Ireland and the UK are not included. The totals are from the period 2015-2019. It is not known what proportions of imports into the UK were destined for Northern Ireland.

Commodity	Exporting Country	IE	UK
Fresh apples (excl. cider apples, in bulk) (CN 0808 10 80)	AUSTRALIA	16 tonnes	2,966 tonnes
	NEW ZEALAND	7,352 tonnes	22,4676 tonnes
	SOUTH AFRICA	10,753 tonnes	35,2112 tonnes
Fresh fruit of species Vaccinium macrocarpum and Vaccinium corymbosum (CN 0810 40 50)	AUSTRALIA		32 tonnes
	SOUTH AFRICA	1,235 tonnes	1,7432 tonnes
Fresh table grapes (CN 0806 10 10)	SOUTH AFRICA	5,299 tonnes	33,0693 tonnes
Fresh nectarines (CN 0809 30 10)	AUSTRALIA		1 tonne
	SOUTH AFRICA	38 tonnes	26,805 tonnes
Fresh peaches (excl. nectarines) (CN 0809 30 90)	AUSTRALIA		2 tonnes
	SOUTH AFRICA	17 tonnes	9,372 tonnes

Table 5 - Imports of plants for planting under various commodity codes from Australia, New Zealand and South Africa into Ireland and the UK. The totals are from 2015-2019. It is not known what proportion of imports into the UK were destined for Northern Ireland.

Commodity	Exporting Country	IE	UK
Live outdoor plants, incl. their roots (CN 0602 90 50)	AUSTRALIA	0.2 tonnes	56.6 tonnes
	NEW ZEALAND	<100 kg	35 tonnes
	SOUTH AFRICA	<100 kg	1.6 tonnes
Trees, shrubs and bushes, with bare roots, grafted or not, of kinds which bear edible fruit or nuts (CN 0602 20 20)	NEW ZEALAND	2.6 tonnes	
Trees, shrubs and bushes, grafted or not, of kinds which bear edible fruit or nuts (CN 0602 20 80)	NEW ZEALAND	3.5 tonnes	
Vegetable and strawberry plants (CN 0602 90 30)	NEW ZEALAND	0.1 tonne	
Outdoor rooted cuttings and young plants of trees, shrubs and bushes (CN 0602 90 45)	AUSTRALIA		<100 kg
	NEW ZEALAND	0.3 tonne	1.9 tonnes
Unrooted cuttings and slips (excl. vines) (CN 0602 10 90)	AUSTRALIA	58.2 tonnes	392.5 tonnes
Unrooted vine cuttings and slips (CN 0602 10 10)	NEW ZEALAND		0.1 tonnes
Indoor rooted cuttings and young plants (excl. cacti) (CN 0602 90 70)	SOUTH AFRICA		2.1 tonnes
Live indoor plants and cacti (CN 0602 90 99)	NEW ZEALAND		1.1 tonnes
	SOUTH AFRICA		0.2 tonnes
Outdoor trees, shrubs and bushes, incl. their roots, with bare roots (CN 0602 90 46)	NEW ZEALAND		5.9 tonnes
Live forest trees (CN 0602 90 41)	AUSTRALIA		22.6 tonnes
Indoor flowering plants with buds or flowers (excl. cacti) (CN 0602 90 91)	AUSTRALIA		0.2 tonnes
Vine slips, grafted or rooted (CN 0602 20 10)	SOUTH AFRICA		0.1 tonnes