



Draft group pest risk analysis for soft and hard scale insects on fresh fruit, vegetable, cut-flower and foliage imports

November 2020



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Cataloguing data

Australian Government Department of Agriculture, Water and the Environment 2020, *Draft group pest risk analysis for scale insects on fresh fruit, vegetable, cut-flower and foliage imports*, Department of Agriculture, Water and the Environment, Canberra.

This publication is available at agriculture.gov.au.

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Stakeholder submissions on draft reports

This draft report has been issued to give all interested parties an opportunity to comment on relevant technical biosecurity issues, with supporting rationale. A final report will then be produced taking into consideration any comments received.

Submissions should be sent to the Australian Government Department of Agriculture, Water and the Environment following the conditions specified within the related Biosecurity Advice, which is available at: <http://www.agriculture.gov.au/biosecurity/risk-analysis/memos>.

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Acronyms and abbreviations

ACT	Australian Capital Territory
ALOP	Appropriate level of protection
APHIS	Animal and Plant Health Inspection Service
APPD	Australian Plant Pest Database
BIRA	Biosecurity import risk analysis
FAO	Food and Agriculture Organization of the United Nations
GVP	Gross value of production
ICTV	The International Committee on Taxonomy of Viruses
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
ISPM	International Standard for Phytosanitary Measures
MSW	Municipal Solid Waste
NSW	New South Wales
NPPO	National Plant Protection Organisation
NT	Northern Territory
PRA	Pest risk analysis
QDPC	The Queensland Primary Industries Insect Collection
Qld	Queensland
SA	South Australia
SDQMA	Subcommittee on Domestic Quarantine and Market Access
SPS	Sanitary and Phytosanitary
Tas.	Tasmania
The department	The Australian Government Department of Agriculture, Water and the Environment
URE	Unrestricted risk estimate
USA	United States of America
USDA	United States Department of Agriculture
VAIC	Victorian Agricultural Insect Collection
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organization

Summary

The Department of Agriculture, Water and the Environment (the department) is improving the effectiveness and consistency of its Pest Risk Analysis (PRA) processes. A key step in this improvement is the development of the Group PRA, which considers the biosecurity risk posed by a group of pests across numerous import pathways. It applies the significant body of available scientific knowledge, including pest interception data and previous PRAs, to provide an overarching analysis of the risks posed by the group.

The International Plant Protection Convention (IPPC) defines PRA as ‘the process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it’ (FAO 2019b). International Standard for Phytosanitary Measures (ISPM) 2: Framework for pest risk analysis (FAO 2019a), states that ‘Specific organisms may ... be analysed individually, or in groups where individual species share common biological characteristics.’ This is the basis for the Group PRA, in which organisms are grouped if they share common biological characteristics, and as a result also have similar likelihoods of entry, establishment and spread and comparable consequences—thus posing a similar level of biosecurity risk.

Undertaking and utilising PRAs on groups of pests that share common biological characteristics provides significant opportunities to improve effectiveness and consistency of commodity-based PRAs in which those pests are also assessed and to maintain a high level of biosecurity protection against new and emerging risks. The group approach to PRA was initiated by the department to take advantage of these opportunities. The Group PRAs can be used to review existing trade pathways, and can also be applied to prospective pathways for which a specific PRA is required.

If a Group PRA is used to review existing or new trade pathways there may be no need to undertake further detailed PRAs on these pests—if the trade-dependent factors relating to the likelihood of entry on specific pathways have been verified, the Group PRA can be applied.

This is the third Group PRA to be released for public consultation—the first Group PRA was for thrips and orthotospoviruses, finalised in 2017, and the second for mealybugs and the viruses they transmit, finalised in 2019. This Group PRA considers the biosecurity risk posed by all members of the family Coccidae (soft scales) and the family Diaspididae (hard scales or armoured scales) in the insect order Hemiptera, a total of more than 3,900 described species. In this report, a generic term ‘scale insect’ or ‘scale insects’ is used to refer to both the soft scales and the hard scales, unless otherwise specified. In addition, this Group PRA reviewed the potential for scale insects to act as vectors for plant viruses and whether these viruses are quarantine pests for Australia.

This Group PRA identifies the key scale insect quarantine pests of biosecurity importance to Australia by a set of criteria. The criteria include consideration of species that have been frequently intercepted by Australia and other countries, and of species that are significant pests recognised internationally, and/or by Australian industry, and those identified by states and territories as regional pests for Australia. Two hundred and forty-three species of soft scales and

331 species of hard scales were confirmed as quarantine pests for Australia from the pest categorisation process.

The pest risk assessment concluded that scale insect quarantine pests were estimated to have an 'indicative' unrestricted risk estimate (URE) of 'Low' which does not achieve the appropriate level of protection (ALOP) for Australia. This risk estimate is regarded as 'indicative' because the likelihood of entry can be influenced by a range of pathway-specific factors (such as the commodity, seasonal considerations, the incidence of pests in specific export production areas, or host range), and must be verified on a case-by-case basis. In some cases, the likelihood of importation may need to be adjusted to take account of these factors. In order to achieve an appropriate level of protection for Australia, measures will be required for soft and hard scale quarantine pests when the unrestricted risk estimate of 'Low' has been confirmed for a specific plant import pathway.

The results of the pest risk assessment are not only applicable to quarantine pests confirmed in the report but also applicable to any other quarantine pests of soft and hard scales species not included in this report.

It is noted that the previous assessments on individual species indicated that the URE for some species of soft scales and the majority of hard scales was 'Very Low' or 'Negligible', which achieved the ALOP for Australia. All the previous assessments and supporting evidence have been reviewed during the course of developing this Group PRA for soft and hard scales. It is concluded that previous ratings of 'Low' for the likelihood of distribution and 'Moderate' for the likelihood of spread for both soft and hard scales should be revised to Moderate and High, respectively. This revision has been based on an extensive evaluation, including re-analysis, of scientific literature, in particular a comprehensive review of the biology of scale insects and their dispersal behaviours. More detailed justification and evidence is presented in the relevant sections of this report. Consistent with this revision, the indicative URE for all soft and hard scale quarantine pests is thus now 'Low'.

The potential for impact on existing trade resulting from this change of the unrestricted risk estimate for soft and hard scale quarantine pests has been considered and reviewed. The review found that this change will not have significant impacts on existing trade, because the relevant plant import pathways already have requisite phytosanitary measures for other pests that are also adequate for soft and hard scale quarantine pests.

This Group PRA also reviewed the potential for soft and hard scale insects to act as vectors of plant viruses. No species of hard scale was found to transmit plant viruses. Eight species of soft scales were identified as being able to transmit a total of four viruses associated with grapevines. However, these viruses are not quarantine pests because they are already present in Australia.

Phytosanitary measures are required for scale insect quarantine pests if the indicative unrestricted risk estimate of 'Low' is verified for a specific plant import pathway and the ALOP for Australia is not achieved. The identified measures are consistent with long-standing established policy for scale insect quarantine pests. These measures and alternative risk management options may be considered on a case-by-case basis when developing new import

conditions for specific commodities, or reviewing existing import conditions for commodities that are currently traded.

Imported commodities will be regulated if they are infested with scale insect quarantine pests to reduce the risk of establishment of these organisms in Australia. Regulation will be in accordance with this PRA and any other relevant commodity-based PRAs.

Where measures are required, they include the following options:

- Pre-export visual inspection and if found, remedial action (e.g. suitable treatment) to manage the identified pest or
- Systems approach, or
- Treatment, or
- Area freedom

On-arrival verification will be undertaken to provide assurance that Australia's import conditions have been met and appropriate level of protection achieved.

Imported goods that are frequently found to be infested with scale insects may be subject to mandatory, pre-export treatment approved by Australia.

Further details are available in this draft report, which has been published on the department's website to allow interested parties to provide comments and submissions within the consultation period.

1 Introduction

1.1 Initiation and scope

Initiation

This pest risk analysis (PRA) was initiated by the department.

A PRA is the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it (FAO 2019b). The 'PRA area', the area in relation to which the PRA is conducted (FAO 2019b), is defined as Australia for this report. A pest is defined as any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2019b). More specifically, a 'quarantine pest' is a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2019b).

Scope

This PRA considers the biosecurity risk posed by all members of the family Coccidae (referred to as soft scales or coccids interchangeably) and the family Diaspididae (referred to as hard scales, armoured scales or diaspidids interchangeably) in the insect order Hemiptera, which are associated with fresh fruit, vegetables and cut-flowers and/or foliage imported into Australia as commercial consignments from any country. This will be referred to as the plant import pathway in this report.

In this report, a generic term 'scale insect' or 'scale insects' is used to refer to both the soft scales and the hard scales, unless otherwise specified.

Plant viruses transmitted by scale insects are also reviewed in this report.

Out of scope

This report does not address the risks posed by soft and hard scale insects on imported propagative plant materials which are another commercial pathway for the possible introduction of these pests. This pathway has a significantly different risk profile and thus will be dealt with separately using an appropriate approach if such an analysis is considered to be necessary for soft and hard scale insects.

1.2 The Group PRA approach

The department is improving the effectiveness and consistency of its pest risk analysis processes. A key step in this improvement is the development of the Group PRA, which considers the biosecurity risks posed by a group of pests across numerous import pathways.

Group PRA basis

The Group PRA approach is consistent with relevant international standards and requirements—including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2019a), ISPM 11: *Pest Risk Analysis for Quarantine Pests* (FAO 2019c) and the SPS Agreement (WTO 1995). ISPM 2 states that 'Specific organisms may ... be analysed individually, or in groups where individual species share common biological characteristics.' This is the basis for the Group PRA in which organisms are grouped where they share common biological characteristics, and as a result also

have similar likelihoods of entry, establishment and spread and comparable consequences—thus posing a similar level of biosecurity risk.

Pest species of scale insects of biosecurity concern share a number of common biological characteristics that would facilitate similar likelihoods of entry, establishment and spread in Australia and cause comparable consequences. These characteristics include:

- small size and cryptic habits
- capacity for active and passive dispersal, most commonly by the ‘crawler’ life stage
- plant feeding and predisposition to polyphagous behaviours
- possession of protective wax body coverings
- ability to reproduce parthenogenetically as well as sexually
- frequent association with and transport on commodities in domestic and international commerce.

It is noted that there are some biological differences between soft scales and hard scales. For example, soft scales feed on phloem of the host plants and produce honeydew, while hard scales feed on cells of the mesophyll and do not produce honeydew. However, it is considered appropriate to assess the soft and hard scales together as these differences are not anticipated to affect the biosecurity risk posed by their similar likelihoods of entry, establishment and spread and comparable consequences.

Group PRA supported by available scientific information

The conclusions of the Group PRA are supported by available scientific evidence including interception data collected at Australia’s borders, similar interception records available from other countries, and extensive literature review, including evaluation and re-analysis of previous PRAs. The Group PRA includes significant pests that have been recognised internationally and/or by Australian industry, and those identified by states and territories as regional pests for Australia.

Group PRA with defined scope

Each Group PRA has clearly defined scope in relation to the pests being grouped and the import pathways under consideration.

Group PRA benefits

Undertaking and utilising PRAs on groups of pests that share common biological characteristics provides significant opportunities to improve effectiveness and consistency of commodity-based PRAs in which those pests are also assessed, and to maintain a high level of biosecurity protection against new and emerging risks. The group approach to PRA was initiated by the department to take advantage of these opportunities and assist with activities aimed at reforming and modernising Australia’s biosecurity system. It is a building block that can be used to review existing trade pathways or be applied to prospective pathways for which a specific PRA is required.

Where a Group PRA approach is used to review existing or new trade pathways there may be no need to undertake further detailed PRAs on these pests—once the trade-dependent factors relating to the likelihood of entry on specific pathways have been verified, the Group PRA can be applied.

Group PRAs identify the key pest species within the group that are of biosecurity importance to Australia. Broader uptake of the group approach to cover other major pest groups would create a master list of Australia’s key quarantine pests.

By clearly identifying key, new and emerging risks, Group PRAs provide opportunities to better inform strategic surveillance and preparedness strategies, including industry biosecurity planning. The approach can also facilitate enhanced alignment and accord between domestic and international biosecurity polices, and ensure greater clarity and visibility of priority and regional pests.

1.3 This Group PRA

This is the third Group PRA to be released for public consultation—the first Group PRA was for thrips and orthospoviruses, finalised in 2017, and the second for mealybugs and the viruses they transmit, finalised in 2019. This Group PRA considers the biosecurity risk posed by all members of soft and hard scale insects, a total of more than 3,900 described species. In addition, this Group PRA reviewed the potential for scale insects to act as vectors for plant viruses and whether these viruses are quarantine pests for Australia.

Comparable risk

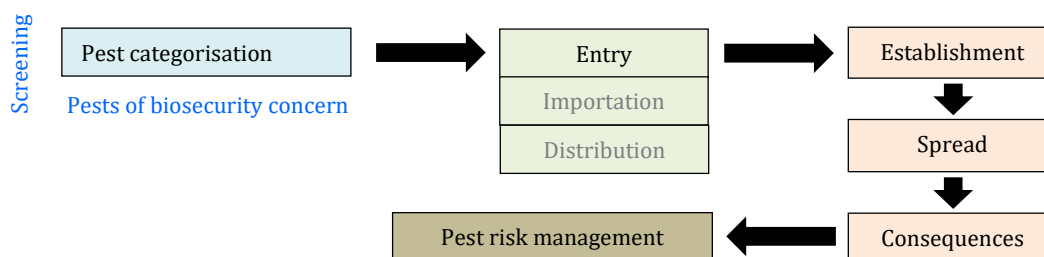
Previous detailed pest risk analyses undertaken by the department on individual scale insect species associated with the plant import pathway show a marked consistency in the estimated level of biosecurity risk relative to the appropriate level of protection (ALOP) for Australia.

Identification of key pests

This Group PRA identifies the key scale insect quarantine pests of biosecurity importance to Australia by a set of criteria (Table 2.1). The criteria include consideration of species that have been frequently intercepted by Australia and other countries, and of species that are significant pests recognised internationally, and/or by Australian industry, and those identified by states and territories as regional pests for Australia. Selected species were assessed in the pest categorisation tables (Table 8.1 for soft scales and Table 9.1 for hard scales) to determine their quarantine status.

Group pest risk analysis and its application

Species that were categorised as quarantine pests for Australia were assessed further. Likelihoods of entry (importation and distribution), establishment and spread, and the magnitudes of economic consequences were then estimated for key pest species of scale insects (Figure 1.1).



The likelihood of entry (importation x distribution) can be affected by a range of pathway-specific factors. For this reason, an 'indicative' likelihood has been assigned for entry based on extensive historic and contemporary analysis of the plant import pathway. When this Group PRA is applied to a specific pathway, these factors must be verified on a case-by-case basis, as appropriate. Until this occurs, the likelihood of entry in this Group PRA is indicative only.

In contrast, the risk factors considered in the likelihoods of establishment and spread, and the impact (consequences) for a pest are not pathway specific, and are therefore comparable across all plant import pathways within the scope of this report. This is because these steps all happen post-border, and their likelihood assessments are based on consistent aspects of pest biology, environmental conditions and commercial practices within Australia.

An 'indicative' unrestricted risk has then been estimated by combining the overall likelihood of entry (indicative), establishment and spread with the estimate of consequences.

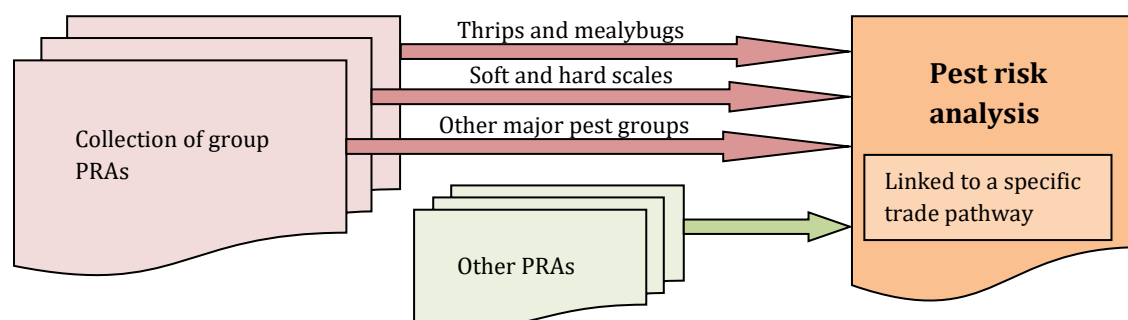
Phytosanitary measures are identified in this report for use when the unrestricted risk is verified for a specific plant import pathway and does not achieve the ALOP for Australia.

1.4 Future of Group PRA

In addition to soft and hard scales (this report), mealybugs and the viruses they transmit, and thrips and orthotospoviruses (previous Group PRAs), the department may also apply the Group PRA approach to other pest groups, where appropriate.

Broader uptake of the Group PRA approach provides opportunities to assemble future pest risk analyses by incorporating pre-existing Group PRAs of the major pests that are relevant to review of existing trade pathways or new market access requests, along with any additional PRAs that may be required (Figure 1.2).

Figure 1.1 Assembly of pest risk analyses by incorporating relevant group and other PRAs



1.5 Australia's biosecurity policy framework

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests entering, establishing and spreading in Australia, thereby threatening Australia's unique flora and fauna, as well as those agricultural industries that are relatively free from serious pests.

The risk analysis process is an important part of Australia's biosecurity policies. It enables the Australian Government to formally consider the level of biosecurity risk that may be associated with proposals to import goods into Australia. If the biosecurity risks do not achieve the ALOP for Australia, risk management measures are proposed to reduce the risks to an acceptable level. If the risks cannot be reduced to an acceptable level, the goods will not be imported into Australia until suitable measures are identified.

Successive Australian Governments have maintained a stringent, but not a zero risk, approach to the management of biosecurity risks. This approach is expressed in terms of the ALOP for Australia, which is defined in the *Biosecurity Act 2015* as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

Australia's risk analyses are undertaken by the Department of Agriculture, Water and the Environment using technical and scientific experts in relevant fields, and involve consultation with stakeholders at various stages during the process.

Risk analyses may take the form of a biosecurity import risk analysis (BIRA) or another form of risk analysis such as scientific review of existing policy and import conditions, pest-specific assessments, weed risk assessments, biological control agent assessments or scientific advice.

Further information about Australia's biosecurity framework is provided in the *Biosecurity Import Risk Analysis Guidelines 2016* located on the Department of Agriculture, Water and the Environment website at <http://www.agriculture.gov.au/biosecurity/risk-analysis/guidelines>.

2 Pest categorisation of soft and hard scales

2.1 Introduction

The pest categorisation process identifies pests with potential to be on the plant import pathway that are quarantine pests for Australia, and that as a result require pest risk assessment. Factors considered in the pest categorisation process are (FAO 2019c):

- identity of the pest
- presence or absence of the pest in the PRA area
- regulatory status of the pest in the PRA area
- potential for pest establishment and spread in the PRA area
- potential for the pest to cause economic consequences (including environmental consequences) in the PRA area.

Soft scales as a group contain 1,281 described species, and hard scales 2,624 species (García Morales et al. 2019). It is not practical or necessary to categorise them all. Instead, a set of criteria (Table 2.1) was used to identify species of soft and hard scales for inclusion in pest categorisation, with inclusion dependent on meeting one or more of those criteria.

Table 2.1 Criteria for inclusion of soft and hard scale species in pest categorisation

Criterion	Description
1	Species is known to have a history of being intercepted at Australian and/or international ports of entry on the plant import pathway
2	Species is known to transmit a plant virus
3	Species is identified by Australian industries as a high priority pest in relevant industry biosecurity plans, provided by Plant Health Australia
4	Species is identified as a pest of importance in the Crop Protection Compendium (CABI 2018a), and/or is listed as an important pest in key references in the soft and hard scale literature
5	Species has previously been considered by Australia at species level in pest categorisation in final risk analyses, regardless of whether it was absent or present in Australia and whether or not it was found to be associated with the specific commodity pathway at the time
6	Species is under official control as a regional pest within Australia

Based on these selection criteria, species were identified for inclusion in the pest categorisation process. This produced a list of 266 species of Coccidae (Table 8.1; Appendix B) and 375 species of Diaspididae (Table 9.1; Appendix C) likely to be of biosecurity concern on the plant import pathway. In the future, subsequent inclusion in pest categorisation of any additional species that meet one or more of the selection criteria will be considered on a case-by-case basis.

In order to support the pest categorisations detailed in Table 8.1 and Table 9.1, relevant information on taxonomy (Section 2.2) and biology (Section 2.3) are presented.

In this pest categorisation of scale insects, the potential for establishment and spread and potential for economic consequences (including environmental consequences) in the PRA area were not considered for individual species in the respective categorisation tables (Table 8.1 and Table 9.1), but rather are addressed together in Sections 2.4 and 2.5. This approach is consistent with the categorisation guideline set out in ISPM 11 (FAO 2019c).

2.2 Taxonomy

Both the Coccidae and Diaspididae belong to the superfamily Coccoidea in the insect order Hemiptera.

2.2.1 Taxonomy of Coccidae

The family Coccidae, referred to as soft scales or coccids, is the third largest family in the Coccoidea, with 1,281 described species in 176 genera (García Morales et al. 2019). The family has been classified into different numbers of subfamilies by different authors. The most recent comprehensive revision of the Coccidae was by Hodgson (1994) who redescribed the adult females of the type species of all the coccid genera known at the time. Hodgson (1994) classified Coccidae into 10 subfamilies based on the morphologies of both adult females and adult males (Table 2.2).

Table 2.2 Subfamily and tribe classification of Coccidae (soft scales)

Subfamily/Tribe (a)	Distinctive appearance of mature adult females (b)
Cardiococcinae	Glassy cover enclosing the often concave body
Ceroplastinae	Thick wax cover
Cissococcinae	Producing true gall enclosing the body
Coccinae	
- Coccini	Thin wax cover
- Paralecaniini	Thin wax cover
- Pulvinariini	Woolly and felted ovisac
- Saissetiini	Thin wax cover
Cyphococcinae	Glassy cover
Eulecaniinae	Felted cover
Eriopeltinae	Felted ovisac
Filippiinae	White ovisac
Myzolecaniinae	Thin wax cover
Pseudopulvinariinae	Dense, woolly cover

a: Classification based on Hodgson (1994). **b:** Refer to illustrations by Hodgson (1997, fig 1.1.3.1.1) and photographs A, B, E, J, L, M, O, P, Q and R in Ben-Dov and Hodgson (1997b) for the typical appearance of the mature adult females of different subfamilies and tribes.

This subfamily system (Table 2.2) was also presented in a subsequent monograph on Coccidae (Ben-Dov & Hodgson 1997b) and remains the most updated subfamily classification for the Coccidae. It should be noted that there have been indications that this classification is likely to be changed based on newly available information, including molecular data from recent studies. Nevertheless, this system is adopted in this report and the names provided in Table 2.2 are considered useful when referring to some obvious biological features; for example, all Pulvinariini have a large woolly ovisac and all Ceroplastinae have very thick wax covering.

2.2.2 Taxonomy of Diaspididae

The family Diaspididae, commonly referred to as hard scales, diaspidids or armoured scales, is the largest family in the Coccoidea, with 2,624 described species in 421 genera (García Morales et al. 2019). There have been different classifications of Diaspididae by different authors, with

some using both a subfamily and tribe system (Andersen et al. 2010; Borchsenius 1966; Howell & Tippins 1990; Morse & Normark 2006) and others using only a tribe classification (Ben-Dov 1990a; Rosen 1990a).

Recently, Normark et al. (2019) published a comprehensive study on the phylogeny and classification of Diaspididae based on molecular phylogenetic estimates and their implications for taxonomy, and offered a revised classification of Diaspididae. The study proposed new subfamilies and new tribes, and synonymised some previously recognised tribes. It also provided numerous new and revised combinations and replacement names for species, which have been adopted in the ScaleNet database (García Morales et al. 2019). The revised high level classification of Diaspididae into four subfamilies and/or their respective tribes and subtribes is as follows:

- Subfamily Ancepspidinae
- Subfamily Aspidiotinae
 - Tribe Aonidiini
 - Tribe Aspidiotini
 - Tribe Gymnaspidini
 - Tribe Leucaspidini
 - Tribe Odonaspidini
 - Tribe Parlatoriini
 - Tribe Smilacicolini
- Subfamily Diaspidinae
 - Tribe Diaspinini
 - Subtribe Chionaspidina
 - Subtribe Diaspidina
 - Subtribe Fioriniina
 - Tribe Lepidosaphidini
- Subfamily Furcaspidinae

2.3 Biology

Most species of Coccidae and Diaspididae reproduce sexually, and their reproduction thus requires both males and females. Some species can however reproduce parthenogenetically. The biology of Coccidae and Diaspididae are reviewed in Section 2.3.1 and Section 2.3.2, respectively.

2.3.1 Biology of Coccidae

Soft scales are covered by a soft waxy covering (Ben-Dov 1997). The cover varies considerably in texture and structure between different groups. For example, the cover is very thin in species of the Coccini, and thick and voluminous in species of the Ceroplastinae (Ben-Dov 1997).

Females

Female soft scales develop through four or five stages: egg, first, second and, for most species, third-instar nymph and adult. The adult female is wingless and neotenic, i.e. resembling the nymphal stage (Camacho & Chong 2015). An adult female can continue to grow slightly or considerably after emerging from the previous instar, and changes significantly in shape and colour prior to oviposition (Camacho & Chong 2015; Matile-Ferrero 1997). Adult female soft scales can increase their body size by two to eight times that of the previous instar and become swollen and heavily sclerotised. Thus, the size of adult female soft scales of different species can vary significantly, ranging from 1mm to 18mm in length (Matile-Ferrero 1997).

Mature adult females lay their eggs either by depositing in a 'brood chamber' beneath the female body or in an ovisac enclosing, beneath or behind the body (Camacho & Chong 2015; Matile-Ferrero 1997). The 'brood chamber' is formed by the progressive development of a cavity beneath the abdomen (Matile-Ferrero 1997: fig. 1.1.2.1.1 C, E and F) and is found in Ceroplastinae, Coccinae (except Pulvinariini), Eulecaniinae and Myzolecaniinae (Camacho & Chong 2015; Marotta 1997). The brood chamber is also produced by Cardiococcinae, Cissococcinae and Cyphococcinae. The ovisac is formed of long white wax filaments secreted by ventral wax glands (Fig. 1.1.2.1.1 A, B, D, G and H of Matile-Ferrero 1997), and is present in Filippiinae, Eriopeltinae and Pulvinariini (Camacho & Chong 2015; Marotta 1997). Pseudopulvinariinae also produce an ovisac similar to Pulvinariini.

Eggs are generally covered with wax filaments secreted from ventral ducts and pores. The number of eggs laid by a female varies greatly from species to species, and is also usually proportional to the size of the female body (Camacho & Chong 2015; Marotta 1997). Individual females can produce from a few dozen to hundreds or several thousand eggs (Camacho & Chong 2015; Marotta 1997). For example, adult females of *Eucalymnatus tessellatus* (Signoret) were recorded to have laid no more than 24 eggs, while females of *Ceroplastes destructor* Newstead produced up to 6,355 eggs (Camacho & Chong 2015, and references therein). Small females of *Parthenolecanium corni* (Bouché) have been reported to produce about 150 eggs, whereas larger individuals lay more than 5,000 eggs (Marotta 1997, and references therein).

First-instar nymphs hatch from the egg and have well developed legs and antennae, and are generally the most active stage of the life cycle. First-instar nymphs are very small, less than 1mm long and less than 0.5mm wide, and their body is oval or elongate. Koteja (1990b) was able to distinguish the life of a first-instar nymph of hard scales into four periods: postnatal torpidity period, moving period (dispersal phase), feeding (growing) period and morphogenetic (moulting) period. This distinction should be equally applicable to the first-instar nymph of soft scales. Strictly speaking, the term 'crawler' should only refer to the second period, i.e. the moving period of a first-instar nymph. However, this term has commonly been used in the literature to refer to the entire life of a first-instar nymph. In this report, the terms 'crawler' and 'first-instar nymph' are used interchangeably.

Crawlers are known to disperse actively by crawling away from their mother, or passively through effects of wind or phoresis (Camacho & Chong 2015).

Second-instar nymphs are usually oval to round in shape (Williams 1997). Their legs and antennae may be reduced, such as for *Pseudophilippia quaintancii* Cockerell, or can remain well developed, such as for *Protopulvinaria pyriformis* (Cockerell) (Williams 1997).

Third-instar nymphs are present in most coccid species (Marotta 1997: fig. 1.2.1.1.1). This stage is often very similar in appearance to the adult and can be very easily overlooked or mistaken for a young adult female in the field; reliable recognition requires examination microscopically (Williams 1997). There have been conflicting observations in relation to the number of moults in the female life cycle of some species. For example, *Sphaerolecanium prunastri* (Fonscolombe) and *Coccus hesperidum* Linnaeus were observed to have only two moults by some authors, but reported to have three moults by others (Marotta 1997, and references therein). Legs and antennae may be reduced or can remain well developed.

It should be noted that species with well-developed legs as second- and third-instar nymphs can still move, although at a much slower pace, and over reduced distances, as compared with their first-instar nymphs.

Males

Coccid male life history comprises six stages: eggs, first and second-instar nymphs, pre-pupae, pupae and adults. Eggs and first-instar nymphs are indistinguishable from the same stages of females. Sexual dimorphism first becomes apparent in second-instar nymphs, in which males are elongated oval in shape and possess tubular ducts on the body while females are generally oval to round and lack tubular ducts (Williams 1997). Pre-pupae are enclosed in a usually semitransparent glassy cover, composed of a series of platelike structures produced by the second instar (Miller et al. 2014b; Miller & Williams 1997). This stage begins a transformation of the body into a form very different to that of the female. The body becomes elongate and membranous, with reduced antennae and legs and the appearance of wing buds. Pupae largely remain membranous, but their antennae and legs become more sclerotised and greater in length, while wing buds become more developed and extend more posteriorly (Williams 1997). The adult male has well-developed front wings, antennae and legs, and a clearly defined head, thorax and abdomen, with a conspicuously elongated penial sheath at the tip of the abdomen (Giliomee 1997: fig. 1.1.2.2).

Generations per year

Soft scales produce one to seven generations per year depending on the species and/or environmental factors (Miller et al. 2014b). Camacho and Chong (2015) reviewed the number of generations per year for 70 species of soft scales and found that 53 percent are strictly univoltine (one generation per year), seven percent strictly bivoltine, and 4% are strictly multivoltine. For these species, the number of generations per year is constant throughout their distributional range, and apparently not affected by environmental factors. For example, *Coccus pseudomagnoliarum* (Kuwana) is strictly univoltine and has only one generation per year in Greece, Israel, Italy, Turkey, California and Australia (Camacho & Chong 2015; Marotta & Tranfaglia 1997).

However, other soft scale species exhibit great variation in voltinism, with the number of generations per year depending on host, geographical and/or climatic conditions (Camacho & Chong 2015; Marotta & Tranfaglia 1997). For example, as reviewed by Camacho and Chong (2015), *Ceroplastes floridensis* Comstock is univoltine on apple and persimmon in Yunnan, China (Yun 1994) and on *Rhododendron* spp. from Florida to Maryland (Kehr 1972), bivoltine on holly (*Ilex* spp.) in Georgia (Hodges, Ruter & Braman 2001), and produces three generations per year on citrus and holly in Florida (Johnson & Lyon 1991). Similarly, *Coccus hesperidum* produces one generation per year in Sardinia and eastern Sicily, two to three generations per year in western

Sicily and southern France, three generations per year in South Africa and three to five generations per year in southern California (Marotta and Tranfaglia (1997)).

Overwintering

Soft scales typically overwinter as nymphs or mated adult females, although a few species, such as *Palaeolecanium bituberculatum* (Signoret), have been found to overwinter in the egg stage (Marotta & Tranfaglia 1997; Vashchinskaya 1969). The overwintering stage for most univoltine species, such as *Parthenolecanium corni* (Bouché), is the second-instar nymph, commonly on the woody parts of the host tree. The life cycle of univoltine species follows a general pattern as shown in Marotta and Tranfaglia (1997, fig. 1.3.4.1). In the spring the overwintered second-instar nymphs on the woody parts of the host plants move onto the branches or twigs and moult into adult females. Mature females then lay their eggs in a brood chamber beneath their body. After hatching, the crawlers move from beneath the female body and onto the plant surface to disperse, and usually settle in clusters along the outer margins of the topmost leaves. The subsequent nymphs usually feed at the settling sites and move less frequently. At the end of summer, the second-instar nymphs are mostly located on the lower surface of the leaves. In the autumn and before leaf-fall they move from the leaves to the woody parts of the host plants where they overwinter. Generally, in species where the adult females lack waxy coverings or ovisacs, the overwintering stage is as second-instar nymphs (Marotta & Tranfaglia 1997).

In Australia, *Parthenolecanium persicae* (Fabricius) overwinters as a third-instar nymph under the bark of grapevines (Hayes, Neeman & Cooper 2017). For species overwintering as adult females, such as *Ceroplastes pseudoceriferus* Green, young, mated females return to the woody parts of the plant in the autumn in preparation for overwintering. Some species can overwinter in different life stages, such as *Pulvinaria floccifera* Westwood which overwinters as second- and third-instar nymphs (Łagowska et al 2017).

Marotta and Tranfaglia (1997) suggest that the sequence of events, from the hatched crawlers moving and settling on the leaves to the return of the overwintering life stage to the woody parts, is synchronised with the phenology of the host plant, which is probably a result of the interaction between genetically determined behaviour patterns and environmental factors.

Honeydew produced by soft scales

'Honeydew' is a sugar-rich sticky liquid, secreted by soft scales and other insects as they feed on plant phloem. Honeydew production by soft scales and its harmful effect on plants were discussed by Malumphy (1997b). Gullan and Kosztarab (1997) reviewed the literature on how phloem-feeding scale insects have evolved effective methods of preventing contamination of themselves by their own honeydew. These insects could quickly become contaminated and trapped in their own waste if it were not discharged some distance away from their bodies or removed regularly by ants. The active crawlers are particularly vulnerable as they are very small and could be trapped more easily by honeydew when they try to disperse after hatching. Malumphy (1997b) described in detail the morphology and anatomy of the anal apparatus of Coccidae, which is responsible for the disposal of honeydew away from the immediate vicinity of the insects. Williams and Williams (1980) described the excretory behaviour in soft scales using *Pulvinaria iceryi* (Signoret) as an example.

Sooty mould

Sooty moulds are saprophytic fungi that form superficial black colonies on leaves, stems, fruits and any other parts of plants infested with honeydew-producing insects, including soft scale insects (Mibey 1997). Taxonomically, sooty moulds are ascomycete fungi belonging to five families in the order Dothideales (Mibey 1997). Some common genera of fungi causing sooty moulds include *Antennariella*, *Aureobasidium*, *Capnodium*, *Cladosporium*, *Limacinula* and *Scorias*.

The impact of sooty moulds on plants includes reduction of photosynthesis, leading to leaf and fruit drop and causing eventual yield loss in crops. They also have cosmetic effects on the marketability of some plant products.

Soft scales and ants

The presence of ants can increase the impact and damage of soft scales on plants because the insects are protected from attack by their natural enemies. The relationship between soft scales and ants has been reviewed by Gullan (1997) and Gullan and Kosztarab (1997).

Possible three-way interactions of soft scales, ants and plants were summarised by Gullan (1997: fig. 1.3.5.3), indicating the direct positive and negative influences of their interactions. The benefits of ants to soft scales include elimination of contamination by the removal of honeydew, protection against predators and parasitoids, transportation and provision of shelter from diseases and unfavourable weather conditions (Gullan 1997). In turn, ants benefit from accessing honeydew as a food source of proteins, and lipids and carbohydrates.

Both obligate and facultative attendance by ants alleviates the honeydew contamination of scale insects (Gullan & Kosztarab 1997; Way 1954). A few taxa, mostly of tropical or subtropical scale insects, have such an intimate relationship with their attendant ants that they survive only in ant nests or shelters (Flanders 1957; Gullan & Kosztarab 1997). These taxa display obvious behavioural and morphological adaptations to living with ants.

Another coccid-ant association has been observed for some soft scales found inside the hollow chambers of 'ant-plants'. These plants have evolved specialised structures known as domatia to house the species of attendant ants. Ant-coccid mutualisms involving domatia occur almost exclusively in tropical or subtropical areas as reviewed and listed by Gullan (1997: table 1.3.5.3).

2.3.2 Biology of Diaspididae

Hard scales are small, sap-sucking insects, and are usually covered with a detached scale covering (Foldi 1990).

Females

Female hard scales develop through four life stages: egg, first and second-instar nymphs, and adult (Koteja 1990b). Adult females are morphologically reduced and non-motile (Normark et al. 2019) and can be elongate, parallel-sided, oval, pyriform, round, flat, convex or hemispherical (Koteja 1990b). Mature adult females can increase in size by expansion of the cuticle, achieved by pulling out the densely crowded wrinkles over the young adult body. Female hard scales are usually 1.0 – 1.5mm, rarely over 2.0mm, in body length at full size (Takagi 1990). The adult female exhibits complete fusion of the head, thorax and abdomen (Ben-Dov 1990b) and has no wings or legs, except for the presence of leg vestiges in the form of short, sclerotised, spine-like process in a few genera (Takagi 1990). The body is flattened dorsoventrally, but may become

swollen when gravid. Some posterior segments of the abdomen are fused to form a pygidium. The structures, shapes, segments and pores of pygidia differ in different groups and species and thus are important taxonomic characters.

Eggs are laid within the gravid female under the scale cover and a small slit is present at the posterior end of the cover that allows the crawlers access to the outside (Miller et al. 2014b). After reviewing the embryonic development of Diaspididae, Koteja (1990a, and references therein) considered that all members of Diaspididae are in fact ovoviviparous (Koteja 1990a), i.e. the first-instar nymphs hatch within the body of the female, although oviparity, ovoviviparity and viviparity have all been reported for various diaspidid species.

Diaspidid eggs are covered with powdery wax products and are elongate-oval, 150-300 µm long and 70-150 µm wide (Koteja 1990a). Each female may produce 1-10 eggs daily (Koteja 1990a). Total fecundity is generally lower in Diaspididae, compared to that in Coccidae. For most species, each female can produce 50-150 offspring; lifetime fecundity has been recorded as being between 10 to 600 offspring (Koteja 1990a).

First-instar nymphs are elongate-oval, mobile and responsible for host and feeding-site selection (Koteja 1990b). Koteja (1990b) was able to distinguish the life of a first-instar nymph into four periods: postnatal torpidity of a few minutes to several hours, a moving period (dispersal phase) to search for a host and/or a feeding site, a feeding (growing) period of stylet insertion into plant tissue to feed, grow and secrete the scale cover, and finally, a morphogenetic (moulting) period to undergo morphogenetic changes to become a second instar. Strictly speaking, the term 'crawler' should only refer to the second period, i.e. the moving period, of a first-instar nymph. However, this term has commonly been used in the literature to refer to the insect in its entire life stage as a first-instar nymph. In this report, the terms 'crawler' and 'first-instar nymph' are being used interchangeably.

As for other scale insects, diaspidid dispersal is undertaken by the crawlers either actively by crawling or passively by air movement (Miller et al. 2014b).

Second-instar nymphs are sessile and continue to feed and grow and undergo the last metamorphosis to become a young adult.

Reproduction in most hard scales is sexual, although several widespread species occur as both sexual and parthenogenetic races, and some others are known only to reproduce parthenogenetically (Beardsley & Gonzalez 1975).

Males

Male hard scales have six life stages: egg, first and second-instar nymphs, non-feeding pre-pupa, pupa and adult. Adult males are minute, with a body length rarely exceeding 1mm and a genital segment terminating with a long thin style about half the body length (Giliomee 1990). Adult males are usually winged, with a clear division of the body into head, thorax and abdomen (Ben-Dov 1990b). Different life stages of males and females are illustrated by Koteja (1990b: fig. 1.3.2.1).

Sexual dimorphism of hard scales can first be detected in the first-instar nymphs. Dimorphism is exhibited through variations in several features, for example, in some groups first-instar males always have campaniform sensilia at the bases of tarsi, while in other groups they possess a pair

of dorsal submedian setae on the first abdominal segment (Howell & Tippins 1990). Second-instar nymphs are always sexually dimorphic to some degree, for example, possession by males of a better-developed glandular system. Pre-pupae and pupae are non-feeding and possess appendages such as antennae, legs and wing buds which are reduced or not present in the previous stages.

Mate finding appears to rely mainly on chemical cues and adult females utilise sex pheromones to attract males (Gieselmann 1990). Females have been observed mating up to eight times with one or more males, and in laboratory conditions, individual males of *Aonidiella aurantii* (Maskell) were observed inseminating up to 30 females (Gieselmann 1990).

Generations per year and overwintering

The number of generations per year and their overwintering stages are influenced by temperature, humidity and rainfall (Beardsley & Gonzalez 1975; McClure 1990). Hard scales can produce one to six or more generations per year depending on species and/or climatic conditions (McClure 1990; Miller et al. 2014b). For example, *Aonidiella aurantii* produces an average of about two generations per year in cool coastal areas of California, slightly more than three generations per year in California's interior areas which have hot and dry summers, and up to six generations per year in areas of the world with relatively uniform warm and dry conditions (Beardsley & Gonzalez 1975, and references therein).

Second-instar nymphs and mated adult females are the most common overwintering life stages (Miller et al. 2014b) but other stages can also overwinter depending on the species and/or the locality. For example, *Fiorinia externa* Ferris overwinters in the egg stage in Quebec, in the first-instar stage in central Europe, in nymphal stages in India and in all stages in warmer climates (McClure 1990, and references therein).

Scale cover of hard scales

The scale cover of hard scales is different from that of soft scales. These coverings can be complex structures, rather resembling a suit of armour, and thus these insects are commonly referred to as 'armoured scales'.

Hard scales always have a cover over the top (dorsal side) of the insect, and sometimes also a bottom (ventral side) cover which together can entirely envelope the insect. The scale covers of Diaspididae were comprehensively reviewed by Foldi (1990), who described their structure, chemical composition, location, shape, size, colour and sexual dimorphism.

The scale cover is formed of secreted wax filaments which are cemented by anal liquid, together with the embedded nymphal exuviae. The scale cover of each species can be characterised by its shape, size, colour, profile, texture, and relative exuvial position. The cover is a product of the insect and not a part of it; it is detached from the body and can be removed without damage to the insect body, but without it, the insect dies from desiccation. The cover's physical properties of hardness and impermeability provides an effective protection against physical and chemical environmental challenges, and often hinders the effectiveness of chemical control of diaspidid pests (Foldi 1990).

Males only incorporate the shed skin of the crawler into their cover; the exuviae of the other instars are kicked off posteriorly from the cover (Miller et al. 2014b).

Honeydew and sooty moulds

Unlike soft scales, hard scales do not produce honeydew and thus there are no sooty moulds associated with hard scales on plants.

Hard scales and ants

Before the 1970's, association of ants with the superfamily Coccoidea had only been recorded with the honeydew-producing members such as Coccidae and Pseudococcidae. Because Diaspididae do not produce honeydew, a relationship with ants was not expected. However, associations of hard scales with ants has since been observed between 11 species of Diaspididae and four species of the ant genus *Melissotarsus* Emery (Ben-Dov 1990c; Ben-Dov & Fisher 2010). This association takes place between populations of hard scales living within galleries constructed by *Melissotarsus* ants in live bark of host plants across 15 dicotyledonous families, and including *Casuarina equisetifolia*, *Ficus capensis* and *Mangifera indica*. These hard scales, such as *Andaspis formicarum* Ben-Dov, *Melissoaspis fisheri* Ben-Dov, *Melissoaspis reticulata* (Ben-Dov) and *Melissoaspis formicaria* (Ben-Dov), lack the normal diaspidid scale covers, because the ant-constructed galleries allow the insects to survive without the covers. This form of association is widely distributed in Africa and Madagascar.

2.4 Potential for establishment and spread

Pests of Coccidae and Diaspididae have the potential to establish and spread in Australia because they possess biological characteristics that enable them to adapt to new regions, the climatic conditions in Australia are suitable, and host plants are widely available.

2.4.1 Biological characteristics

Biological characteristics that enable scale insect pests to establish and spread include their small size and cryptic habitats, their protective wax body coverings, their plant feeding nature and predisposition to polyphagous behaviours, their ability to reproduce parthenogenetically as well as sexually, and their capacity for active and passive dispersal, most commonly by the 'crawler' life stage. These biological characteristics have been described and detailed in Section 2.3. These characteristics could facilitate the spread of the pests through their association with and long-distance transport on plant and plant products.

Normark et al. (2019) stated that armoured scales are extraordinarily invasive, in part because they are very small, cryptic, and nearly ubiquitous associates of woody plants. These attributes are also basically true for soft scales.

2.4.2 Suitable climatic conditions

Species of soft scales (Kozár & Ben-Dov 1997) and hard scales (Kozár 1990) are reported from all the zoogeographical regions of Europe, Asia, North America, South America, Africa and Australasia (Miller et al. 2014b). They occur in climatic conditions of tropics, subtropics and temperate regions (Kozár 1990; Kozár and Ben-Dov 1997) and thus display capacity to reproduce in a wide range of terrestrial environments.

Eighty-eight species of soft scales and 262 species of hard scales have been reported in Australia (García Morales et al. 2019), including native species as well as introduced pests. These records indicate that suitable climatic conditions for their establishment and spread are available in

Australia, across a range of tropical, subtropical, temperate, and cool temperate regions (Bureau of Meteorology 2016).

2.4.3 Available hosts plants

Both coccids and diaspidids are recorded to occur on a diverse range of host plants. The ten most common host plant families for both groups are listed in Table 2.3, together with the recorded number of host plant genera and species, based on records from the ScaleNet database (García Morales et al. 2019).

Coccids (1,281 species) are recorded on a total of 1,993 species, 1,506 genera and 240 families of host plants, while diaspidids (2,624 species) are recorded on a total of 2,843 species, 2,043 genera and 290 families of host plants (García Morales et al. 2019; García Morales et al. 2015). For soft scales, the ten most common host families, in descending order, are Fabaceae, Asteraceae, Rosaceae, Poaceae, Rubiaceae, Myrtaceae, Malvaceae, Moraceae, Rutaceae and Sapindaceae (Table 2.3). For hard scales, the ten most common host families, in descending order, are Fabaceae, Poaceae, Rosaceae, Myrtaceae, Orchidaceae, Asteraceae, Euphorbiaceae, Pinaceae, Arecaceae, and Fagaceae (Table 2.3). The reported host plants of soft scales range from woody perennials to herbaceous grasses, while those of hard scales are generally long-lived plant species such as trees and shrubs, but are occasionally found on annuals (Miller et al. 2014b).

Lin, Gullan and Cook (2010) found that on angiosperms about 63% of coccid species were restricted to a single host plant family, and of these, about 90% were restricted to only one plant genus. About 37% of coccid species were recorded as polyphagous on angiosperms and 48% were reported as polyphagous on gymnosperms (Lin, Gullan & Cook 2010).

Many important pest species of coccids are highly polyphagous. Lin, Gullan and Cook (2010) indicated that eight species of Coccidae were extremely polyphagous, being recorded from more than 50 plant families. For example, *Parasaissetia nigra* (Nietner), a parthenogenetic and cosmopolitan pest likely comprising at least two ecotypes – one in Australia and New Zealand, and the other in the rest of the world (Lin et al. 2017) – is recorded on at least 383 species, 260 genera and 95 families of host plants (García Morales et al. 2019; García Morales et al. 2015). *Ceroplastes pseudoceriferus* Green, an exotic species for Australia, has been recorded on at least 128 species, 89 genera and 46 families of host plants (García Morales et al. 2019; García Morales et al. 2015).

From information in ScaleNet (García Morales et al. 2019; García Morales et al. 2015), two-thirds of diaspidid species are found only on one plant family, and the majority of these on only one host genus. About 25 percent are found on two to 120 plant families. A small percentage of hard scales are, however, highly polyphagous, especially many important pest species. For example, *Aspidiotus nerii* has been recorded on 520 species, 326 genera and 120 families of host plants (García Morales et al. 2019; García Morales et al. 2015).

From the host plant context, a single host genus or species can be attacked by many scale insect species. For example, 91 species of coccids and 114 species of diaspidids have been reported on *Citrus* and 68 species of coccids and 70 species of diaspidids on mango (*Manifera indica*) (García Morales et al. 2019).

Table 2.3 The ten most common host plant families for species of Coccidae and Diaspididae

Coccidae			Diaspididae		
Host family	Host genera	Host species (a)	Host family	Host genera	Host species (a)
Fabaceae	136	223	Fabaceae	157	302
Asteraceae	92	128	Poaceae	110	201
Rosaceae	31	104	Rosaceae	39	154
Poaceae	65	100	Myrtaceae	37	137
Rubiaceae	60	99	Orchidaceae	86	120
Myrtaceae	30	97	Asteraceae	92	110
Malvaceae	44	81	Euphorbiaceae	36	103
Moraceae	13	73	Pinaceae	12	101
Rutaceae	35	61	Areaceae	84	98
Sapindaceae	25	58	Fagaceae	8	96

a: The data presented are from the ScaleNet database (García Morales et al. 2019; García Morales et al. 2015). The actual number of host species may be higher than the figures provided because (i) there were no host plants recorded for many described species of soft and hard scales, (ii) all unidentified host species in the same host genus were counted as a single species entity, and (iii) the species count is based on the Flat Catalogue (García Morales et al. 2015) created in the ScaleNet database, containing only the original ScaleNet data before the original version of ScaleNet was retired in 2015. The indicated number of host genera and families is based on the current version of ScaleNet (García Morales et al. 2019).

As shown in Table 2.6, many host plants of coccids and diaspidids are cultivated as agricultural and horticultural crops. Australia grows a wide range of fruit, vegetable and ornamental species, such as apple, banana, citrus, cucurbits, grapes, mango, eggplant, orchids and roses. These host plants are therefore widely available in Australia. In addition, other host plants, such as members of the families Poaceae and Asteraceae, are also commonly distributed in the Australian environment. Availability of these host plants could be expected to facilitate the establishment and spread of quarantine scale insects in the PRA area.

Exotic soft and hard scales that have established and spread within Australia

There is a long history of exotic scale insects becoming established globally. For example, Miller and Miller (2003) and Miller et al. (2005) listed exotic species of Coccoidea that were introduced into and established in the USA. Similarly, species of scale insects have also been accidentally introduced to and become established in Australia.

There are 88 species of Coccidae and 262 species of Diaspididae reported from Australia (García Morales et al. 2019). Many of these species were most likely accidentally introduced to and subsequently established. It can be determined that at least 26 species of soft scales and 40 species of hard scales have been introduced into and established in Australia, based on their probable geographical origins provided in Miller and Miller (2003) and Miller et al. (2005) (Table 2.4). It is likely that these represent only a part of the total of all introductions, and that the actual number of introduced species of scale insects in Australia is much higher because the origin of many widespread species reported in Australia is not yet known.

Table 2.4 Examples of introduced species of soft and hard scales in Australia

	Species (a)	Geographical origin (b)	References
Coccidae			
1.	<i>Ceroplastes ceriferus</i> (Fabricius)	NEO	(Miller et al. 2005)
2.	<i>Ceroplastes destructor</i> Newstead	AFR	(Miller & Miller 2003)
3.	<i>Ceroplastes floridensis</i> Comstock	NEO	(Miller & Miller 2003)
4.	<i>Ceroplastes rubens</i> Maskell	AFR	(Miller et al. 2005)
5.	<i>Ceroplastes rusci</i> (Linnaeus)	AFR	(Miller et al. 2005)
6.	<i>Ceroplastes sinensis</i> Del Guercio	NEO	(Miller et al. 2005)
7.	<i>Ceroplastes stellifer</i> (Westwood)	ORI?	(Miller et al. 2005)
8.	<i>Coccus hesperidum</i> Linnaeus	ORI	(Miller et al. 2005)
9.	<i>Coccus longulus</i> (Douglas)	ORI?	(Miller et al. 2005)
10.	<i>Coccus pseudomagnoliarum</i> (Kuwana)	PAL	(Miller et al. 2005)
11.	<i>Coccus viridis</i> (Green)	AFR	(Miller et al. 2005)
12.	<i>Eucalymnatus tessellatus</i> (Signoret)	NEO	(Miller et al. 2005)
13.	<i>Milviscutulus mangiferae</i> (Green)	ORI	(Miller et al. 2005)
14.	<i>Parasaissetia nigra</i> (Nietner)	AFR or ORI	(Miller et al. 2005)
15.	<i>Parthenolecanium persicae</i> (Fabricius)	PAL	(Miller et al. 2005)
16.	<i>Parthenolecanium pruinosum</i> (Coquillett)	NEO	(Miller & Miller 2003)
17.	<i>Protopulvinaria pyriformis</i> Cockerell	NEO?	(Miller et al. 2005)
18.	<i>Pulvinaria elongata</i> Newstead	AFR	(Miller et al. 2005)
19.	<i>Pulvinaria floccifera</i> (Westwood)	PAL	(Miller et al. 2005)
20.	<i>Pulvinaria hydrangeae</i> Steinweden	NEO	(Miller & Miller 2003)
21.	<i>Pulvinaria polygonata</i> Cockerell	ORI	(Miller & Miller 2003)
22.	<i>Pulvinaria psidii</i> Maskell	ORI?	(Miller et al. 2005)
23.	<i>Pulvinaria urbicola</i> Cockerell	NEO	(Miller et al. 2005)
24.	<i>Pulvinariella mesembryanthemi</i> (Vallot)	AFR	(Miller et al. 2005)
25.	<i>Saissetia coffeae</i> (Walker)	AFR	(Miller et al. 2005)
26.	<i>Saissetia oleae</i> (Olivier)	AFR	(Miller et al. 2005)
Diaspididae			
1.	<i>Aonidiella aurantii</i> (Maskell)	ORI	(Miller et al. 2005)
2.	<i>Aonidiella citrina</i> (Coquillett)	ORI	(Miller et al. 2005)
3.	<i>Aonidiella inornata</i> McKenzie	ORI	(Miller et al. 2005)
4.	<i>Aonidiella orientalis</i> (Newstead)	ORI	(Miller et al. 2005)
5.	<i>Aulacaspis rosae</i> (Bouché)	PAL	(Miller et al. 2005)
6.	<i>Aulacaspis tubercularis</i> Newstead	ORI or PAL	(Miller et al. 2005)
7.	<i>Carulaspis juniperi</i> (Bouché)	PAL	(Miller et al. 2005)
8.	<i>Chrysomphalus aonidum</i> (Linnaeus)	ORI	(Miller et al. 2005)
9.	<i>Clavaspis herculeana</i> (Cockerell & Hadden)	NEO	(Miller et al. 2005)
10.	<i>Diaspidiotus ostreaeformis</i> (Curtis)	PAL	(Miller et al. 2005)
11.	<i>Diaspis boisduvalii</i> (Signoret)	NEO	(Miller et al. 2005)
12.	<i>Diaspis bromeliae</i> (Kerner)	NEO or NEA	(Miller et al. 2005)
13.	<i>Diaspis echinocacti</i> (Bouché)	NEO or NEA	(Miller et al. 2005)
14.	<i>Duplachionaspis divergens</i> (Green)	ORI or PAL	(Miller et al. 2005)
15.	<i>Fiorinia fiorinae</i> (Targioni Tozzetti)	ORI	(Miller et al. 2005)
16.	<i>Fiorinia japonica</i> (Kuwana)	PAL	(Miller et al. 2005)
17.	<i>Furcaspis bififormis</i> (Cockerell)	NEO or NEA	(Miller et al. 2005)

Species (a)	Geographical origin (b)	References
18. <i>Hemiberlesia lataniae</i> (Signoret)	Uncertain	(Miller et al. 2005)
19. <i>Hemiberlesia palmae</i> (Cockerell)	Uncertain	(Miller et al. 2005)
20. <i>Hemiberlesia rapax</i> (Comstock)	PAL	(Miller et al. 2005)
21. <i>Howardia biclavis</i> (Comstock)	AFR?	(Miller et al. 2005)
22. <i>Ischnaspis longirostris</i> (Signoret)	AFR	(Miller et al. 2005)
23. <i>Lepidosaphes beckii</i> (Newman)	ORI	(Miller et al. 2005)
24. <i>Lepidosaphes gloverii</i> (Packard)	ORI	(Miller et al. 2005)
25. <i>Lepidosaphes pinnaeformis</i> (Bouché)	ORI?	(Miller et al. 2005)
26. <i>Lepidosaphes tokionis</i> (Kuwana)	ORI or PAL	(Miller et al. 2005)
27. <i>Lepidosaphes ulmi</i> (Linnaeus)	PAL	(Miller et al. 2005)
28. <i>Lopholeucaspis japonica</i> (Cockerell)	PAL	(Miller et al. 2005)
29. <i>Odonaspis ruthae</i> Kotinsky	Uncertain	(Miller et al. 2005)
30. <i>Odonaspis saccharicaulis</i> (Zehntner)	ORI?	(Miller et al. 2005)
31. <i>Parlatoria blanchardi</i> (Targioni Tozzetti)	PAL	(Miller et al. 2005)
32. <i>Parlatoria oleae</i> (Colvée)	ORI	(Miller et al. 2005)
33. <i>Parlatoria pergandii</i> Comstock	ORI or PAL	(Miller et al. 2005)
34. <i>Parlatoria proteus</i> (Curtis)	Old world	(Miller et al. 2005)
35. <i>Pinnaspis aspidistrae</i> (Signoret)	ORI	(Miller et al. 2005)
36. <i>Pinnaspis buxi</i> (Bouché)	ORI	(Miller et al. 2005)
37. <i>Pseudaonidia trilobitiformis</i> (Green)	PAL	(Miller et al. 2005)
38. <i>Pseudaulacaspis cockerelli</i> (Cooley)	PAL or ORI	(Miller et al. 2005)
39. <i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti)	PAL or ORI	(Miller et al. 2005)
40. <i>Unaspis citri</i> (Comstock)	ORI	(Miller et al. 2005)

a: Note that the species listed in the Table 2.4 are considered to be introduced into Australia because they are considered to originate in geographical areas other than Australia, based largely on the information provided by Miller and Miller (2003) and Miller et al. (2005). **b:** Abbreviations for areas of zoogeographical regions: AFR – Afrotropical region, including Trans-Saharan Africa and Arabia; NEA – Nearctic region, including most of North America; NEO – Neotropical region, including South America, Central America, and the Caribbean; ORI – Oriental region, including the Indian subcontinent, Southeast Asia, and southern China; PAL – Palearctic region, including the bulk of Eurasia and North Africa.

Summary

All exotic scale insect pests included in the pest categorisation tables (Appendix B and Appendix C) were considered to have the potential to establish and spread in the PRA area on the basis that their biological characteristics are adaptive to new environment, their actual or potential host plants are widely available, and there are suitable climatic conditions in Australia. This assessment is supported by the observation that many introduced scale insect pests have already established and spread in Australia (Table 2.4).

This conclusion is consistent with previous pest categorisations undertaken by the department, in which scale insect quarantine pests have been repeatedly assessed as having potential to establish and spread in Australia.

2.5 Potential for economic consequences

Scale insects feed by inserting their stylets through plant tissues to suck plant sap. Stylet penetration is accomplished by secretion of solidified saliva that forms a sheath around the stylets. Scale insect saliva is toxic to plants and thus feeding often results in chlorotic, yellow or

red discoloration on leaves and fruit, and/or deformation of shoots, twigs and branches (Gill & Kosztarab 1997). Heavy infestation can result in loss of plant vigour, poor growth, splitting and dieback of twigs and branches, defoliation, and sometimes even death of the host plant (Gill & Kosztarab 1997; Kosztarab 1990).

As noted (Section 2.4.3), many species of Coccidae and Diaspididae are highly polyphagous, increasing their potential to cause significant economic consequences. Table 2.5 lists the ten most polyphagous species of Coccidae and Diaspididae together with information on the number of species, genera and families of their host plants.

Table 2.5 The ten most polyphagous species of Coccidae and Diaspididae

Pest species	Host species (a)	Host genera	Host families
Coccidae			
<i>Coccus hesperidum</i> Linnaeus	521	362	125
<i>Saissetia coffeae</i> (Walker)	445	294	107
<i>Parasaissetia nigra</i> (Nietner)	383	260	95
<i>Saissetia oleae</i> (Olivier)	304	216	76
<i>Ceroplastes rubens</i> Maskell	274	168	79
<i>Ceroplastes floridensis</i> Comstock	233	152	67
<i>Coccus viridis</i> (Green)	205	144	61
<i>Coccus longulus</i> (Douglas)	200	139	54
<i>Pulvinaria psidii</i> Maskell	199	141	67
<i>Parthenolecanium corni</i> (Bouché)	183	105	48
Diaspididae			
<i>Aspidiotus nerii</i> Bouché	520	326	120
<i>Hemiberlesia lataniae</i> (Signoret)	478	321	114
<i>Pinnaspis strachani</i> (Cooley)	366	244	74
<i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti)	363	221	85
<i>Lepidosaphes ulmi</i> (Linnaeus)	313	153	68
<i>Howardia biclavis</i> (Comstock)	290	196	69
<i>Chrysomphalus dictyospermi</i> (Morgan)	286	186	79
<i>Chrysomphalus aonidum</i> (Linnaeus)	260	169	73
<i>Hemiberlesia rapax</i> (Comstock)	259	188	79
<i>Aonidiella aurantii</i> (Maskell)	246	177	83

a: The data presented are from the ScaleNet database (García Morales et al. 2019; García Morales et al. 2015). The actual number of host species may be higher than the figures provided because (i) there were no host plants recorded for many described species of soft and hard scales, (ii) all unidentified host species in the same host genus were counted as a single species entity, and (iii) the species count is based on the Flat Catalogue (García Morales et al. 2015) created in the ScaleNet database, containing only the original ScaleNet data before the original version of ScaleNet was retired in 2015. The indicated number of host genera and families is based on the current version of ScaleNet (García Morales et al. 2019).

2.5.1 Major scale insect pests

Gill and Kosztarab (1997) compiled a list of 50 major soft scale pests of the world (including 9 of the 10 most polyphagous species listed in Table 2.5), twenty-three of which are not present in Australia, including species in the genera of *Ceroplastes*, *Coccus*, *Eulecanium*, *Pulvinaria* and *Toumeyella*. Many other pests of soft scales that are important only in small geographical areas

and/or only found on a narrow range of hosts were not included in the list of Gill and Kosztarab (1997).

Miller and Miller (2003) listed 147 species of soft scales that are considered either pests or represent a threat to agriculture for the United States. Miller et al. (2005) believed that 43 species of soft scales were introduced into the United States, with usually at least one species introduction every decade since the 1890's and the greatest introduction of nine species occurring in the decade of the 1900's.

For Diaspididae, Miller and Davidson (1990) compiled a list of 199 pest species of hard scales based on published literature and also their own unpublished information. Among them, 38 were considered to be serious pests in many areas of the world (note all the ten most polyphagous diaspidid species listed in Table 2.5 also belong to this group), and 23 to be serious pests in a small area of the world with the remaining being occasional pests. Miller and Davidson (1990) believed that the obvious pests had been included in their list but many species that are pests in small geographic areas/or on a narrow range of hosts were excluded. They also reviewed the percentage of pest species in some important studies on hard scales and found that 23 to 41% of the species included in those publications would be pests (Miller & Davidson 1990). If these percentages are translated to the current reported 2,624 species of hard scales (Garcia et al. 2018), 602 to 1074 species of hard scales could be pests. It should be noted that the 199 pest species listed by Miller and Davidson (1990) only represents 7.7% of the diaspidid species described to date.

Miller et al. (2005) listed 132 species of Diaspididae as being introduced into the United States, including information on the pest status, principal host plants and geographical origin for each species. Many of the species listed are exotic to Australia, such as the serious pests *Aulacaspis yasumatsui*, *Fiorinia theae*, *Gymnaspis aechmeae*, *Mercetaspis hall* and *Unaspis euonymi* (Miller et al. 2005) and would have the potential to be introduced and to cause economics consequences if introduced.

2.5.2 Scale insect pests associated with important crops

Coccid pests associated with many important crops were reviewed by different authors in the monograph titled 'Soft scale insects: their biology, natural enemies and control' (volume 7B) edited by Ben-Dov and Hodgson (1997a), such as on citrus (Gill 1997a), avocado (Swirski, Wysoki & Ben-Dov 1997), mango (Swirski, Ben-Dov & Wysoki 1997b), persimmon (Swirski, Ben-Dov & Wysoki 1997d), various subtropical fruit (Swirski, Ben-Dov & Wysoki 1997c), deciduous fruit (Pfeiffer 1997), grapevine (Pellizzari 1997a) and ornamental and house plants (Kosztarab 1997c).

Likewise, diaspidid pests on many crops and fruit trees and their control were discussed in the monograph titled 'Armoured scale insects, their biology, natural enemies and control' Volume 4B edited by Rosen (1990), including on citrus (Rose 1990), tropical fruit trees and shrubs (Chua & Wood 1990), date palm (Benassy 1990) and deciduous fruit trees (Kozar 1990).

Using the information available in ScaleNet (García Morales et al. 2019), the number of genera and species of coccids and diaspidids recorded on some economically important host plants included in the scope defined in this Group PRA (fresh fruit, vegetables, cut-flowers and foliage) are presented in Table 2.6. It is clear that many scale insect pests are found on each of the many

economically important crops. For example, 91 species in 26 genera of coccids and 114 species in 43 genera of diaspidids are recorded on citrus, 68 species in 23 genera of coccids and 70 species in 31 genera of diaspidids on mango, 10 species in seven genera of coccids and 23 species in eight genera of diaspidids on *Capsicum* and 32 species in 11 genera of coccids and 53 in 27 genera of diaspidids on *Rosa* species (Table 2.6) (García Morales et al. 2019).

Table 2.6 Numbers of Coccidae and Diaspididae recorded on economically important host plants

Host plants	Coccidae	Diaspididae
	No. of genera - species	No. of genera - species
Apple (<i>Malus</i> spp.)	13 - 28	23 - 59
Avocado (<i>Persea americana</i>)	16 - 37	22 - 42
Banana (<i>Musa</i> spp.)	9 - 19	23 - 49
Citrus spp.	26 - 91	43 - 114
Grape (<i>Vitis</i> spp.)	13 - 25	32 - 62
Mango (<i>Mangifera indica</i>)	23 - 68	31 - 70
Persimmon (<i>Diospyros</i> spp.)	10 - 38	31 - 68
Pineapple (<i>Ananas comosus</i>)	2 - 2	7 - 8
Chilli (<i>Capsicum</i> spp.)	7 - 10	8 - 13
Eggplant (<i>Solanum melongena</i>)	6 - 9	10 - 13
<i>Chrysanthemum</i> spp.	4 - 13	5 - 4
<i>Rosa</i> spp.	11 - 32	27 - 53

Data were based on information in the ScaleNet database (García Morales et al. 2019)

There are also many reported instances of introduced scale insect pests causing more serious damage to host plants in newly colonised regions than in regions of origin. Miller et al. (2005) state that scale insects pose serious problems when introduced into new areas of the world where their natural enemies are not present, and list many species that have been introduced into the USA and become serious pests (Table 2.7). Many species listed by Miller et al. (2005) are not yet present in Australia, but have the potential to become important economic pests if they were to be introduced and become established. From the Coccidae these include *Eulecanium cerasorum* (Cockerell), *Eulecanium kunoense* (Kuwana), *Pulvinaria citricola* (Kuwana) and *Sphaerolecanium prunastri* (Boyer de Fonscolombe) (Table 2.7). From the Diaspididae these include *Aulacaspis yasumatsui* Takagi, *Fiorinia externa* Ferris, *Gymnaspis aechmeae* Newstead and *Unaspis euonymi* (Comstock).

Table 2.7 Examples of introduced scale insects becoming serious pests in the USA

Pest (a)	Likely area of origin (b)	Earliest U.S. record (c)	Principal host plants	Present within Australia
Coccidae				
<i>Coccus viridis</i> (Green)	AFR	FL, 1921	Polyphagous	Yes
<i>Eucalymnatus tessellatus</i> (Signoret)	NEO	CA, 1897	Polyphagous, green house pest	Yes
<i>Eulecanium cerasorum</i> (Cockerell)	PAL	CA, 1909	Deciduous trees	No
<i>Eulecanium kunoense</i> (Kuwana)	PAL	CA, 1896	Deciduous fruit trees	No
<i>Eulecanium tiliae</i> (Linnaeus)	PAL	CA, 1908	Polyphagous	Yes
<i>Milviscutulus mangiferae</i> (Green)	ORI	FL, 1917	Polyphagous	Yes
<i>Parasaissetia nigra</i> (Nietner)	AFR or ORI	FL 1920	Polyphagous	Yes
<i>Parthenolecanium persicae</i> (Fabricius)	PAL	CA, 1897	Polyphagous	Yes
<i>Pulvinaria citricola</i> (Kuwana)	PAL	CA, 1939	Oligophagous, including citrus and persimmon	No
<i>Pulvinaria delottoi</i> Gill	AFR	CA 1973	Iceplant	No
<i>Pulvinaria urbicola</i> Cockerell	NEO	FL, 1923	Polyphagous	Yes
<i>Sphaerolecanium prunastri</i> (Boyer de Fonscolombe)	PAL	PA, 1895	Fruit trees	No
Diaspididae				
<i>Aonidiella aurantii</i> (Maskell)	ORI	CA, 1875	Citrus	Yes
<i>Aulacaspis yasumatsui</i> Takagi	ORI	FL, 1996	Cycads	No
<i>Chrysomphalus aonidum</i> (Linnaeus)	ORI	FL, 1880	Polyphagous	Yes
<i>Comstockaspis perniciosus</i> (Comstock)	PAL	CA, 1807	Polyphagous including Rosaceae	Yes
<i>Diaspis boisduvalii</i> Signoret	NEO	FL, 1896	Polyphagous, including orchards and palms	Yes
<i>Fiorinia externa</i> Ferris	PAL	NY, 1908	Hemlock	No
<i>Gymnaspis aechmeae</i> Newstead	ORI	FL, 1917	Bromelias	No
<i>Hemiberlesia rapax</i> (Comstock)	PAL	CA, FL, 1880	Polyphagous	Yes
<i>Lepidosaphes beckii</i> (Newman)	ORI	FL, 1859	Polyphagous, including citrus	Yes
<i>Lepidosaphes ulmi</i> (Linnaeus)	PAL	ME, 1794	Polyphagous, including Salicaceae, Rosaceae, Oleaceae	Yes
<i>Lindingaspis rossi</i> (Maskell)	AUS	CA, 1892	Polyphagous, including <i>Sequoia</i> , and <i>Araucaria</i>	Yes
<i>Parlatoria oleae</i> (Colvée)	ORI	CA, 1931	Polyphagous, including olive	Yes
<i>Pinnaspis aspidistrae</i> (Signoret)	ORI	CA, 1896	Polyphagous, including ferns	Yes
<i>Pinnaspis strachani</i> (Cooley)	ORI	FL, 1911	Polyphagous, including hibiscus	Yes
<i>Unaspis citri</i> (Comstock)	ORI	LA, 1880	Oligophagous, including citrus	Yes
<i>Unaspis euonymi</i> (Comstock)	PAL	VA, 1879	Polyphagous, including euonymus	No

a: The species listed in Table 2.7 are considered to be introduced and serious pests in the USA by Miller et al. (2005, table 1). **b:** Abbreviations: AFR – Afrotropical region, including Trans-Saharan Africa and Arabia; NEO – Neotropical region, including South America, Central America, and the Caribbean; ORI – Oriental region, including the Indian subcontinent, Southeast Asia, and southern China; PAL – Palearctic region, including the bulk of Eurasia and North Africa. **c:** Abbreviations: CA – California, FL – Florida, LA – Louisiana, ME – Maine, NY – New York, PA – Pennsylvania and VA – Virginia.

Many scale insects have also become serious pests in Australia after being accidentally introduced, such as the soft scales *Coccus viridis* (Green), *Eulecanium tiliae* (Linnaeus), *Milviscutulus*

mangiferae (Green), *Parasaissetia nigra* (Nietner), *Parthenolecanium persicae* (Fabricius), and the hard scales *Aonidiella aurantii* (Maskell), *Comstockaspis perniciosus* (Comstock), *Lepidosaphes beckii* (Newman), *Lepidosaphes ulmi* (Linnaeus), *Lindingaspis rossi* (Maskell), *Parlatoria oleae* (Colvée) and *Pinnaspis strachani* (Cooley) (Table 2.7).

An additional and well-documented example of a scale insect becoming an economic pest after being accidentally introduced to a new region is that of *Ceroplastes sinensis* Del Guercio, a soft scale pest. This species is believed to originate in Central or South America and has subsequently spread to Southern Europe, Northern Africa, North America, Australia and New Zealand (Qin et al. 1994). The species is considered an economic pest in the USA, Spain and Italy (Gill & Kosztarab 1997). It is not reported as pest in its native region. *Ceroplastes sinensis* was first collected in Australia in August 1966 in the Royal Botanic Gardens, Sydney and heavy infestation on citrus was recorded in outer metropolitan Sydney six months later. The species then quickly spread to major citrus growing districts of coastal NSW and it subsequently also became pest in southern Queensland and Western Australia (Qin et al. 1994) and other parts of Australia (García Morales et al. 2019).

Summary

All scale insect quarantine pests in the pest categorisation process were considered to have potential to cause economic (including environmental) consequences in Australia on the basis that they feed on and damage plants. Exotic pests have the potential to cause more serious damage in newly colonised regions than in their native areas.

This assessment is consistent with the outcomes of previous pest categorisations undertaken by the department, in which species found to be on the plant import pathway and to have the potential for establishment and spread were repeatedly assessed as having potential to cause economic consequences in Australia.

2.6 Conclusion of pest categorisation process

2.6.1 Conclusion for Coccidae

Based on the selection criteria (Table 2.1) for inclusion of species in the pest categorisation process, a total of 266 species of Coccidae were categorised in Table 8.1 (Appendix B). As an outcome of the pest categorisation process, a total of 247 species were considered further in the pest risk assessment (Table 2.8). Of these, 231 species are quarantine pests for Australia; eight species are pests of regional concern for Western Australia (WA), and one species for New South Wales (NSW), South Australia (SA) and Victoria (Vic.); four species are virus vectors, although not quarantine pests; two species are both quarantine pests for Australia and virus vectors, and one species is both of regional concern for WA and a virus vector (Table 2.8).

Table 2.8 Outcome of pest categorisation of Coccidae (soft scales)

Species	Quarantine pest	Virus vector
<i>Alecanium hirsutum</i> Morrison	Yes	No
<i>Alecanochiton arborescens</i> (Laing)	Yes	No
<i>Alecanochiton marquesi</i> Hempel	Yes	No
<i>Anapulvinaria pistaciae</i> (Bodenheimer)	Yes	No
<i>Anapulvinaria cephalocarinata</i> Fonseca	Yes	No

Species	Quarantine pest	Virus vector
<i>Anthococcus keravatae</i> Williams & Watson	Yes	No
<i>Ceroplastes actiniformis</i> Green	Yes	No
<i>Ceroplastes ajmerensis</i> (Avasthi & Shafee)	Yes	No
<i>Ceroplastes bergi</i> Cockerell	Yes	No
<i>Ceroplastes brevicauda</i> Hall	Yes	No
<i>Ceroplastes campinensis</i> Hempel	Yes	No
<i>Ceroplastes cirripediformis</i> (Comstock)	Yes	No
<i>Ceroplastes cistudiformis</i> (Cockerell)	Yes	No
<i>Ceroplastes deodorensis</i> Hempel	Yes	No
<i>Ceroplastes depressus</i> Cockerell	Yes	No
<i>Ceroplastes diospyros</i> Hempel	Yes	No
<i>Ceroplastes dugesii</i> Lichtenstein	Yes	No
<i>Ceroplastes eugeniae</i> Hall	Yes	No
<i>Ceroplastes ficus</i> Newstead	Yes	No
<i>Ceroplastes floridensis</i> Comstock	Yes (WA)	No
<i>Ceroplastes flosculoides</i> Matile-Ferrero	Yes	No
<i>Ceroplastes galeatus</i> Newstead	Yes	No
<i>Ceroplastes grandis</i> Hempel	Yes	No
<i>Ceroplastes janeirensis</i> (Gray)	Yes	No
<i>Ceroplastes japonicus</i> Green	Yes	No
<i>Ceroplastes lamborni</i> Newstead	Yes	No
<i>Ceroplastes macgregori</i> Sampedro & Butze	Yes	No
<i>Ceroplastes magnificus</i> (Green)	Yes	No
<i>Ceroplastes martinae</i> Mosquera	Yes	No
<i>Ceroplastes murrayi</i> Froggatt	Yes	No
<i>Ceroplastes nakaharai</i> Gimpel	Yes	No
<i>Ceroplastes personatus</i> Newstead	Yes	No
<i>Ceroplastes pseudoceriferus</i> Green	Yes	No
<i>Ceroplastes quadrilineatus</i> Newstead	Yes	No
<i>Ceroplastes rusci</i> (Linnaeus)	No	Yes
<i>Ceroplastes singularis</i> Newstead	Yes	No
<i>Ceroplastes stellifer</i> (Westwood)	Yes (WA)	No
<i>Ceroplastes theobromae</i> Newstead	Yes	No
<i>Ceroplastes toddaliae</i> Hall	Yes	No
<i>Ceroplastes trochezi</i> Mosquera	Yes	No
<i>Ceroplastes utilis</i> Cockerell	Yes	No
<i>Ceroplastes vinsonioides</i> Newstead	Yes	No
<i>Ceroplastodes bahiensis</i> Bondar	Yes	No
<i>Ceroplastodes ritchiei</i> Laing	Yes	No
<i>Ceroplastodes zavattarii</i> Bellio	Yes	No

Species	Quarantine pest	Virus vector
<i>Coccus africanus</i> (Newstead)	Yes	No
<i>Coccus almoraensis</i> Avasthi & Shafee	Yes	No
<i>Coccus alpinus</i> De Lotto	Yes	No
<i>Coccus brasiliensis</i> Fonseca	Yes	No
<i>Coccus capparidis</i> (Green)	Yes	No
<i>Coccus celatus</i> De Lotto	Yes	No
<i>Coccus colemani</i> Kannan	Yes	No
<i>Coccus discrepans</i> (Green)	Yes	No
<i>Coccus elatensis</i> Ben-Dov	Yes	No
<i>Coccus formicarii</i> (Green)	Yes	No
<i>Coccus guerinii</i> (Signoret)	Yes	No
<i>Coccus kozstarabi</i> Avasthi & Shafee	Yes	No
<i>Coccus latioperculatum</i> (Green)	Yes	No
<i>Coccus longulus</i> (Douglas)	No	Yes
<i>Coccus moestus</i> De Lotto	Yes	No
<i>Coccus ophiorrhizae</i> (Green)	Yes	No
<i>Coccus pseudhesperidum</i> (Cockerell)	Yes	No
<i>Coccus subacutus</i> (Newstead)	Yes	No
<i>Coccus subhemisphaericus</i> (Newstead)	Yes	No
<i>Coccus takanoi</i> Takahashi	Yes	No
<i>Coccus viridulus</i> De Lotto	Yes	No
<i>Cryptinglisia lounsburyi</i> Cockerell	Yes	No
<i>Cryptostigma inquilinum</i> (Newstead)	Yes	No
<i>Cryptostigma silveirai</i> (Hempel)	Yes	No
<i>Crystallotesta fagi</i> (Maskell)	Yes	No
<i>Dicyphococcus castilloae</i> (Green)	Yes	No
<i>Didesmococcus koreanus</i> Borchsenius	Yes	No
<i>Didesmococcus unifasciatus</i> (Archangelskaya)	Yes	No
<i>Discochiton cocophyllae</i> Banks	Yes	No
<i>Discochiton expansum</i> (Green)	Yes (WA)	No
<i>Discochiton metallicum</i> (Green)	Yes	No
<i>Discochiton milleri</i> (Takahashi)	Yes	No
<i>Drepanococcus cajani</i> (Maskell)	Yes	No
<i>Drepanococcus chiton</i> (Green)	Yes	No
<i>Drepanococcus virescens</i> (Green)	Yes	No
<i>Edwallia rugosa</i> Hempel	Yes	No
<i>Ericerus pela</i> (Chavannes)	Yes	No
<i>Eucalymnatus hempeli</i> Costa Lima	Yes	No
<i>Eucalymnatus magarinosi</i> Costa Lima	Yes	No
<i>Eucalymnatus spinosus</i> Costa Lima	Yes	No

Species	Quarantine pest	Virus vector
<i>Eucalymnatus tessellatus</i> (Signoret)	Yes (WA)	No
<i>Eulecanium alnicola</i> Chen	Yes	No
<i>Eulecanium caryae</i> (Fitch)	Yes	No
<i>Eulecanium cerasorum</i> (Cockerell)	Yes	No
<i>Eulecanium ciliatum</i> (Douglas)	Yes	No
<i>Eulecanium douglasi</i> (Šulc)	Yes	No
<i>Eulecanium excrescens</i> (Ferris)	Yes	No
<i>Eulecanium franconicum</i> (Lindinger)	Yes	No
<i>Eulecanium giganteum</i> (Shinji)	Yes	No
<i>Eulecanium kunoense</i> (Kuwana)	Yes	No
<i>Eulecanium lespedezae</i> Danzig	Yes	No
<i>Eulecanium nocivum</i> Borchsenius	Yes	No
<i>Eulecanium perinflatum</i> (Cockerell)	Yes	No
<i>Eulecanium rugulosum</i> (Archangelskaya)	Yes	No
<i>Eulecanium sericeum</i> (Lindinger)	Yes	No
<i>Eulecanium transcaucasicum</i> Borchsenius	Yes	No
<i>Filippia follicularis</i> (Targioni Tozzetti)	Yes	No
<i>Hemilecanium cacao</i> (Hodgson)	Yes	No
<i>Hemilecanium imbricans</i> (Green)	Yes	No
<i>Hemilecanium mangiferae</i> Kondo & Williams	Yes	No
<i>Hemilecanium theobromae</i> Newstead	Yes	No
<i>Inglisia theobromae</i> Newstead	Yes	No
<i>Kilifia acuminata</i> (Signoret)	Yes	No
<i>Kilifia americana</i> Ben-Dov	Yes	No
<i>Kilifia deltoides</i> De Lotto	Yes	No
<i>Lagosinia aristolochiae</i> (Newstead)	Yes	No
<i>Lagosinia strachani</i> (Cockerell)	Yes	No
<i>Lichtensia carissae</i> (Brain)	Yes	No
<i>Lichtensia viburni</i> Signoret	Yes	No
<i>Maacoccus bicruciatu</i> s (Green)	Yes	No
<i>Maacoccus piperis</i> (Green)	Yes	No
<i>Maacoccus watti</i> (Green)	Yes	No
<i>Mametia louisiae</i> Matile-Ferrero	Yes	No
<i>Mariacoccus marianus</i> (Cockerell)	Yes	No
<i>Marsipococcus marsupialis</i> (Green)	Yes	No
<i>Marsipococcus proteae</i> (Brain)	Yes	No
<i>Megalocryptes bambusicola</i> (Green)	Yes	No
<i>Megalocryptes buteae</i> Takahashi	Yes	No
<i>Megapulvinaria burkilli</i> (Green)	Yes	No
<i>Megapulvinaria maxima</i> (Green)	Yes	No

Species	Quarantine pest	Virus vector
<i>Mesolecanium nigrofasciatum</i> (Pergande)	Yes	No
<i>Metaceronema japonica</i> (Maskell)	Yes	No
<i>Millericoccus costalimai</i> (Bondar)	Yes	No
<i>Milviscutulus ciliatus</i> Williams & Watson	Yes	No
<i>Milviscutulus pilosus</i> Williams & Watson	Yes	No
<i>Milviscutulus spiculatus</i> Williams & Watson	Yes	No
<i>Neolecanium cornuparvum</i> (Thro)	Yes	No
<i>Neolecanium craspeditae</i> Morrison	Yes	No
<i>Neoplatylecanium adersi</i> (Newstead)	Yes	No
<i>Neopulvinaria innumerabilis</i> (Rathvon)	Yes	Yes
<i>Neosaissetia triangularum</i> (Morrison)	Yes	No
<i>Nipponpulvinaria horii</i> (Kuwana)	Yes	No
<i>Palaeolecanium bituberculatum</i> (Signoret)	Yes	No
<i>Palaeolecanium kosswigi</i> (Bodenheimer)	Yes	No
<i>Paralecanium album</i> Takahashi	Yes	No
<i>Parasaissetia nigra</i> (Nietner)	No	Yes
<i>Parthenolecanium corni</i> (Bouché)	Yes (WA)	Yes
<i>Parthenolecanium fletcheri</i> (Cockerell)	Yes	No
<i>Parthenolecanium glandi</i> (Kuwana)	Yes	No
<i>Parthenolecanium jabolicabae</i> (Hempel)	Yes	No
<i>Parthenolecanium orientale</i> Borchsenius	Yes	No
<i>Parthenolecanium perlatum</i> (Cockerell)	Yes	No
<i>Parthenolecanium persicae</i> (Fabricius)	No	Yes
<i>Parthenolecanium putmani</i> (Philips)	Yes	No
<i>Parthenolecanium quercifex</i> (Fitch)	Yes	No
<i>Parthenolecanium rufulum</i> (Cockerell)	Yes	No
<i>Pendularia pendens</i> Fonseca	Yes	No
<i>Phalacrocooccus howertoni</i> Hodges & Hodgson	Yes	No
<i>Philephedra broadwayi</i> (Cockerell)	Yes	No
<i>Philephedra lutea</i> (Cockerell)	Yes	No
<i>Philephedra tuberculosa</i> Nakahara & Gill	Yes	No
<i>Physokermes hemicryphus</i> (Dalman)	Yes	No
<i>Physokermes inopinatus</i> Danzig & Kozár	Yes	No
<i>Physokermes piceae</i> (Schrank)	Yes	No
<i>Physokermes taxifoliae</i> Coleman	Yes	No
<i>Platinglisia noacki</i> Cockerell	Yes	No
<i>Platylecanium cocotis</i> Laing	Yes	No
<i>Platysaissetia armata</i> (Takahashi)	Yes	No
<i>Prococcus acutissimus</i> (Green)	Yes	No
<i>Protopulvinaria longivalvata</i> Green	Yes	No

Species	Quarantine pest	Virus vector
<i>Protopulvinaria pyriformis</i> (Cockerell)	Yes (NSW, SA, Vic)	No
<i>Pseudocribroleanium andersoni</i> (Newstead)	Yes	No
<i>Pseudokermes nitens</i> (Cockerell)	Yes	No
<i>Pseudokermes vitreus</i> (Cockerell)	Yes	No
<i>Pseudophilippia lanigera</i> (Hempel)	Yes	No
<i>Pseudophilippia quaintancii</i> Cockerell	Yes	No
<i>Pulvinaria acericola</i> (Walsh & Riley)	Yes	No
<i>Pulvinaria aethiopica</i> (De Lotto)	Yes	No
<i>Pulvinaria amygdali</i> Cockerell	Yes	No
<i>Pulvinaria aurantii</i> Cockerell	Yes	No
<i>Pulvinaria avasthii</i> Yousuf & Shafee	Yes	No
<i>Pulvinaria bambusicola</i> (Tang)	Yes	No
<i>Pulvinaria cacao</i> Williams & Watson	Yes	No
<i>Pulvinaria citricola</i> (Kuwana)	Yes	No
<i>Pulvinaria delottoi</i> Gill	Yes	No
<i>Pulvinaria ericicola</i> McConnell	Yes	No
<i>Pulvinaria eugeniae</i> Hempel	Yes	No
<i>Pulvinaria ficus</i> Hempel	Yes	No
<i>Pulvinaria flavescens</i> Brethes	Yes	No
<i>Pulvinaria floccifera</i> (Westwood)	Yes (WA)	No
<i>Pulvinaria fujisana</i> Kanda	Yes	No
<i>Pulvinaria hydrangeae</i> Steinweden	Yes (WA)	No
<i>Pulvinaria iceryi</i> (Signoret)	Yes	No
<i>Pulvinaria idesiae</i> Kuwana	Yes	No
<i>Pulvinaria ixorae</i> Green	Yes	No
<i>Pulvinaria kuwacola</i> Kuwana	Yes	No
<i>Pulvinaria mammeae</i> Maskell	Yes	No
<i>Pulvinaria occidentalis</i> Cockerell	Yes	No
<i>Pulvinaria okitsuensis</i> Kuwana	Yes	No
<i>Pulvinaria ornata</i> Hempel	Yes	No
<i>Pulvinaria peregrina</i> (Borchsenius)	Yes	No
<i>Pulvinaria persicae</i> Newstead	Yes	No
<i>Pulvinaria polygonata</i> Cockerell	Yes (WA)	No
<i>Pulvinaria portblairensis</i> Yousuf & Shafee	Yes	No
<i>Pulvinaria pruni</i> Hunter	Yes	No
<i>Pulvinaria regalis</i> Canard	Yes	No
<i>Pulvinaria rhois</i> Ehrhorn	Yes	No
<i>Pulvinaria salicicola</i> Borchsenius	Yes	No
<i>Pulvinaria simulans</i> Cockerell	Yes	No
<i>Pulvinaria taiwana</i> Takahashi	Yes	No

Species	Quarantine pest	Virus vector
<i>Pulvinaria tenuivalvata</i> (Newstead)	Yes	No
<i>Pulvinaria vitis</i> (Linnaeus)	Yes	Yes
<i>Pulvinarisca inopheron</i> (Laing)	Yes	No
<i>Pulvinarisca jacksoni</i> (Newstead)	Yes	No
<i>Rhodococcus sariuoni</i> Brochsenius	Yes	No
<i>Rhodococcus turanicus</i> (Archangelskaya)	Yes	No
<i>Saccharolecanium fujianense</i> Tang	Yes	No
<i>Saccharolecanium krugeri</i> (Zehntner)	Yes	No
<i>Saissetia anonae</i> Hempel	Yes	No
<i>Saissetia chitonoides</i> De Lotto	Yes	No
<i>Saissetia discoides</i> (Hempel)	Yes	No
<i>Saissetia hurae</i> (Newstead)	Yes	No
<i>Saissetia neglecta</i> De Lotto	Yes (WA)	No
<i>Saissetia persimilis</i> (Newstead)	Yes	No
<i>Saissetia privigna</i> De Lotto	Yes	No
<i>Saissetia socialis</i> Hempel	Yes	No
<i>Saissetia somereni</i> (Newstead)	Yes	No
<i>Saissetia vivipara</i> Williams & Watson	Yes	No
<i>Saissetia zanzibarensis</i> Williams	Yes	No
<i>Sphaerolecanium prunastri</i> (Boyer de Fonscolombe)	Yes	No
<i>Stictolecanium ornatum</i> (Hempel)	Yes	No
<i>Takahashia japonica</i> (Cockerell)	Yes	No
<i>Tillancoccus mexicanus</i> Ben-Dov	Yes	No
<i>Tillancoccus tillandsiae</i> Ben-Dov	Yes	No
<i>Toumeyella cubensis</i> Heidel & Köhler	Yes	No
<i>Toumeyella liriodendri</i> (Gmelin)	Yes	No
<i>Toumeyella parvicornis</i> (Cockerell)	Yes	No
<i>Toumeyella pini</i> (King)	Yes	No
<i>Toumeyella virginiana</i> Williams & Kosztarab	Yes	No
<i>Trijuba oculata</i> (Brain)	Yes	No
<i>Udinia catori</i> (Green)	Yes	No
<i>Udinia farquharsoni</i> (Newstead)	Yes	No
<i>Udinia glabra</i> De Lotto	Yes	No
<i>Udinia newsteadi</i> Hanford	Yes	No
<i>Udinia paupercula</i> De Lotto	Yes	No
<i>Udinia pterolobina</i> (De Lotto)	Yes	No
<i>Udinia setigera</i> (Newstead)	Yes	No
<i>Umwinsia nitidula</i> (De Lotto)	Yes	No
<i>Vitrococcus conchiformis</i> (Newstead)	Yes	No
<i>Waxiella subdenudata</i> (Newstead)	Yes	No

Species	Quarantine pest	Virus vector
<i>Waxiella subsphaerica</i> (Newstead)	Yes	No
<i>Xenolecanium mangiferae</i> Takahashi	Yes	No

2.6.2 Conclusion for Diaspididae

Based on the selection criteria (Table 2.1) for inclusion of species in the pest categorisation process, a total of 375 species of Diaspididae were categorised in Table 9.1 (Appendix C). As an outcome of the pest categorisation process, a total of 331 species were considered further in the pest risk assessment (Table 2.9). Of these species 299 are quarantine pests for Australia; two species are pests of regional concern for Northern Territory (NT), 29 species for Western Australia (WA) and one species for NT, South Australia (SA) and WA (Table 2.9). No species of Diaspididae were identified as virus vectors.

Table 2.9 Outcome of pest categorisation of Diaspididae (hard scales)

Species	Quarantine pest
<i>Acanthomytilus intermittens</i> (Hall)	Yes
<i>Acanthomytilus sacchari</i> (Hall)	Yes
<i>Acutaspis albopicta</i> (Cockerell)	Yes
<i>Acutaspis paulista</i> (Hempel)	Yes
<i>Acutaspis perseae</i> (Comstock)	Yes
<i>Acutaspis scutiformis</i> (Cockerell)	Yes
<i>Acutaspis umbonifera</i> (Newstead)	Yes
<i>Adiscodiaspis ericicola</i> (Marchal)	Yes
<i>Andaspis hawaiiensis</i> (Maskell)	Yes
<i>Aonidia lauri</i> (Bouché)	Yes
<i>Aonidia oleae</i> Leonardi	Yes
<i>Aonidiella replicata</i> (Lindinger)	Yes
<i>Aonidiella taxus</i> Leonardi	Yes
<i>Aonidomytilus albus</i> (Cockerell)	Yes
<i>Aspidiella agalegae</i> Mamet	Yes
<i>Aspidiella hartii</i> (Cockerell)	Yes
<i>Aspidiotus atomarius</i> (Hall)	Yes
<i>Aspidiotus capensis</i> (Newstead)	Yes
<i>Aspidiotus chinensis</i> Kuwana & Muramatsu	Yes
<i>Aspidiotus coryphae</i> Cockerell & Robinson	Yes
<i>Aspidiotus cryptomeriae</i> Kuwana	Yes
<i>Aspidiotus elaeidis</i> Marchal	Yes
<i>Aspidiotus excisus</i> Green	Yes
<i>Aspidiotus kellyi</i> Brain	Yes
<i>Aspidiotus rigidus</i> Reyne	Yes
<i>Aspidiotus tafiranus</i> Lindinger	Yes

Species	Quarantine pest
<i>Aulacaspis actinidiae</i> Takagi	Yes
<i>Aulacaspis bambusae</i> (Green)	Yes
<i>Aulacaspis cinnamomorum</i> Takagi	Yes
<i>Aulacaspis citri</i> Chen	Yes
<i>Aulacaspis crawii</i> (Cockerell)	Yes
<i>Aulacaspis depressa</i> (Zehntner)	Yes
<i>Aulacaspis hedyotidis</i> (Green)	Yes
<i>Aulacaspis ima</i> Scott	Yes
<i>Aulacaspis longanae</i> Chen, Wu & Su	Yes
<i>Aulacaspis mali</i> Borchsenius	Yes
<i>Aulacaspis neospinosa</i> Tang	Yes
<i>Aulacaspis spinosa</i> (Maskell)	Yes
<i>Aulacaspis takarai</i> Takagi	Yes
<i>Aulacaspis tegalensis</i> (Zehntner)	Yes (WA)
<i>Aulacaspis vitis</i> (Green)	Yes
<i>Aulacaspis yasumatsui</i> Takagi	Yes
<i>Carulaspis minima</i> (Signoret)	Yes
<i>Childaspis asiatica</i> (Archangelskaya)	Yes
<i>Chionaspis alnus</i> Kuwana	Yes
<i>Chionaspis americana</i> Johnson	Yes
<i>Chionaspis caryae</i> Cooley	Yes
<i>Chionaspis corni</i> Cooley	Yes
<i>Chionaspis etrusca</i> Leonardi	Yes
<i>Chionaspis furfura</i> (Fitch)	Yes
<i>Chionaspis heterophyllae</i> (Cooley)	Yes
<i>Chionaspis pinifoliae</i> (Fitch)	Yes
<i>Chionaspis salicis</i> (Linnaeus)	Yes
<i>Chrysomphalus ansei</i> (Green)	Yes
<i>Chrysomphalus bifasciculatus</i> Ferris	Yes
<i>Chrysomphalus dictyospermi</i> (Morgan)	Yes (WA)
<i>Chrysomphalus propisimus</i> Banks	Yes
<i>Circulaspis canaliculata</i> (Green)	Yes
<i>Clavaspis covilleae</i> (Ferris)	Yes
<i>Clavaspis disclusa</i> Ferris	Yes
<i>Clavaspis perseae</i> (Davidson)	Yes
<i>Clavaspis ulmi</i> (Johnson)	Yes
<i>Comstockaspis perniciosa</i> (Comstock)	Yes (NT)
<i>Comstockiella sabalis</i> (Comstock)	Yes
<i>Contigaspis farsetiae</i> (Hall)	Yes
<i>Cupidaspis cupressi</i> (Coleman)	Yes

Species	Quarantine pest
<i>Cupressaspis mediterranea</i> (Lindinger)	Yes
<i>Cynodontaspis piceae</i> Takagi	Yes
<i>Davidsonaspis aguacatae</i> (Evans, Watson & Miller)	Yes
<i>Diaspidiotus aesculi</i> (Johnson)	Yes
<i>Diaspidiotus africanus</i> (Marlatt)	Yes
<i>Diaspidiotus ancylus</i> (Putnam)	Yes (WA)
<i>Diaspidiotus armenicus</i> (Borchsenius)	Yes
<i>Diaspidiotus caucasicus</i> (Borchsenius)	Yes
<i>Diaspidiotus coniferarum</i> (Cockerel)	Yes
<i>Diaspidiotus degeneratus</i> (Leonardi)	Yes
<i>Diaspidiotus distinctus</i> (Leonardi)	Yes
<i>Diaspidiotus elaeagni</i> (Borchsenius)	Yes
<i>Diaspidiotus forbesi</i> (Johnson)	Yes
<i>Diaspidiotus fraxini</i> (McKenzie)	Yes
<i>Diaspidiotus gigas</i> (Ferris)	Yes
<i>Diaspidiotus juglansregiae</i> (Comstock)	Yes
<i>Diaspidiotus leguminosum</i> (Archangelskaya)	Yes
<i>Diaspidiotus lenticularis</i> (Lindinger)	Yes (WA)
<i>Diaspidiotus lepineyi</i> (Balachowsky)	Yes
<i>Diaspidiotus liquidambaris</i> (Kotinsky)	Yes
<i>Diaspidiotus mairei</i> (Balachowsky)	Yes
<i>Diaspidiotus maleti</i> (Vayssière)	Yes
<i>Diaspidiotus marani</i> (Zahradník)	Yes
<i>Diaspidiotus osborni</i> (Cockerell)	Yes
<i>Diaspidiotus ostreaeformis</i> (Curtis)	Yes (WA)
<i>Diaspidiotus prunorum</i> (Laing)	Yes
<i>Diaspidiotus pyri</i> (Lichtenstein)	Yes (WA)
<i>Diaspidiotus shastae</i> (Coleman)	Yes
<i>Diaspidiotus slavonicus</i> (Green)	Yes
<i>Diaspidiotus transcaspensis</i> (Marlatt)	Yes
<i>Diaspidiotus turanicus</i> (Borchsenius)	Yes
<i>Diaspidiotus uvae</i> (Comstock)	Yes
<i>Diaspidiotus wuenni</i> (Lindinger)	Yes
<i>Diaspidiotus zonatus</i> (Frauenfeld)	Yes
<i>Diaspis boisduvalii</i> Signoret	Yes (WA)
<i>Diaspis bromeliae</i> (Kerner)	Yes (WA)
<i>Diaspis echinocacti</i> (Bouché)	Yes (WA)
<i>Dicirculaspis philippina</i> Ben-Dov	Yes
<i>Duplachionaspis berlesii</i> (Leonardi)	Yes
<i>Duplachionaspis graminis</i> (Green)	Yes

Species	Quarantine pest
<i>Duplachionaspis natalensis</i> (Maskell)	Yes
<i>Duplachionaspis saccharifolii</i> (Zehntner)	Yes
<i>Duplaspidotus claviger</i> (Cockerell)	Yes (WA)
<i>Duplaspidotus tesseratus</i> (Grandpré & Charmoy)	Yes
<i>Dynaspidotus abietis</i> (Schrank)	Yes
<i>Dynaspidotus britannicus</i> (Newstead)	Yes
<i>Dynaspidotus californicus</i> (Comstock)	Yes
<i>Dynaspidotus ephedrarum</i> (Lindinger)	Yes
<i>Dynaspidotus ericarum</i> (Goux)	Yes
<i>Dynaspidotus tsugae</i> (Marlatt)	Yes
<i>Epidiaspis leperii</i> (Signoret)	Yes
<i>Fiorinia externa</i> Ferris	Yes
<i>Fiorinia fioriniae</i> (Targioni Tozzetti)	Yes (WA)
<i>Fiorinia japonica</i> (Kuwana)	Yes (WA)
<i>Fiorinia phantasma</i> Cockerell & Robinson	Yes
<i>Fiorinia pinicola</i> Maskell	Yes
<i>Fiorinia proboscidea</i> Green	Yes
<i>Fiorinia randiae</i> (Takahashi)	Yes
<i>Fiorinia theae</i> Green	Yes
<i>Formosaspis stegana</i> Ferris	Yes
<i>Formosaspis takahashii</i> (Takahashi)	Yes
<i>Froggattiella inusitata</i> (Green)	Yes
<i>Froggattiella mcclurei</i> Ben-Dov	Yes
<i>Furchadaspis zamiae</i> (Morgan)	Yes
<i>Furchaspis oceanica</i> Lindinger	Yes
<i>Getulaspis bupleuri</i> (Marchal)	Yes
<i>Gomezmenoraspis pinicola</i> (Leonardi)	Yes
<i>Gonaspidotus minimus</i> (Leonardi)	Yes
<i>Greenaspis arundinariae</i> (Green)	Yes
<i>Greenaspis bambusifoliae</i> (Takahashi)	Yes
<i>Greenaspis decurvata</i> (Green)	Yes
<i>Greenaspis elongata</i> (Green)	Yes
<i>Hemiberlesia cupressi</i> (Cockerell)	Yes
<i>Hemiberlesia cyanophylli</i> (Signoret)	Yes (WA)
<i>Hemiberlesia diffinis</i> (Newstead)	Yes
<i>Hemiberlesia ithacae</i> (Ferris)	Yes
<i>Hemiberlesia mendax</i> McKenzie	Yes
<i>Hemiberlesia musae</i> Takagi & Yamamoto	Yes
<i>Hemiberlesia ocellata</i> Takagi & Yamamoto	Yes
<i>Hemiberlesia palmae</i> (Cockerell)	Yes (WA)

Species	Quarantine pest
<i>Hemiberlesia pictor</i> (Williams)	Yes
<i>Hemiberlesia pitysophila</i> Takagi	Yes
<i>Himalaspis caroli</i> (Green)	Yes
<i>Howardia biclavis</i> (Comstock)	Yes (WA)
<i>Ischnafiorinia bambusae</i> (Maskell)	Yes
<i>Ischnafiorinia malayana</i> Takahashi	Yes
<i>Ischnaspis longirostris</i> (Signoret)	Yes (WA)
<i>Kuwanaspis annandalei</i> (Green)	Yes
<i>Kuwanaspis arundinariae</i> Takahashi	Yes
<i>Kuwanaspis bambusicola</i> (Cockerell)	Yes
<i>Kuwanaspis bambusifoliae</i> (Takahashi)	Yes
<i>Kuwanaspis elongata</i> (Takahashi)	Yes
<i>Kuwanaspis hikosani</i> (Kuwana)	Yes
<i>Kuwanaspis howardi</i> (Cooley)	Yes
<i>Kuwanaspis linearis</i> (Green)	Yes
<i>Kuwanaspis neolinearis</i> (Takahashi)	Yes
<i>Kuwanaspis pseudoleucaspis</i> (Lindinger)	Yes
<i>Kuwanaspis suishana</i> (Takahashi)	Yes
<i>Kuwanaspis takahashii</i> Takagi	Yes
<i>Kuwanaspis tanzawensis</i> Takagi & Kawai	Yes
<i>Kuwanaspis vermiformis</i> (Takahashi)	Yes
<i>Leonardianna pimentae</i> (Newstead)	Yes
<i>Lepidosaphes beckii</i> (Newman)	Yes (NT)
<i>Lepidosaphes camelliae</i> Hoke	Yes
<i>Lepidosaphes chinensis</i> Chamberlin	Yes
<i>Lepidosaphes cocculi</i> (Green)	Yes
<i>Lepidosaphes conchiformis</i> (Gmelin)	Yes
<i>Lepidosaphes cornuta</i> Ramakrishna Ayyar	Yes
<i>Lepidosaphes euryae</i> (Kuwana)	Yes
<i>Lepidosaphes flava</i> (Signoret)	Yes
<i>Lepidosaphes granati</i> Koroneos	Yes
<i>Lepidosaphes japonica</i> (Kuwana)	Yes
<i>Lepidosaphes juniper</i> Lindinger	Yes
<i>Lepidosaphes karkarica</i> Williams & Watson	Yes
<i>Lepidosaphes kuwacola</i> Kuwana	Yes
<i>Lepidosaphes laterochitinsa</i> Green	Yes
<i>Lepidosaphes leei</i> Takagi	Yes
<i>Lepidosaphes malicola</i> Borchsenius	Yes
<i>Lepidosaphes mcgregori</i> Banks	Yes
<i>Lepidosaphes newsteadii</i> (Sulc)	Yes

Species	Quarantine pest
<i>Lepidosaphes noxia</i> McKenzie	Yes
<i>Lepidosaphes pallida</i> (Maskell)	Yes
<i>Lepidosaphes pallidula</i> Fernald	Yes (WA)
<i>Lepidosaphes pini</i> (Maskell)	Yes
<i>Lepidosaphes pinnaeformis</i> (Bouché)	Yes (WA)
<i>Lepidosaphes pistaciae</i> Archangelskaya	Yes
<i>Lepidosaphes punicae</i> Laing	Yes
<i>Lepidosaphes rubrovittata</i> Cockerell	Yes
<i>Lepidosaphes serrulata</i> (Ganguli)	Yes
<i>Lepidosaphes shikohabadensis</i> Dutta	Yes
<i>Lepidosaphes similis</i> Beardsley	Yes
<i>Lepidosaphes tapleyi</i> Williams	Yes
<i>Lepidosaphes tubulorum</i> Ferris	Yes
<i>Lepidosaphes ussuriensis</i> (Borchsenius)	Yes
<i>Lepidosaphes yanagicola</i> Kuwana	Yes
<i>Leucaspis gigas</i> (Maskell)	Yes
<i>Leucaspis lowi</i> Colvée	Yes
<i>Leucaspis pini</i> (Hartig)	Yes
<i>Leucaspis pusilla</i> Löw	Yes
<i>Leucaspis riccae</i> Targioni Tozzetti	Yes
<i>Leucaspis signoreti</i> Signoret	Yes
<i>Lindingaspis ferrisi</i> McKenzie	Yes
<i>Lindingaspis floridana</i> Ferris	Yes
<i>Lindingaspis greeni</i> (Brain & Kelly)	Yes
<i>Lindingaspis misrae</i> (Laing)	Yes
<i>Lindingaspis musae</i> (Laing)	Yes
<i>Lindingaspis picea</i> (Malenotti)	Yes
<i>Lindingaspis tingi</i> McKenzie	Yes
<i>Lineaspis striata</i> (Newstead)	Yes
<i>Lopholeucaspis cockerelli</i> (Grandpré & Charmoy)	Yes
<i>Lopholeucaspis japonica</i> (Cockerell)	Yes (WA)
<i>Mangaspis bangalorensis</i> Takagi & Kondo	Yes
<i>Melanaspis bromiliae</i> (Leonardi)	Yes
<i>Melanaspis calura</i> (Cockerell)	Yes
<i>Melanaspis glomerata</i> (Green)	Yes
<i>Melanaspis inopinata</i> (Leonardi)	Yes
<i>Melanaspis obscura</i> (Comstock)	Yes
<i>Melanaspis smilacis</i> (Comstock)	Yes
<i>Melanaspis sulcata</i> Ferris	Yes
<i>Melanaspis tenebricosa</i> (Comstock)	Yes

Species	Quarantine pest
<i>Mercetaspis baluchistanensis</i> (Rao)	Yes
<i>Mercetaspis halli</i> (Green)	Yes
<i>Microparlatoria fici</i> (Takahashi)	Yes
<i>Mixaspis bambusicola</i> (Takahashi)	Yes
<i>Morganella longispina</i> (Morgan)	Yes (WA)
<i>Mycetaspis apicata</i> (Newstead)	Yes
<i>Mycetaspis personata</i> (Comstock)	Yes
<i>Neoleucaspis parallela</i> Green	Yes
<i>Neopinnaspis harperi</i> McKenzie	Yes
<i>Neoselenaspis silvaticus</i> (Lindinger)	Yes
<i>Nikkoaspis formosana</i> (Takahashi)	Yes
<i>Nikkoaspis hichiseisana</i> (Takahashi)	Yes
<i>Nikkoaspis sasae</i> (Takahashi)	Yes
<i>Nikkoaspis shiranensis</i> Kuwana	Yes
<i>Oceanaspidiotus spinosus</i> (Comstock)	Yes
<i>Octaspidiotus stauntoniae</i> (Takahashi)	Yes
<i>Octaspidiotus tamarindi</i> (Green)	Yes
<i>Odonaspis arcusnotata</i> Ben-Dov	Yes
<i>Odonaspis bambusarum</i> (Cockerell)	Yes
<i>Odonaspis benardi</i> Balachowsky	Yes
<i>Odonaspis crenulatus</i> (Ben-Dov)	Yes
<i>Odonaspis greenii</i> Cockerell	Yes
<i>Odonaspis lingnani</i> Ferris	Yes
<i>Odonaspis pacifica</i> Ben-Dov	Yes
<i>Odonaspis paucipora</i> Ben-Dov	Yes
<i>Odonaspis serrata</i> Ben-Dov	Yes
<i>Odonaspis siamensis</i> (Takahashi)	Yes
<i>Odonaspis tsinjoarivensis</i> Mamet	Yes
<i>Opuntiaspis philococcus</i> (Cockerell)	Yes
<i>Parlatoareopsis chinensis</i> (Marlatt)	Yes
<i>Parlatoareopsis longispina</i> (Newstead)	Yes
<i>Parlatoria blanchardi</i> (Targioni Tozzetti)	Yes (NT, SA, WA)
<i>Parlatoria camelliae</i> Comstock	Yes (WA)
<i>Parlatoria cinerea</i> Hadden	Yes
<i>Parlatoria citri</i> McKenzie	Yes
<i>Parlatoria crypta</i> McKenzie	Yes
<i>Parlatoria desolator</i> McKenzie	Yes
<i>Parlatoria fluggeae</i> Hall	Yes
<i>Parlatoria leucaspis</i> (Lindinger)	Yes
<i>Parlatoria multipora</i> McKenzie	Yes

Species	Quarantine pest
<i>Parlatoria mytilaspiformis</i> Green	Yes
<i>Parlatoria parlatoriae</i> (Šulc)	Yes
<i>Parlatoria pergandii</i> Comstock	Yes (WA)
<i>Parlatoria theae</i> Cockerell	Yes
<i>Parlatoria yanyuanensis</i> Tang	Yes
<i>Parlatoria yunnanensis</i> Ferris	Yes
<i>Parlatoria ziziphi</i> (Lucas)	Yes
<i>Pentalaminaspis minuta</i> (Kotinsky)	Yes
<i>Pinnaspis aspidistrae</i> (Signoret)	Yes (WA)
<i>Pinnaspis exercitata</i> (Green)	Yes
<i>Pinnaspis musae</i> Takagi	Yes
<i>Pinnaspis theae</i> (Maskell)	Yes
<i>Pinnaspis uniloba</i> (Kuwana)	Yes
<i>Poliaspis media</i> Maskell	Yes
<i>Poliaspoides formosana</i> (Takahashi)	Yes
<i>Prodiaspis tamaricicola</i> (Malenotti)	Yes
<i>Pseudaonidia corbetti</i> Hall & Williams	Yes
<i>Pseudaonidia curculiginis</i> (Green)	Yes
<i>Pseudaonidia duplex</i> (Cockerell)	Yes
<i>Pseudaonidia paeoniae</i> (Cockerell)	Yes
<i>Pseudaonidia trilobitiformis</i> (Green)	Yes (WA)
<i>Pseudaulacaspis cockerelli</i> (Cooley)	Yes (WA)
<i>Pseudaulacaspis coloisuvae</i> Williams & Watson	Yes
<i>Pseudaulacaspis manni</i> (Green in Green & Mann)	Yes
<i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti)	Yes (WA)
<i>Pseudaulacaspis prunicola</i> (Maskell)	Yes
<i>Pseudaulacaspis rubra</i> (Green)	Yes
<i>Pseudischnaspis bowreyi</i> (Cokerell)	Yes
<i>Pseudoparlatoria mammata</i> (Ferris)	Yes
<i>Pseudoparlatoria ostreata</i> Cockerell	Yes
<i>Pseudoparlatoria parlatorioides</i> (Comstock)	Yes
<i>Quernaspis lepineyi</i> (Balachowsky)	Yes
<i>Quernaspis quercus</i> (Comstock)	Yes
<i>Radionaspis indica</i> (Marlatt)	Yes
<i>Rhizaspidotus canariensis</i> (Lindinger)	Yes
<i>Rhizaspidotus dearnessi</i> (Cockerell)	Yes
<i>Rolaspis leucadendri</i> (Brain)	Yes
<i>Rolaspis lounsburyi</i> (Cooley)	Yes
<i>Rutherfordia major</i> (Cockerell)	Yes
<i>Saharaspis ceardi</i> (Balachowsky)	Yes

Species	Quarantine pest
<i>Salicicola kermanensis</i> (Lindinger)	Yes
<i>Selenaspidopsis browni</i> Nakahara	Yes
<i>Selenaspidus albus</i> McKenzie	Yes
<i>Selenaspidus articulatus</i> (Morgan)	Yes (WA)
<i>Selenaspidus rubidus</i> McKenzie	Yes
<i>Selenaspidus spinosus</i> Laing	Yes
<i>Semelaspidus mangiferae</i> Takahashi	Yes
<i>Silvestraspis uberifera</i> (Lindinger)	Yes
<i>Situlaspis yuccae</i> (Cockerell)	Yes
<i>Stramenaspis kelloggi</i> (Coleman)	Yes
<i>Suturaspis archangelskyae</i> (Lindinger)	Yes
<i>Targionia arthrophyti</i> (Archangelskaya)	Yes
<i>Targionia vitis</i> (Signoret)	Yes
<i>Thysanofiorinia leei</i> Williams	Yes
<i>Unachionaspis bambusae</i> (Cockerell)	Yes
<i>Unachionaspis signata</i> (Maskell)	Yes
<i>Unachionaspis tenuis</i> (Maskell)	Yes
<i>Unaspis acuminata</i> (Green)	Yes
<i>Unaspis citri</i> (Comstock)	Yes (WA)
<i>Unaspis euonymi</i> (Comstock)	Yes
<i>Unaspis mabilis</i> Lit & Barbecho	Yes
<i>Unaspis yanonensis</i> (Kuwana)	Yes (WA)
<i>Varicaspis fiorineides</i> (Newstead)	Yes
<i>Voraspis ceratoniae</i> (Marchal)	Yes
<i>Xiphuraspis spiculata</i> (Green)	Yes

3 Pest risk assessment

3.1 Introduction

Scale insect pests have been assessed individually in previous PRAs undertaken by the department. The results of the previous risk assessments are summarised in Table 10.1 for soft scales and Table 10.2 for hard scales. By 2019, a total of 10 species of soft scales in seven genera had been fully assessed in 13 PRAs on seven commodities from 16 countries (Table 10.1 of Appendix D), while 48 species of hard scales in 22 genera had been fully assessed in 25 PRAs on 18 commodities from 26 countries or regions (Table 10.2 of Appendix D).

In the previous assessments on individual species, the likelihood of importation was rated as High for all soft scales and for a majority of hard scales. The likelihood of distribution was rated variously, sometimes even for the same species, as either Moderate or Low for soft scales and as High, Moderate or Low for species of hard scales. The likelihood of establishment was rated as High for all soft scales and for a majority of hard scales. The likelihood of spread was rated as either High or Moderate for both soft and hard scales. The assessment for consequences was consistent, being rated as Low for all soft and hard scale species, although there were minor differences for the impact scores assigned to specific direct and/or indirect impacts.

When the likelihood of importation was rated as high, likelihood of distribution rated as moderate and the likelihood of spread rated as high, the unrestricted risk estimate (URE) was found to be low, which does not achieve the ALOP for Australia. On the other hand, when the likelihood of entry (importation x distribution) was rated as low and/or the likelihood of spread assessed as moderate, the URE was found to be very low or negligible, which achieves the ALOP for Australia.

The difference in the likelihood of entry (importation x distribution) can be explained by factors such as commercial pre-border production practices and time of year at which import takes place, and other influences such as the specific commodity, which influenced the likelihood of entry by reducing the likelihood of scale insects being present on a given pathway in a given country.

However, factors considered in assessing the ratings for likelihood of establishment and spread and the estimate of consequences are in effect independent of plant import pathway, being post-border and based on pest biology, environmental conditions and other commercial practices within Australia.

The difference in ratings in the previous estimated likelihood of distribution and that of spread for different species of soft scales in different PRAs is to be reviewed and discussed in detail in subsequent relevant sections of this report.

The pest risk assessment in this report builds on previous risk assessments for individual species, where appropriate. Entry, establishment, spread and consequences are estimated according to the method described in Appendix A. The likelihood ratings and the estimate of consequence are applied to individual species of scale insects.

Based on the selection criteria listed in Table 2.1, a total of 266 species of soft scales (Table 8.1) and 375 species of hard scales (Table 9.1) were included in the pest categorisation process for this Group PRA. Two hundred and forty-seven species of soft scales (Table 2.8) and 341 species

of hard scales (Table 2.9) were identified as requiring further pest risk assessment. The results of this risk assessment are not only applicable to quarantine pests identified in Table 2.8 and Table 2.9 but also applicable to any other quarantine pests of soft and hard scale species not included in this report.

3.2 Likelihood of entry (indicative)

Entry is defined as the movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2019b).

The likelihood of entry is considered in two parts, the likelihood of importation and the likelihood of distribution, which consider pre-border and post-border issues, respectively. The overall likelihood of entry is determined by combining the likelihood of importation with the likelihood of distribution using the matrix of rules shown in Table 7.2 of Appendix A.

In this Group PRA, the likelihood of entry is assessed in an indicative manner because the assessment is not linked to a specific plant import pathway. The likelihood of importation and likelihood of distribution are influenced by a range of factors. Most of these factors, such as pest biology, can be considered fully at the group level, but some factors, such as commercial pre-border production practices and time of year at which import takes place, cannot be considered at this level. These factors were considered in this Group PRA in generic terms, based on extensive historic and contemporary analysis of the plant import pathway. Entry is also conditional on the pest being present in the export region.

If this Group PRA is applied to a specific pathway, these factors must be verified on a case-by-case basis, as appropriate. Until this occurs, the likelihood of entry in this Group PRA is indicative only and potentially subject to revision.

Likelihood of importation (indicative)

The likelihood (indicative) that a scale insect quarantine pest will be imported into Australia on the plant import pathway is assessed as **High**.

The supporting evidence for this assessment is provided.

Association with export crops and commodities

More than 1,200 species of soft scales and 2,600 species of hard scales have been reported from all over the world (García Morales et al. 2019). The reported host plants of soft scales range from woody perennials to herbaceous grasses, while those of hard scales are also diverse, including long-lived perennial plants such as trees and shrubs as well as annuals (Miller et al. 2014b).

Members of Coccidae have been reported from 1,993 species, 1,506 genera and 240 families of host plants, while those of Diaspididae have been reported from 2,843 species, 2,043 genera and 290 families of host plants (García Morales et al. 2019; García Morales et al. 2015). The ten most common host families of soft scales are Fabaceae, Asteraceae, Rosaceae, Poaceae, Rubiaceae, Myrtaceae, Malvaceae, Moraceae, Rutaceae and Sapindaceae, with the number of hosts varying between 58 and 223 species for each plant family (Table 2.3). Likewise, the ten most common host families of hard scales are Fabaceae, Poaceae, Rosaceae, Myrtaceae, Orchidaceae, Asteraceae, Euphorbiaceae, Pinaceae, Arecaceae and Fagaceae, with the number of hosts varying between 96 and 302 species for each plant family (Table 2.3).

Many host plants are important agricultural and horticultural crops, such as fruit trees (e.g. apples, blueberry, citrus, grapes, mango and lychees), vegetables (e.g. eggplants, potato and lettuce) and cut-flowers and foliage (e.g. azalea, lily and orchids). Scale insect species feeding on these plants cause damage and are considered as important pests (Gill & Kosztarab 1997). A single scale insect species can be highly polyphagous and is able to attack hundreds of species of host plants (Table 2.4). Likewise, a single host plant can be attacked by many species of scale insects (Table 2.5).

Scale insects feed on almost any live part of the host plant (Ben-Dov 1990b, 1997), collectively attacking root, stem, trunk, bark, leaf, flower and fruit. Eggs, nymphs and adult females of scale insects are all relatively small. For example, adult females of Diaspididae are usually 1.0–1.5mm and rarely over 2.0mm in body length (Takagi 1990). Scale insects usually do not move again once settled on a host plant. They can often be located in crevices and protected spaces, such as under the calyx of fruit. This makes them difficult to detect during harvest and routine commercial quality inspections in the packing houses.

These characteristics make soft scales likely to be associated with export commodities of fresh fruit, vegetables and cut-flowers and foliage. These commodities typically arrive in Australia as non-refrigerated air freight, most being subject to cold storage both before and after air transportation. Refrigerated sea transport is also used for a number of commodities, such as avocado, citrus fruit, kiwifruit and table grapes.

There are limited studies of cold tolerance of scale insects in the literature, but different species appear to have variable resistance to cold temperatures. The cold tolerance of scale insects may be inferred from their overwintering behaviours. Soft scales can overwinter as eggs (Marotta & Tranfaglia 1997; Vashchinskaya 1969), nymphs (Hayes, Neeman & Cooper 2017; Marotta & Tranfaglia 1997)(Łagowska et al 2017) and/or adult females (Pellizzari, Rainato & Stathas 2010). For hard scales, any stage of the female can overwinter depending on the species and/or the localities, but the second-instar nymphs and mated adult females are the most common overwintering life stages (Miller et al. 2014b). For example, *Fiorinia externa* Ferris overwinters in the egg stage in Quebec, in the first-instar stage in central Europe, as nymphs in India and as all stages in warmer climates (McClure 1990, and references therein).

Based on this information, it is considered that scale insects on plant commodities would have the ability to tolerate cold storage used before and after air transportation and refrigerated conditions used in sea transportation. This is supported by the evidence that live scale insect pests have been intercepted in international trade by Australia and other countries (Appendix B and Appendix E), discussed in detail in next two parts of this report.

Scale insect interceptions (Australian data)

There have been 496 coccid and 2691 diaspidid interception events recorded on the plant import pathway by Australia in the last 18 years (2000–2018) (Table 3.1). On average, there were 27.6 interceptions of soft scales and 149.5 interceptions of hard scales per year for the last 18 years (Table 3.1).

For Coccidae, almost three-quarters (74.9%) of intercepted insects were identified only to family level, 9.7% to generic level and 15.4% to species level (Table 3.1). For Diaspididae, 44.9% of intercepted specimens were identified only to family level, 7.1% to generic level and 48% to

species level (Table 3.1). It is noted that the percentage of identified species of hard scales (48%) is much higher than that of mealybugs (10%) (Department of Agriculture and Water Resources 2019) and soft scales (15.4%). This is mainly due to the three most frequently intercepted hard scale species *Aonidiella aurantii*, *Hemiberlesia lataniae* and *Pseudaulacaspis pentagona*, together making up 35.4% of the total hard scale interceptions (Table 11.2 of Appendix E).

Intercepted scale insects could not be identified into generic or species levels due to several reasons, including lack of adequate taxonomic expertise in Australia, the time-consuming process of preparing slide-mounted specimens for identification, intercepted specimens being damaged and/or immature, and importers opting for treatment of their goods without requesting specimen identification.

Table 3.1 Identified levels of Australian interceptions of scale insects (2000–2018)

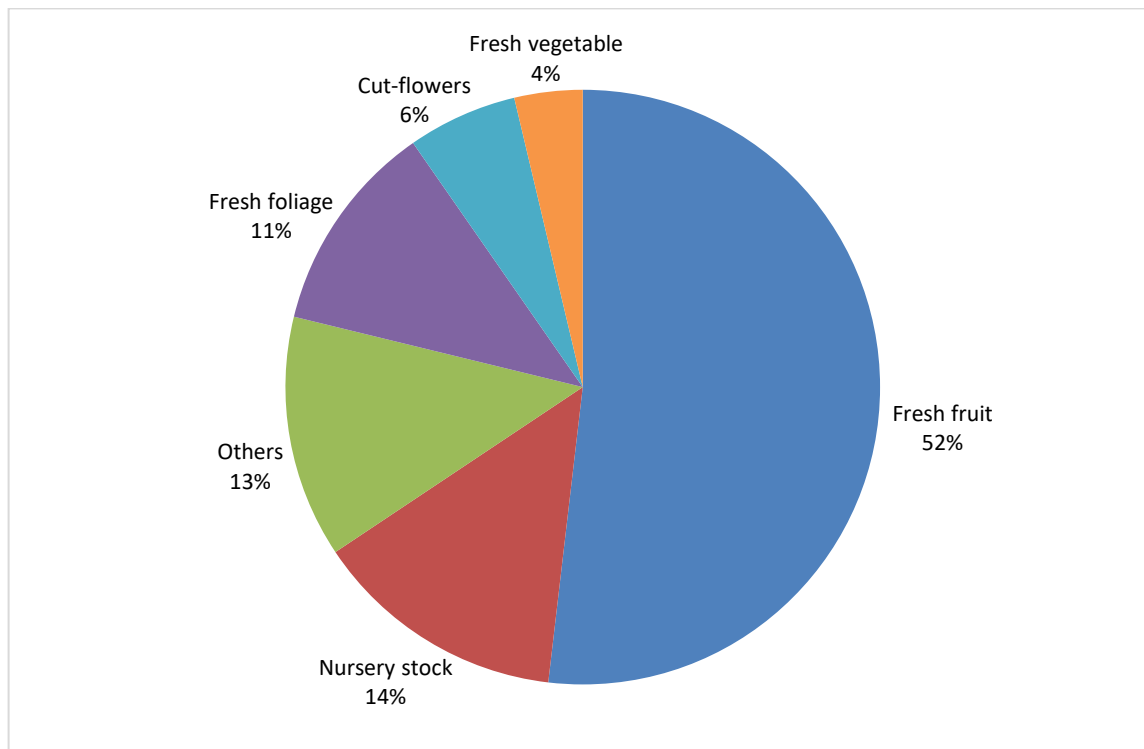
Identified level	Number of taxa	Interception events (a)	Percentage (%)
Coccids			
Family – Coccidae	1	364	74.9
Coccid genera	10	47	9.7
Coccid species	15	75	15.4
Coccid total	N/A	486 (b)	100
Diaspidids			
Family – Diaspididae	1	1207	44.9
Diaspidid genera	30	192	7.1
Diaspidid species	55	1292	48.0
Diaspidid total	N/A	2691 (c)	100

a: Each interception is based on presence of at least a single individual insect on a consignment. The number of individuals present per event is not generally recorded, and multiple insects can contaminate the same or different commodities in the same consignment. **b:** of the 486 coccid interception events, 21 (4.3%) were confirmed to contain only dead specimens. **c:** of the 2691 diaspidid interception events, 86 (3.2%) were confirmed to contain only dead specimens.

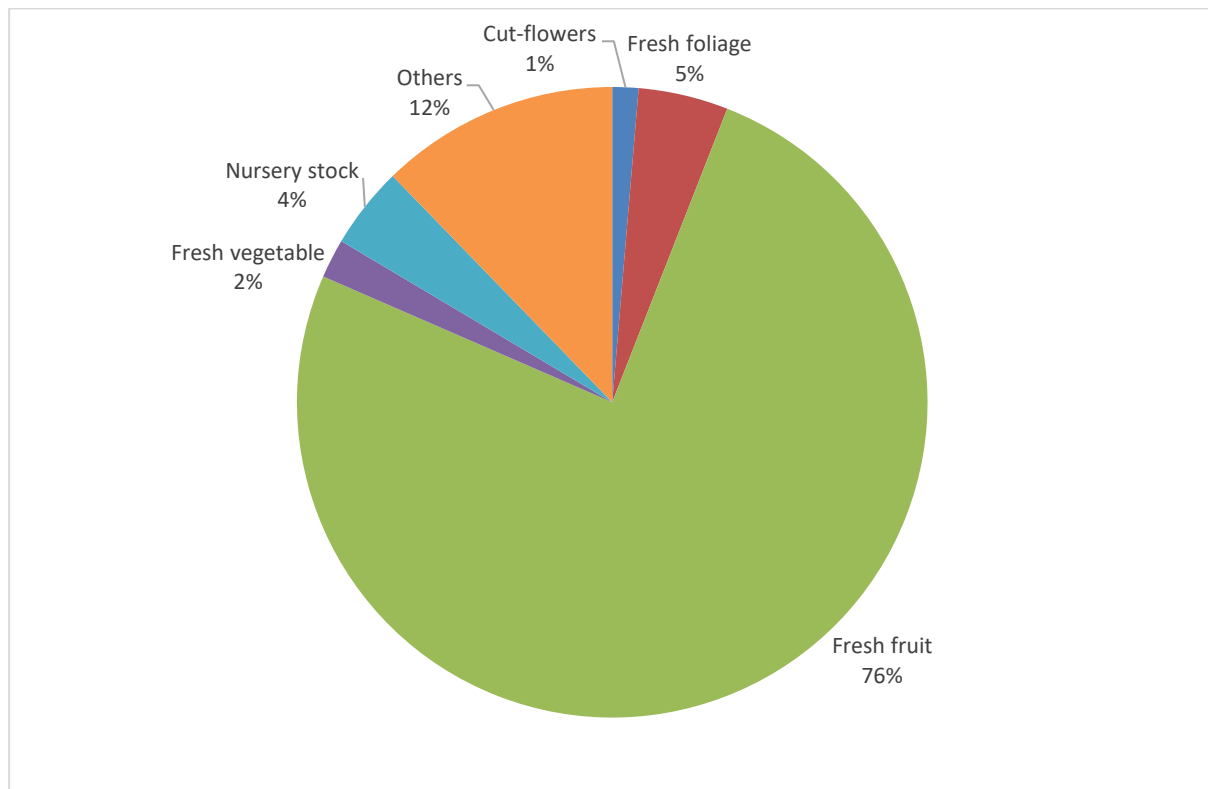
A total of 10 genera of intercepted soft scales were identified (Table 3.1). The most frequently intercepted genera, in descending order, were *Coccus*, *Saissetia*, *Pulvinaria* and *Ceroplastes* (Table 11.1 of Appendix E). Thirty genera of intercepted hard scales were identified and the most frequently intercepted genera, in descending order, were *Aonidiella*, *Hemiberlesia*, *Pseudaulacaspis* and *Lepidosaphes* (Table 11.2 of Appendix E).

A total of 15 species of soft scales were identified (Table 3.2), the most frequently intercepted, in descending order, were *Coccus hesperidum*, *Coccus viridis*, *Pulvinaria psidii* and *Saissetia coffeae* (Table 11.1 of Appendix E). Fifty-five species of hard scales were identified and the most frequently intercepted, in descending order, were *Aonidiella aurantii*, *Hemiberlesia lataniae* and *Pseudaulacaspis pentagona* (Table 11.2 of Appendix E).

The main commodities on which scale insects were intercepted by Australia in the last 18 years (2000-2018) are presented in Figure 3.1 for soft scales and in Figure 3.2 for hard scales.

Figure 3.1 Commodity groups on which soft scales were intercepted by Australia (2000-2018)

For soft scales, 52% were intercepted on various forms of fresh fruit, including kiwifruit, longan, lychee, mango, mangosteen, orange, persimmon and pomegranate; 4% on fresh vegetable, mainly taro leaves; 6% on cut-flowers, including orchids and roses and 11% on foliage, including khat and bele leaves; 14% on a variety of nursery stock, including *Dracaena* spp., bromeliads and citrus; and the remaining 13% on a number of other plant products such as herbs (Figure 3.1).

Figure 3.2 Commodity groups on which hard scales were intercepted by Australia (2000–2018)

For hard scales, more than three quarters (76%) were intercepted on various forms of fresh fruit, most frequently on avocado, blueberry, kiwifruit, various citrus fruit and mangosteen; 2% on fresh vegetables such as asparagus and yams; 1% on cut-flowers such as roses and chrysanthemum and 5% on foliage such as bele leaves; 4% on a variety of nursery stock, including *Dracaena* spp., bromeliads and *Tillandsia* and the remaining 12% on a number of other plant products such as dried herbs and spice and seeds for sowing (Figure 3.2).

Scale insect interceptions (International data)

Scale insects are frequently intercepted on plant material in international trade by other countries, although only some countries make the interception records publicly available. Detailed interception information for soft scales in international trade is included in Table 8.1 of Appendix B, and that for hard scales in Table 9.1 of Appendix C.

The USDA/APHIS published an online identification tool for scale insects of quarantine significance, in which the history of quarantine interceptions of the species by APHIS is summarised in fact sheets, including 48 species of soft scales intercepted at the U. S. ports-of-entry between 1995 and 2012 (Miller et al. 2014b).

Suh and co-authors published several papers on the interceptions of Coccoidea in South Korea (Suh & Hyun 2015; Suh, Yu & Hong 2013; Suh 2016a). It was reported that 14 species of soft scales were intercepted on plants imported into South Korea during the period of 2007 to 2011 (Suh, Yu & Hong 2013) and 88 species of hard scale intercepted on plant material from 40 countries between 1996 to 2015 (Suh 2016a).

Chen, Wong and Wu (2014) indicated that 34 species in 20 genera of Diaspididae from at least 19 countries were intercepted by Taiwan between 2001 and 2013.

Australian and international interceptions of scale insects suggest that these pests will continue to be present on plant import pathways as long as trade is occurring.

Summary for the likelihood of importation

Scale insect pests have been reported worldwide, including in countries that Australia trades with, on a wide range of host plants, including many important agricultural and horticultural crops and commodities for export such as fruit, vegetables, cut-flowers and foliage. Scale insects can stay sessile and hide in plant material such as the calyx of fruit. Such factors make their detection difficult during routine commercial quality control inspections for export commodities because these inspections tend to focus on grading produce according to size, colour and appearance. At best, removal of distorted or damaged products, or cleaning process as part of commercial packhouse procedures may remove some, but not all, scale insects from the plant import pathway. Scale insects associated with plant products are likely to survive international transportation, as evidenced by the many species intercepted on plant material by Australia and other countries in international trade.

Notwithstanding the pathway-dependent factors, the indicative likelihood of importation for scale insect quarantine pests arriving in Australia as a result of the import of fresh fruit, vegetables, cut-flowers and foliage is considered to be high.

Likelihood of distribution

The likelihood that a scale insect quarantine pest will be distributed within Australia in a viable state following its importation on the plant import pathway and subsequently transfer to a susceptible host is assessed as **Moderate**.

The supporting evidence for this assessment is provided.

Transport and delivery of commodities

Fresh fruit, vegetables, cut-flowers and foliage infested with soft scale pests would be expected to be transported for retail sale to multiple destinations within the PRA area, so a proportion of these commodities are likely to reach areas with susceptible host plants.

During transport and delivery, these commodities may be kept cool. However, the perishable nature of these commodities mean transit times will be relatively short, and transit temperatures are unlikely to be lethal for soft scales as they are able to tolerate cold, as discussed under Likelihood of importation. At retail outlets, these commodities may be displayed at ambient temperature that would support the survival and development of soft scales.

Pests entering the external environment through disposal of wastes

Assessment of the likelihood of distribution must consider whether a scale insect pest can enter the external environment during the process of unpacking, transportation and retail sale, and/or from wastes disposed by retailers and individual consumers. Although cross-contamination among host commodities could occur, it is considered that scale insects are unlikely to be successful in entering the external environment during unpacking in warehouses and during transportation to retail outlets, or at point of sale, because these activities are undertaken within an indoor environment.

Live scale insects on the plant import pathway could enter the external environment as a result of disposal of waste generated through the consumption of fruit and vegetables, and by discarding used cut-flowers and foliage. The majority of waste resulting from imported commodities is likely to be disposed of as municipal solid waste (MSW) to be processed accordingly, including into landfill, or to a lesser extent by commercial composting as green waste (Atalia et al. 2015; EPHC 2009). Scale insect pests are not likely to be able to enter the external environment through the MSW stream.

The infested material would also be disposed, for example, in compost, green waste, and general household waste in backyards, on roadsides or in parks by individual consumers. Disposal of this waste will almost certainly occur at numerous locations throughout the PRA area, especially for commodities consumed or used by households. Thus, the most likely scenario for scale insects to enter the external environment is through the disposal of waste by individual consumers, or from waste from retail activities before it enters the MSW stream.

Pests reaching host plants from disposed wastes

Scale insect pests on the waste disposed in the external environment will need to find a suitable host quickly, as the waste would deteriorate. All stages of the insects, including eggs, first-instar nymphs (crawlers), second- and/or third-instar nymphs and adult females, could be on the disposed waste. Crawlers are the only stage or the main stage responsible for finding and reaching a host plant from the disposed waste because they are most active (see Section 2.3).

The crawlers already on the waste could initiate dispersal and locate host plants once in the external environment. Other life stages present on the waste would need to develop and become crawlers for dispersal. Eggs present on the waste could hatch into crawlers. Mated or parthenogenetic adult females present on the waste may be able to produce eggs which could emerge into crawlers. Second- and/or third-instar nymphs present on the waste would require a period of time to develop into adults, which in turn could lay eggs for crawlers to hatch from. However, this latter scenario is considered to be extremely unlikely because the waste is likely to have deteriorated before the insects could have the time to develop from nymphs to mature adults.

For some soft scale species, second- and/or third-instar nymphs and adult females are able to walk around, although individuals become progressively less mobile as they develop into later life stages. Thus these stages also have the potential to reach a nearby host plant from the waste. Adult males usually have a pair of wings, but they do not feed and are fragile, and have a life span of only a few days to find a female to mate.

As the crawlers are the most likely stage to reach a host plant via their own movement, it is important to understand their behaviours.

Crawler behaviours

Crawler behaviours are reviewed for Coccidae by Marotta (1997) and Greathead (1997a) and for Diaspididae by Greathead (1990). Dispersal behaviour of crawlers of all Coccoidea, including mealybugs as well as soft and hard scales, would be similar, as noted by Greathead (1997a: 340) that there is 'similarity in behaviour and dispersal mechanism exhibited by the crawlers of the investigated species from the various families' [of the superfamily Coccoidea].

In fact, the review articles on crawler behaviour of Coccidae (Greathead 1997a; Marotta 1997) and on that of Diaspididae (Greathead 1990) commonly cite relevant information from the other families of the Coccoidea to supplement the meagre data available on dispersal by the two families (Greathead 1997a). This is also the approach taken in the present report, i.e. the crawler dispersal behaviour observed for other families of Coccoidea are considered to be applicable to that of the Coccidae and the Diaspididae.

Duration of crawler life-stage

Studies on the duration of different life stages of scale insects have generally been done in the laboratory. Studies have most commonly been carried out at constant temperatures ranging from 15°C to 35°C, under conditions of 50 to 75% relative humidity, and at various photoperiod combinations. These types of studies have been carried out for many species, including soft scale species of *Ceroplastes rusci* (L.) (Vu et al. 2006), *Coccus hesperidum* L. (Aliakbarpour, Che Salmah & Salehi 2010), *Phalacrocooccus howertoni* Hodges & Hodgson (Amarasekare & Mannion 2011), and *Saissetia coffeae* (Walker) (Abd-Rabou, Ali & El-Fatih 2009; Ibrahim 1985), and hard scale species of *Aonidiella aurantii* (Vanaclocha et al. 2012), *Aspidiotus destructor* (Salahuddin et al. 2015), *Aulacaspis yasumatsui* (Cave, Sciacchetano & Diaz 2009; Ravuiwasa et al. 2012), *Nuculaspis abietis* (Rasekh, Michaud & Barimani Varandi 2011) and *Unaspis euonymi* (Savopoulos-Soultani 1997). These studies demonstrate that the development of scale insect crawlers varies for different species and at different temperatures.

The first-instar nymphs of soft scales can live for an average of nine days at 30°C, as for *Saissetia coffeae* (Abd-Rabou, Ali & El-Fatih 2009), to as long as 29 days at 25°C, as for *Coccus hesperidum* (Aliakbarpour, Che Salmah & Salehi 2010). Those of hard scales can live for an average of six days at 30°C, as for *Aspidiotus destructor* (Salahuddin et al. 2015) to as long as 39 days at 15°C, as for *Unaspis euonymi* (Savopoulos-Soultani 1997).

Duration of the crawler stage depends on temperature and humidity, for example, crawlers of *Saissetia oleae* can live for 12 days at 23°C at 100% relative humidity but only for less than a day at 29°C regardless of humidity (Mendel, Podoler & Rosen 1984), and those of *Aulacaspis yasumatsui* can live for about 9 days at 32°C at 50–60 percent relative humidity and live for about 31 days at 18°C at the same relative humidity (Cave, Sciacchetano & Diaz 2009).

In addition, duration of the crawler stage may be different in the external environment compared to laboratory conditions. There would be many other factors that could influence the survival and/or development of a crawler in the external environment, such as variable temperatures and humidity, and availability of host plants, as reviewed for Diaspididae by Beardsley and Gonzalez (1975).

Rasekh, Michaud and Barimani Varandi (2011) found that all life stages of *Dynaspidiotus abietis* (Schrank) (as *Nuculaspis abietis*) (Diaspididae) took longer time to develop and thus lived much longer in the field than in laboratory conditions. Its life cycle took an average of 315.7 days for a female and 329.4 days for a male in the field in Iran but only 206.4 days for a female and 215 days for a female under laboratory conditions, a difference of 109 to 114 days. The first-instar nymphs of this species lived for an average of 29.2 days in the field compared to 21.6 days in the laboratory under constant temperature of 25°C, 65–75% relative humidity and 14:10D photoperiod under fluorescent lighting. This study suggests that insects may live longer in the field environment possibly partly due to the temperature fluctuation, than in the laboratory

environment with constant temperature. This may or may not be true when the insects do not have access to a host plant, such as on the disposed waste in the external environment.

Survival of unfed crawlers

Collinge (1911) examined the survival of some 200 crawlers of *Pulvinaria vitis* (L.) from a cutting of heavily infested black currant bush on a cardboard box placed on a laboratory bench in the window with full sunlight from 9 am to 6 pm. The results indicated that, without food, a proportion of the crawlers were still alive and active after various period of time: 50% after nine days, 35% after 12 days, 10% after 14 days, 6% after 16 days, 5% after 18 days, 3.5% after 19 days and 1.5% after 20 days (Collinge 1911). Collinge (1911) concluded that the fact that an appreciable percentage of the crawlers survived for two weeks or more suggests great dispersal possibilities of *Pulvinaria vitis*.

Washburn and Washburn (1984) found that crawlers of *Pulvinariella mesembryanthemi* can live up to eight days without feeding and may survive up to four days in dry air and may double this survival period in moist air (Washburn & Frankie 1981).

Without food, crawlers of *Chrysomphalus aonidum* (Diaspididae) lived for 6–13 days on slightly moistened filter paper and 3–4 days on dry filter paper and the crawlers starved for four days were still able to settle on plant leaves (Mathis 1947). On leaves picked and placed in petri dishes without additional moisture during winter months, crawlers of *Chrysomphalus aonidum* lived up to 25 days (Mathis 1947).

Cornwell (1956) found that 90% of completely starved first-instar and second-instar nymphs of *Formicococcus njalensis* (Laing) (as *Pseudococcus njalensis*) (Pseudococcidae) die within four days.

These studies indicate that an unfed crawler may be able to survive between a few days and 25 days depending on the species and the conditions.

Survival and movement of crawlers under high temperatures

Quayle (1911) carried out experiments to test the effect of high temperatures on the survival of crawlers of *Saissetia oleae* (Olivier). Crawlers on a white cardboard in the sun at a temperature of 34.4–37.8°C were unharmed after 2 hours. Similar results were also obtained at a temperature of 41.1–43.3°C but crawler movement slowed down with the increase of temperature and the movement ceased at 43.3°C, although 2 hours exposure did not kill the crawlers (Quayle 1911). Newly hatched crawlers on soil at a temperature of 42.2–43.3°C were active for 1 hour but nearly all died at the end of 1.5 hours (Quayle 1911). Crawlers on a board at 47.8°C all died within 5 minutes, whereas those on soil in the sun died within 15 minutes at 48.3–50°C and died within 5 minutes at 54.4°C. Similar high temperature experiments were repeated by Collinge (1911) who reported very similar results.

Collinge (1911) exposed 60–70 newly-hatched crawlers of *Pulvinaria vitis* to a temperature of 37.8 to 38.9°C on white cardboard. These crawlers walked slowly and were fairly well scattered over an area of about 61 cm² after 3.5 hours. The board was then turned upside down and about 27% of crawlers made their way on to the upper surface after 4 hours and about 71% made it to the upper surface after 16 hours.

Marotta (1997) indicates that crawlers of soft scales are most active between 21 and 32°C, with a lower threshold of about 10–13°C and an upper lethal threshold of about 42°C. Some species of soft scales may have a lethal threshold higher than 42°C because crawlers of *Saissetia oleae* were able to survive for at least two hours at 43°C. Koteja (1990b) points out that crawlers of hard scales are most active between 25 and 32°C, with a lower threshold of about 13°C and an upper lethal threshold of about 43°C.

Crawlers of different species may differ in tolerance for high temperatures. However, from these limited studies, it can be contended that unfed crawlers would be able to survive and travel for a period of time even under high temperatures, which has implications for crawler dispersal in the disposed waste situation.

Dispersal phase of crawlers

The first-instar nymphs remain motionless for a short period under the body of the adult female or in the ovisac after hatching. This period may last from only a few minutes to several hours or even days, depending on the environmental conditions, mainly temperature (Greathead 1990; Koteja 1990b; Marotta 1997). Once the crawlers emerge from the female body, from beneath the parental brood chamber or from the ovisac, they actively crawl around seeking suitable settling sites. This active moving period may last from several hours to several days (Koteja 1990b; Marotta 1997), with 80% settling within 24 hours (Greathead 1997a). The first-instar nymphs spend the majority of their life in feeding and growing before moulting into the second instar.

Beardsley and Gonzalez (1975) recognised three factors that would primarily control the dispersal and settling behaviour of crawlers: (i) innate behaviour to initiate wandering and settling, (ii) availability of acceptable settling sites and (iii) ambient environmental conditions. Wandering and settling can be initiated after the crawlers hatch from the eggs. They can also be initiated when suitable feeding sites are not available, as in the study of the first-instar nymphs of *Pulvinaria mesembryanthemi* (Washburn & Frankie 1985). When the second factor (availability of acceptable settling sites) is used to assess situations where crawlers are associated with disposed waste, it needs to be expanded to consider how a crawler on disposed waste could migrate to an acceptable settling site on a suitable host plant some distance away.

Hulley (1962) described in detail five phases of the wandering–settling period of *Lepidosaphes beckii* (Newman) (Diaspididae) on orange leaves and noticed that the sequence of these five phases might be broken and sometimes reversed. Even after settling in the last phase, the crawler may reverse to wandering again. This behaviour suggests that crawlers can still move around after initial settling and may disperse in several phases in its lifetime not just in one phase. This can increase the distance it travels because it can obtain energy from the initial feeding.

Schweig and Grunberg (1936) undertook a study on the dispersal of *Chrysomphalus aonidum* (L.) (as *C. ficus*) (Diaspididae) in a citrus grove by placing a moderately infested tree in the centre of eight other clean trees (Schweig & Grunberg 1936, fig. 2). They observed all clean trees became infested to nearly the same degree although the experiment was conducted under the influence of a westerly wind with a velocity of about 32–48km/h. This indicates that the crawlers may have the ability to disperse against the prevailing wind.

There is no specific study on the dispersal behaviours of crawlers associated with waste. Unlike on the host plant, there would be no suitable settling sites available on the waste. Suitable host plants and/or settling sites would only be available at a distance away from the waste. Whether or not a crawler will find an acceptable settling site on a host away from the waste will depend on the mobility of the crawler, and how far the available host is from the waste. The fact that the active dispersal phase may last for several hours to several days (Koteja 1990b; Marotta 1997) suggests that a crawler would have enough time with enough stored energy to travel to a host nearby. It is expected that crawlers associated with disposed waste would initiate the search for their host plants and settling site because these are not available on the waste. Success of reaching a host plant is likely to be affected by environmental factors at the time of dispersal.

Walking speed of a crawler

There are very few studies on the walking speed of a crawler. Quayle (1911) tested the distance travelled by the crawlers of a soft scale *Saissetia oleae*, and two hard scales *Aonidiella aurantii* (Maskell) (as *Chrysomphalus aurantii*) and *Lepidosaphes beckii* on a smooth paper surface. Using the average distance travelled in two hours, it is possible to work out the average walking speed of a crawler, as presented in Table 3.2. The speed is greatly influenced by the temperature. For example, the speed was 1.51 cm per minute at 23.1°C and more than doubled to 3.20 cm per minute at 32.2°C for *Saissetia oleae*; it was 0.41 cm per minute at 16.7°C and increased to 2.35 cm per minute at 31.7°C for *Lepidosaphes beckii*; and it was 0.65 cm per minute at 18.9°C and increased to 2.35 cm per minute at 32.8°C for *Aonidiella aurantii* (Table 3.2).

Washburn and Frankie (1981) found that crawlers of *Pulvinariella mesembryanthemi* (Coccidae) walked at an average speed of 4.32 ± 1.32 cm per minute (0.72 ± 0.22 mm per second) on its iceplant host. Cornwell (1956) indicated that crawlers of *Formicococcus njalensis* (Pseudococcidae) were able to walk at a rate of about 5.7 cm (2.24 in) per minute over paper.

Distance moved by a crawler on host plants

Crawlers usually do not travel far on their host plants and generally settle within several dozen of centimetres for hard scales (Koteja 1990b) or about a metre from the mother for soft scales (Marotta 1997). Washburn and Frankie (1981) observed that crawlers of *Pulvinariella mesembryanthemi* showed little tendency to move by walking among host plants and a significantly higher proportion remained in the inner layer of available host plants (within 8 cm of their point of origin) than moved onto the outer layer of the plants.

Similar behaviour has also been observed for crawlers of *Chionaspis furfura* (Fitch) (Diaspididae), which usually remained within 7.6 cm of their parent and the maximum distance to settling was 61 cm. On the surface of grapefruit, *Chrysomphalus aonidum* travelled 3.8 to 22.9 cm in 15–60 minutes before settling (Mathis 1947).

Distance travelled by a crawler on a smooth surface

The distance travelled by crawlers on a smooth paper surface in two hours was studied for *Saissetia oleae*, *Aonidiella aurantii* and *Lepidosaphes beckii* by Quayle (1911), for *Pulvinaria vitis* by Collinge (1911) and for *Chrysomphalus aonidum* by Mathis (1947). The results are summarised in Table 3.2. It is clear that the distance travelled by a crawler is influenced by the temperature. For example, at 23°C, crawlers of *Saissetia oleae* travelled an average distance of 182cm, with a maximum distance of 206cm; whereas at 32°C, the distance travelled by the

crawlers is doubled to an average of 385cm, with a maximum of 457cm (Quayle 1911). The distance travelled by crawlers of *Aonidiella aurantii*, *Chrysomphalus aonidum*, *Lepidosaphes beckii* and *Pulvinaria vitis* ranged from an average of 48.7cm to 281.9cm in two hours, depending on the species and temperature (Table 3.2).

Table 3.2 Distance travelled by crawlers on a smooth paper surface in two hours

Species (Family)	Temperature (°C) (a)	Travel range (cm) (b)	Average distance (cm)	Average speed (cm/m) (c)	References
<i>Aonidiella aurantii</i> (Diaspididae)	18.9	58–104	79.0	0.65	(Quayle 1911)
	32.8	282	281.9	2.35	
<i>Chrysomphalus aonidum</i> (Diaspididae)	20.6	–	52.3	0.44	(Mathis 1947)
	30.0	–	96.5	0.80	
<i>Lepidosaphes beckii</i> (Diaspididae)	16.7	23–70	48.7	0.41	(Quayle 1911)
	20.0	71–96	83.5	0.70	
	31.7	282	281.9	2.35	
<i>Pulvinaria vitis</i> (d) (Coccidae)	25.6	188–196	190.8	1.59	(Collinge 1911)
	27.8	193–196	193.3	1.61	
	28.9	221–236	231.1	1.93	
<i>Saissetia oleae</i> (Coccidae)	23.1	157–206	181.6	1.51	(Quayle 1911)
	26.7	185–203	194.3	1.62	
	28.3	262–356	313.3	2.61	
	32.2	274–457	384.4	3.20	

a: temperature was converted from original Fahrenheit. **b:** distance was converted from original inches and was measured from the tracings of actual path travelled by the crawler. **c:** the average speed was calculated by dividing the average distance travelled by 120 minutes, the length of two hours for the experiment. **d:** the distance travelled by crawlers of *Pulvinaria vitis* on the glass surface is practically the same as that on a paper surface (Collinge 1911).

Quayle (1911) also observed that the maximum life of an active crawler is four days and calculated the possible maximum distance that could be travelled by a crawler in this time frame: 219.5 m for *Saissetia oleae* and 135.3 m for *Aonidiella aurantii* and *Lepidosaphes beckii* respectively. It is considered that this will never be achieved under natural conditions as the surface will not be as smooth as paper and the travel speed would not be maintained constantly.

Distance travelled by a crawler on a teak boarded surface

Collinge (1911) tested the distance travelled by crawlers of *Pulvinaria vitis* on an oiled teak top, a surface more resembling the actual natural conditions than that of the paper or the glass. Although the distance travelled is shorter than that on paper, the crawlers can still travel an average of 112.0–132.6cm in two hours (Table 3.3).

Table 3.3 Distance travelled by crawlers on a teak boarded surface in two hours

Species	Temperature (°C) (a)	Travel range (cm) (b)	Average distance (cm)	Average speed (cm/m) (c)	References
<i>Pulvinaria vitis</i> (Coccidae)	25.8	94–168	129.5	1.08	(Collinge 1911)
	28.3	46–160	112.0	0.93	
	34.4	119–168	132.6	1.11	

a: temperature was converted from original Fahrenheit. b: distance converted from original inches. c: the average speed was calculated by dividing the average distance travelled by 120 minutes, the length of two hours for the experiment.

Distance travelled by a crawler on sand, litter and soil

Sand and soil. Quayle (1911) designed and performed an experiment on the travel by crawlers of *Saissetia oleae*, *Aonidiella aurantii* and *Lepidosaphes beckii* over sand and ordinary mulch orchard soil. Crawlers released from under the adult were able to walk in a plot of sand. At 29.4°C, crawlers of *Saissetia oleae* were able to travel 7.6cm in 30 minutes from the centre of the sand plot to the edge. At 28.9°C, they travelled 10.2cm in 25 minutes. Results for distance travelled by the crawlers on orchard soil are similar to those on sand. Quayle (1911) indicated that the active crawlers of *Saissetia oleae* would travel a maximum of about 122cm on ordinary mulch soil and thus should be able to travel from one citrus tree to another or a second or third tree away. Quayle (1911) observed that crawlers travelled more over compact soil than on mulch soil. For example, crawlers of *Aonidiella aurantii* made no travel progress in loose mulch but were able to travel 61cm or 91cm over a compacted irrigation furrow.

Chrysomphalus aonidum was able to travel on dry sandy soil (Mathis 1947). Crawlers started moving when temperatures reached 12.8°C and travelled very slowly until temperatures reached 15.6°C (Mathis 1947). It took two hours for a crawler to travel from the centre to the edge of a 15.2cm circle of dry sandy soil.

Singh and Singh Ojha (2005) studied the behaviour of *Aonidiella orientalis* in natural condition and observed that crawlers move slowly over sandy soil. They travelled 7.5cm in 30 minutes over sandy soil and 45cm in 15 minutes over compact irrigated land. Hennessey et al. (2013) confirmed that crawlers of *Aonidiella orientalis* were able to travel across sand and bare soil and some were shown to colonise trees two metres away.

Bare soil and soil with cacao litter. Cornwell (1956) observed the impact of different surfaces on the travel of *Formicococcus njalensis* (Pseudococcidae) and concluded that soil with cacao leaf litter had a marked effect on the mobility of the insects after comparing their movement on a smooth plywood surface with that on soil with cacao litter. The number of individuals that travelled over soil with cacao litter was less than 6% of those that moved over the smooth plywood surface. The majority of the migrated individuals were crawlers: 95% on a plywood surface and 80% on soil.

Cornwell (1956) also tested the distance of travel from slash piles of cacao trees to target cacao twigs placed around the piles. *Formicococcus njalensis* walked about 120cm over cacao leaf litter and 60cm over bare soil after three days (Cornwell 1956). There was a rapid decrease in the number of mealybugs captured at greater distances from the slash piles. When the distance was doubled, the mealybug number was reduced to about one third. Cornwell (1956) concluded that *Formicococcus njalensis* would not travel more than 7.3 metres from slash piles.

Overall, the dispersal capability of crawlers by walking is limited, and local in nature (Cornwell 1956). The actual travel distance of a crawler depends on their energy reserves (Koteja 1990b) and the surface over which they must move.

The information presented is relevant in the assessment of how a crawler on disposed waste could find a host. It indicates that crawlers are able to travel on sand, litter and soil surfaces. Crawlers on disposed waste are likely to be forced to travel to search for suitable host plants, as demonstrated by Schweig and Grunberg (1936) who found that the crawlers of *Chrysomphalus aonidum* are forced to migrate when desiccated leaves no longer offer suitable conditions. Although insects may behave differently when travelling from disposed waste compared to travelling from their hosts, the data support the contention that crawlers leaving disposed waste could travel some distance to find a suitable host. In addition, the crawlers may be attracted by chemicals released by live host plants near disposed waste, discussed under the subheading *Host detection and selection*.

It is concluded that scale insect crawlers would have the ability to find a suitable host or settling site from disposed waste if the host plant is in a reasonably close proximity, and environmental conditions are suitable.

Wind dispersal of crawlers

Crawlers are tiny and could be transferred to a host plant with the assistance of wind. There are many well documented studies to indicate that crawlers can be dispersed by air currents (Greathead 1990, 1997a; Gullan & Kosztarab 1997; Hommay et al. 2019; Washburn & Washburn 1984). Crawlers may be accidentally detached from their host plants to enter the air currents, such as *Aonidiella aurantii* (Greathead 1997a), or more importantly, they may deliberately enter the air as a result of their behaviour, such as *Aulacaspis tegalensis* and *Pulvinariella mesembryanthemi* (Greathead 1997a; Washburn & Washburn 1984), depending on the species involved.

Behaviours of crawlers deliberately entering air currents in order to be carried away has been demonstrated by Washburn and Washburn (1984) in wind tunnel experiments with *Pulvinariella mesembryanthemi*. Crawlers submitted to wind strengths between 1.8 and 4.0 metres per second would take up a position to facilitate removal from the substrate. They rise, facing away from the air current, on their second and/or third pairs of legs, with the antennae and free legs outstretched to form an upright dispersal posture to facilitate dislodgement from the substrate (Washburn & Washburn 1984, fig 1B). This behaviour is displayed by unfed crawlers over an average age of 76 hours. Crawlers became progressively responsive to airstreams. This behaviour could be relevant in the crawlers associated with the waste situation, where they are likely to be forced to respond to the air current after several days of starvation in the waste.

Another relevant behaviour is that crawlers can accumulate at the tips of leaves at the tops of the host plant from which they are carried away by the wind (Greathead 1997a; Washburn & Washburn 1984). In the crawlers associated with waste situation, if there are plants near the waste, not necessarily the host plants, crawlers may be able to climb onto the plants to take up an upright dispersal position at the tips of leaves for the wind to carry them away to reach their host plants.

Although crawlers are considered most likely to reach nearby host plants through their own movements in the disposed waste situation, it is also feasible they may reach a host via airborne due to their dispersal behaviours.

Behaviours of other life stages

For Coccidae, the second- and third-instar nymphs and adult females of species have functional legs and can move short distances. For example, the second-instar nymphs or preovipositional female of *Parthenolecanium corni* are able to move to the woody parts of the plant in autumn in preparation for overwintering (Marotta & Tranfaglia 1997).

For Diaspididae, apart from the crawlers and adult males, the other life stages, including both females and immature males, do not move.

There is apparently no information on the speed of travel by life stages other than the first-instar nymphs of soft scales. For mealybugs, adult females of *Formicococcus njalensis* were observed to travel at a mean speed of 5.18cm per minute over paper, but this was reduced to 3.35cm per minutes after starvation (Cornwell 1956). Adult females of soft scales may also be able to travel at a similar speed.

In addition, Cornwell (1956) showed that when cut cacao started to wilt it stimulated the reproduction of *Formicococcus njalensis*. From this it can be extrapolated that deteriorating waste may also stimulate the reproduction of adult scale insects, resulting in production of eggs for additional crawlers.

Adult male scale insects have one pair of wings but are fragile and considered not responsible for the dispersal of the species.

Host detection and selection

Phytophagous insects select their hosts by a sequence of behavioural responses to an array of stimuli associated with host and non-host plants (Visser 1986). Phytophagous insects possess sensory receptors, mainly located on their antennae, which enable them to perceive these stimuli. Potential plant stimuli include various visual, mechanical, gustatory and olfactory characteristics. Host-produced olfactory kairomones play an important role in enabling insects to recognise host plants at a distance using olfactory receptors (Bruce, Wadhams & Woodcock 2005).

The role of plant odours in host selection can be traced in the orientation of phytophagous insects toward particular plants, and in the ultimate recognition of host plants for feeding and oviposition. Plant odours are attractive to both adults and immatures (Visser 1986). Aphids (Chapman, Bernays & Simpson 1981; Pettersson 1970, 1973) and whiteflies (Vaishampayan, Waldbauer & Kogan 1975) of the insect suborder Sternorrhyncha, to which Coccoidea also belong, and rice brown planthoppers (Obata et al. 1983) are attracted to host plant odours by use of their olfactory receptors. Olfactory receptors in Coccoidea have been examined for the mealybug species of *Planococcus citri* (Salama & Saleh 1971) and *Phenacoccus manihoti* (Le Rü et al. 1995; Le Ru et al. 1995) and recently for the soft scale species *Didesmococcus koreanus* Borchsenius (Wang et al. 2018).

The antennal and labial sensilla of crawlers of *Phenacoccus manihoti* most probably mediate orientation towards its cassava host (Calatayud & Le Rü 2006). The multiporous pegs of

antennal olfactory sensilla in the crawlers and adult females of *Didesmococcus koreanus* are used to sense the volatiles released from host plants (Wang et al. 2018)

Although there are no data on how far the insects can detect host plants, soft scales may also have the potential to detect a host in close proximity.

Climatic factors

Climatic factors such as temperature and humidity will influence a scale insect's ability to reach a suitable host from disposed waste. The degree of influence will depend on the species, for example, whether it is a tropical, subtropical or temperate species. Australia's climate includes tropical, subtropical, temperate and cool temperate regions (Bureau of Meteorology 2011), and different parts of Australia have climatic conditions suitable for different species.

Available host plants

Species of Coccidae are found on 1,993 species, 1,506 genera and 240 families of host plants (García Morales et al. 2019; García Morales et al. 2015). The ten most common host families are presented in Table 2.3, including Fabaceae, Asteraceae, Rosaceae, Poaceae, Rubiaceae, Myrtaceae, Malvaceae, Moraceae, Rutaceae and Sapindaceae.

Species of Diaspididae are found on 2,843 species, 2,043 genera in 290 families of host plants (García Morales et al. 2019; García Morales et al. 2015). The ten most common host families are presented in Table 2.3, including Fabaceae, Poaceae, Rosaceae, Myrtaceae, Orchidaceae, Asteraceae, Euphorbiaceae, Pinaceae, Arecaceae and Fagaceae.

Hosts belonging to these plant families are abundant and widely available in Australia.

Scale insect species can be monophagous (feeding on a single plant genus), oligophagous, (feeding on different genera in a single plant family), or polyphagous (feeding on genera in different plant families).

Based on these definitions, of the 247 quarantine and/or potential virus vector species of soft scales included in the pest categorisation, 25% (62 species) are monophagous, 46% (114 species) oligophagous and 29% (71 species) polyphagous, including five species highly polyphagous, feeding on 54–95 plant families (Table 8.1 of Appendix B). For Coccidae as a whole, Lin, Gullan and Cook (2010) found that about 37% of the species are polyphagous on angiosperms and 48% polyphagous on gymnosperms.

For Diaspididae, of the 331 quarantine species included in the pest categorisation, 16% (54 species) are monophagous, 47% (156 species) oligophagous and 37% (121 species) polyphagous, including 10 species highly polyphagous, feeding on 50–85 plant families.

The economically important species are usually highly polyphagous. For example, *Ceroplastes floridensis* has been found on 264 species of 152 genera of 67 plant families (García Morales et al. 2019), and is a pest of a variety of crops such as citrus (*Citrus* spp.), mango (*Mangifera indica*) and persimmon (*Diospyros kaki*); *Chrysomphalus dictyospermi* has been recorded on 314 species of 186 genera of 79 plant families (García Morales et al. 2019), and is a pest of a variety of crops such as avocado, banana, mango and grapevine.

Importantly, many scale insect hosts are herbaceous plants, such as daisies (Asteraceae) and grasses (Poaceae), that are likely to be accessible at ground level, and could be available near disposed waste. Asteraceae have been reported as hosts for 88 species of soft scales and 102 species of hard scale and Poaceae as hosts of 94 species of soft scales and 257 species of hard scales (García Morales et al. 2019). Scale insect pests associated with disposed waste would likely be able to find such hosts by means of their own movement because species of Asteraceae and Poaceae are widespread in backyard, roadside and park environments where infested wastes are likely to be disposed of by retailers and individual consumers.

It is concluded that suitable host plants are readily available in the Australian environment, and would be exposed to potential infestation by scale insect pests from disposed waste.

Summary for the likelihood of distribution

Scale insect pests imported with fresh fruit, vegetables, cut-flowers and foliage would likely survive transportation, retail sale, and waste disposal. They are most likely to enter the external environment through the disposal of wastes by retailers and individual consumers. The most active stage of the scale insects is the crawler, which would be the most likely life stage to reach a host plant through its own activity. It is also feasible that crawlers may be able to use the wind to become airborne and reach a host. The species of soft scales that have well developed legs in other nymphal and adult stages are able to move short distances and thus may also be able to reach a nearby host plant from disposed waste. A large number of scale insect hosts are species close to or at ground level, such as species of Asteraceae and Poaceae, and potentially in close proximity to disposed waste in backyards, roadsides and parks. Disposed wastes would deteriorate quickly, so scale insects would need to find a suitable host in a limited timeframe.

The likelihood of distribution, that is, the likelihood that a scale insect pest will be distributed to a host plant in Australia as a result of the import of fresh fruit, vegetables, cut-flowers or foliage is considered to be Moderate.

Likelihood of distribution was previously rated differently for different species and/or for the same species in different PRA reports (Appendix D). After review of the previous assessments and consideration of the similar crawler dispersal behaviour across the Coccoidea, as presented in this report based on a far more extensive investigation and evaluation of the literature, it is now considered that an indicative likelihood of distribution of Moderate is appropriate for all pest species of soft and hard scales.

It is also worth noting that Hennessey et al. (2013) investigated the likelihood of infestation of orchard trees by crawlers of a hard scale species *Aonidiella orientalis* originating from artificially infested fruit into an avocado orchard and concluded 'that establishment [equivalent to the distribution step in this report] via the pathway of commercially produced fruit for consumption is low'. This finding should not be considered as contradictory to the assessment of the likelihood of distribution for hard scale pests as presented in this report. The study of Hennessey et al. (2013) only dealt with the infestation of avocado trees from discarded infested fruit in the orchard. It did not include infestation of other hosts by discarded infested fruit in other environments. *Aonidiella orientalis* is highly polyphagous and has been reported on 252 species of 163 genera in 74 families of host plants (García Morales et al. 2019), many of which are commonly available in back yards, roadside and parks. If infested fruit is discarded into such

environments by retailers or individual consumers, the crawlers would have more chance to access a nearby host plant.

3.3 Likelihood of establishment

The likelihood that a scale insect quarantine pest will establish within Australia, following entry on the plant import pathway is assessed as **High**.

Establishment is defined as the '*perpetuation for the foreseeable future, of a pest within an area after entry*' (FAO 2019b).

The supporting evidence for this assessment is provided.

Availability of suitable hosts, alternate hosts and vectors in the PRA area

Collectively, soft scales as a group have been found on 1,993 species, 1,506 genera and 240 families of host plants (García Morales et al. 2019; García Morales et al. 2015). The reported host plants range from woody perennials to herbaceous grasses (Miller et al. 2014b). The most common plant families include Fabaceae, Asteraceae, Rosaceae and Poaceae (Table 2.3).

Similarly, hard scales as a group have been found on 2,843 species, 2,043 genera in 290 families of host plants (García Morales et al. 2019; García Morales et al. 2015). The reported host plants are generally long lived trees and shrubs and occasionally include annuals as well (Miller et al. 2014b). The most common plant families include Fabaceae, Poaceae, Rosaceae and Myrtaceae (Table 2.3).

Apart from commercially grown host crops such as apple, banana, citrus and grapes, many suitable hosts such as Poaceae are also available in the environment, including backyards, roadsides and parks. Moreover, a single plant genus or species can be a host for many soft scale species (Table 2.5). For example, citrus has been reported as host for 91 species of soft scales and 114 species of hard scales, and mango as host for 68 soft scales and 70 hard scales. (Table 2.5).

In addition, many species of scale insects are polyphagous. About 37% of the species of soft scales are polyphagous on angiosperms and 48% polyphagous on gymnosperms (Lin, Gullan & Cook 2010). About 29% of the 247 soft scale species requiring further assessment are polyphagous, including five species that are highly polyphagous, feeding on 54–95 plant families (Appendix B), whereas 37% of the 373 quarantine pests of hard scale are polyphagous, including 10 species that are highly polyphagous, feeding on more than 50–85 plant families (Appendix C).

Scale insect pests do not require vectors for their establishment in the PRA area.

An exotic scale insect pest would be able to find a suitable host to establish a population in Australia due to a number of factors: scale insects have been found on a wide range of host plants, a single plant can be attacked by many species, and a large proportion of scale insects are polyphagous.

Suitability of the environment

Australia's climate includes tropical, subtropical, temperate and cool temperate regions (Bureau of Meteorology 2011). Agricultural crops and horticultural fruit trees are grown in many parts of Australia. Large numbers of other non-crop host plants are also available in the different

climatic regions. The ecological conditions in these areas are similar to those of the countries or regions where the exotic scale insect pests are currently present. Therefore, suitable environments are available in Australia for the establishment of exotic scale insects. For example, at least 26 species of soft scales and 40 species of hard scales are considered to have been accidentally introduced to Australia where they have subsequently established (Table 2.4).

Reproductive strategies and potential for adaptation

Details of the biology, including reproductive strategies, are reviewed for Coccidae in Section 2.3.1 and for Diaspididae Section 2.3.2. Most scale insect species reproduce sexually, and some parthenogenetically, due to the advantage of maintaining a superior genotype, an increased reproductive output and/or the ability to reproduce without males (Gullan & Kosztarab 1997; Nur 1990).

For Coccidae, the female is wingless and its life cycle includes egg, first, second and, for most species of soft scales, third-instar nymph and adult (Camacho & Chong 2015). Mature females deposit their eggs either in a 'brood chamber' beneath the female body as in Ceroplastinae, Coccinae (except Pulvinariini), Eulecaniinae and Myzolecaniinae (Camacho & Chong 2015; Marotta 1997; Matile-Ferrero 1997) or in an ovisac enclosing, beneath or behind the body as in Filippiinae, Eriopeltinae and Pulvinariini (Camacho & Chong 2015; Marotta 1997; Matile-Ferrero 1997). An individual adult female can produce a few dozen to hundreds or several thousand eggs depending on the species and the size of the female body (Camacho & Chong 2015; Marotta 1997).

For Diaspididae, the female life cycle includes egg, first-, second-instar nymph and adult (Koteja 1990a, b). Mature females deposit their eggs within the gravid body under the scale cover, which has a small slit at the posterior end to allow the crawlers egress to the outside (Miller et al. 2014b). Total fecundity is lower in Diaspididae, compared to other Coccoidea. An individual adult female may produce 1–10 eggs daily and 10–600 offspring in a lifetime (Koteja 1990a).

Some species show the ability to adapt to different environments and climatic conditions and can produce different numbers of generations per year on different hosts and in different areas. For example, *Ceroplastes floridensis* reproduces one generation on apple and persimmon in Yunnan, China (Yun 1994) and also one generation on *Rhododendron* spp. from Florida to Maryland (Kehr 1972). However, the pest was reported to produce two generations on holly (*Ilex* spp.) in Georgia (Hodges, Ruter & Braman 2001) and three generations on citrus and holly in Florida (Johnson & Lyon 1991). *Aonidiella aurantii* reproduces through an average of about two generations in cool coastal areas of California, three generations in hot and dry summer interior areas of California and up to six generations in the other areas of the world with relatively uniform warm and dry conditions (Beardsley & Gonzalez 1975, and references therein).

In theory, a single mated female for the sexually-reproducing species or a single unmated female for the parthenogenetic species would be able to initiate a population. The likelihood of establishment would increase with pioneer population size and rates of incipient infestations and would be positively associated with the numbers of founding individuals, thus the more individuals that enter with the commodity, the higher the likelihood they will establish successfully.

In summary, the ability to utilise either a sexual or asexual reproductive strategy and to adapt to different conditions enables scale insects to take advantage of new environments for establishment.

Cultural practice and control measures

The management of pests on agricultural and horticultural crops usually involves a variety of practices, a strategy commonly known as integrated pest management (IPM). Chemical control is usually one of the components of IPM, but is only employed when required. Given that these management practices are applied to existing pest species for commercial crops, they may also have some impact on newly introduced exotic species. However, as many economically important scale insect pests are highly polyphagous, they are likely to also occur in non-commercial and natural environments where commercial management practices would not be used.

In addition, the initial small population may not be noticed, especially in the natural environment and control measures are unlikely to be applied in an early stage to eliminate the population.

Summary for the likelihood of establishment

A wide range of host plants are available in the natural environment, as garden plants and agricultural and horticultural crops. A single host plant can attract many pest species, while a single pest species can attack a large number of host plants. Climatic conditions in Australia are suitable for the pests to establish. Scale insects are able to use effective reproductive strategies including parthenogenesis for some species. They can also adapt to different environments. In addition, it is probable that initial populations in the natural environment will not be noticed and/or managed at an early stage. All these factors support a likelihood of establishment of High.

3.4 Likelihood of spread

The likelihood that a scale insect quarantine pest will spread within Australia, following its establishment is assessed as **High**.

Spread is defined as '*the expansion of the geographical distribution of a pest within an area*' (FAO 2019b).

The supporting evidence for this assessment is provided.

Biological information relevant to the likelihood of spread

Crawler mobility

The main dispersal stage is the newly emerged crawlers (Gullan & Kosztarab 1997). The crawlers are responsible not only for their own survival but also for the species' survival, dispersal and acquisition of new host plants (Koteja 1990b). The duration, walking speed and distance travelled by a crawler on different surfaces were discussed in detail under the *Likelihood of distribution* section. Crawlers can walk and wander around in searching for a settling site and can travel on their host plants, between plants in proximity, and on sand, litter and soil surface as well as on smooth surfaces. The actual duration and distance travelled by a crawler depend on the insect's energy availability (Koteja 1990b) and the surface over which

they travel (Cornwell 1956; Quayle 1911) and can be influenced by ambient environmental conditions (Beardsley & Gonzalez 1975).

Due to the mobility and the small size of crawlers, they may also be spread between production areas on the clothes of people who have been in direct contact with infested material. They may also be transferred by phoresy on other insects, birds and mammals (Washburn & Frankie 1981). This type of spread may deposit crawlers directly into new uninfested areas at a faster rate than the insects could naturally spread.

The dispersal capability of crawlers through their own mobility is limited and expected to be responsible for short-range spread of the species in the local environment. The dispersal of crawlers on clothes of people and by phoresy on animals can be anticipated to assist their spread between districts in a state and/or territory as well as in the local environment.

Wind dispersal

Wind dispersal of crawlers has been studied for members of Coccoidea. It is expected that crawlers of all soft and hard scales can be airborne. Crawlers can be dispersed by air currents for a few metres to several or a few hundred kilometres from the natal trees (Greathead 1990, 1997a; Gullan & Kosztarab 1997; Hommay et al. 2019; Pedgley 1982; Washburn & Washburn 1984). Crawlers may be accidentally detached from their host plants to enter the air currents (Greathead 1997a), or more importantly, they may deliberately prepare for wind to carry them (Greathead 1990; Washburn & Washburn 1984). In the field, crawlers accumulate at the tip of leaves at the tops of the host plants, from which they are carried away by the wind (Greathead 1997a). Once airborne, the trajectory of a crawler is likely to be erratic because of the influence of air turbulence caused by wind up- and down-drifts (Pedgley 1982).

Wind dispersal was probably responsible for the rapid spread of *Pulvinariella mesembryanthemi* throughout California (Washburn & Frankie 1981). Washburn and Frankie (1981) suggested that if crawlers of *Pulvinariella mesembryanthemi*, which may survive up to eight days in moist air, were suspended in a moist column of air for 24 hours with a conservative mean wind speed of 8 km/h they could spread well over 190 km in a single generation. Airborne crawler dispersal has been used to explain some unexpected mealybug incursions that occur at long distances from known sources of infestation, such as up to 260 km inland from an infested area on the Kenyan coast (Greathead 1990; Gullan & Kosztarab 1997).

It is expected that wind dispersal would facilitate both short-range spread in local and district levels and long-range spread between states/territories.

Suitability of the natural and/or managed environment for natural spread of the pest

The natural environment in Australia is suitable for the natural spread of scale insects. The same or similar environmental conditions to where scale insect pests currently occur are available for throughout Australia, which includes tropical, subtropical, temperate and cool temperate regions (Bureau of Meteorology 2011).

Managed environment is also available in Australia for the spread of scale insects. Greenhouse and nursery environments would be suitable for aiding the spread of some soft scales.

Presence of natural barriers

Natural barriers exist between different areas within Australia. Arid areas and long geographic distances exist between the east and the west, for example, the Nullarbor Plain. The Bass Strait separates the mainland from Tasmania. Climatic differentials occur between the north and the south. It would be difficult for scale insects to naturally disperse via the movement of crawlers from one such area to another without the assistance of wind dispersal and long distance transportation of infested plant material.

The potential for movement with commodities or conveyances

Crawlers, other immature stages and young adult females are small and inconspicuous. They can easily be concealed in buds and leaf bases, under bracts and in the calyx of fruit. After settling and inserting their stylet into the plant tissues, scale insects cannot be easily dislodged from plants. The concealed habit enables scale insects to hide in plants and plant material. These infested materials can be unwittingly transported between orchards, between nurseries and between states or territories. Many species are believed to have been introduced into new regions through this means.

The small size and concealed habit of scale insects on infested fresh plants and/or cuttings and nursery stocks could be responsible for the long-range spread between states/territories, including overcoming natural barriers, as well as for short-range dispersal.

Intended use of the commodity

The intended use of commodities and live plants derived from the large number of potential hosts, such as fresh fruit, vegetables, cut-flowers and foliage, cereal crops, and propagative material are likely to include human consumption, decoration, nursery stock and animal feeds. These commodities and live plants would be moved around the country, and this assists spread of eggs, nymphs and adults of associated scale insects.

Potential vectors of the pest in the PRA area

Scale insect pests do not require a vector for dispersal.

Crawlers of some ant-attended scale insects can be carried to new feeding sites by colony-founding queen ants (Gullan 1997; Gullan & Kosztarab 1997).

Potential natural enemies of the pest in the PRA area

Natural enemies have been comprehensively reviewed for soft scales in Part 2 of the monograph titled: 'Soft scale insects, their biology, natural enemies and control' edited by Ben-Dov and Hodgson (1997a) and for hard scales in Part 2 of the monograph titled: 'Armoured scale insects, their biology, natural enemies and control' Volume 4B edited by Rosen (1990). For soft scales, they include entomopathogenic fungi such as the genera *Cordyceps*, *Beauveria*, *Hypocrella* and *Verticillium* (Evans & Hywel-Jones 1997), predatory beetles such as *Cryptolaemus montrouzieri* and *Chilocorus nigrit* of the Coccinellidae (Ponsonby & Copland 1997) and predatory flies such as Cecidomyiidae (Harris 1997) and parasitoid wasps such as Encyrtidae (Prinsloo 1997) and Aphelinidae (Hayat 1997). For hard scales, natural enemies include entomopathogenic fungi, such as many species listed by Evans and Prior (1990: Table 2.1.1), predators such as lady bird beetles of the family Coccinellidae (Drea & Gordon 1990), predaceous thrips (Palmer & Mound

1990) and mites (Gerson, O'Connor & Houck 1990) and parasitoid wasps such as Aphelinidae (Viggiani 1990).

Members of these families and/or genera of natural enemies are reported in Australia. However, they are unlikely to have significant impact on the spread of introduced species because they can also use local scale insects as food sources, and would not specifically target the introduced species.

Summary for the likelihood of spread

The natural and/or managed environments in Australia are suitable for the pest's spread. Crawlers are motile and have the capacity for short-range dispersal. They also have the potential for long-range dispersal by wind and human activities allowing natural barriers to be overcome. These factors all support a likelihood of spread of High

Likelihood of spread was previously rated differently for different species in different PRA reports (Appendix D). After review of the previous assessments and consideration of the similar crawler dispersal behaviour across the Coccoidea, as presented in this report based on a far more extensive investigation and evaluation of the literature, it is now considered that a likelihood of spread of high is appropriate for all soft and hard scale insect pests.

3.5 Overall likelihood of entry (indicative), establishment and spread

The overall likelihood of entry, establishment and spread is determined by combining the likelihoods of entry (indicative), of establishment and of spread using the matrix of rules shown in Appendix A. These likelihoods are summarised in Table 3.3.

The overall likelihood that a scale insect quarantine pest will enter Australia on the plant import pathway, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia is assessed as **Moderate**.

Table 3.4 Overall likelihood of entry (indicative), establishment and spread for scale insect pests

Step	Likelihood
Importation (indicative)	High
Distribution (indicative)	Moderate
Overall likelihood of entry (indicative)	Moderate
Establishment	High
Spread	High
Overall likelihood estimate (indicative)	Moderate

3.6 Consequences

The overall consequences for the establishment and spread of a scale insect quarantine pest are estimated to be **Low**.

The potential consequences of the establishment of a scale insect quarantine pest in Australia have been estimated according to the method described in Appendix A.

Impact scores for consequences are summarised in Table 3.5.

Table 3.5 Summary of consequences for a scale insect quarantine pest

Consequences criterion	Impact (magnitude and geographic scale)	Impact score
Direct impact on plant life or health	Major significance at the local level	D
Direct impact on other aspects of the environment	Minor significance at the local level	B
Indirect impact on eradication and control	Major significance at the local level	D
Indirect impact on international trade	Major significance at the local level	D
Indirect impact on domestic trade	Significant at the local level	C
Indirect impact on environment	Minor significance at the local level	B
Overall consequences rating		Low

The assessment of consequences considered only the impacts caused by a scale insect quarantine pest. It did not consider any additional impacts caused by viruses that they may transmit. A separate risk assessment was undertaken for these viruses in Section 5.

The overall consequences rating of low for a scale insect quarantine pest is consistent with all previous assessments conducted by Australia.

The supporting evidence for this assessment is provided.

Direct impact on plant life or health

Impact score is estimated as **D**.

The direct impact of a scale insect pest on plant life or health would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'. This is because the impact would be expected to threaten economic viability through a large decrease in production of infested crops at the local level. Damage caused by a scale insect pest includes weakening plant vigour to decrease yield and impacting the appearance of produce to reduce market value. For soft scales, secondary impacts are caused by sooty mould development resulting from honeydew secretion. The impact on plant industries is expected to be significant at the district level and of minor significance at the regional level because these industries within a state or territory are usually diverse in composition of hosts and physically dispersed.

This impact score is consistent with all previous risk assessments of scale insect pests conducted by Australia.

Scale insects damage plant by inserting their stylets through the plant tissues to feed. Heavy infestation can result in a loss of plant vigour, poor growth, splitting and die back of twigs and branches, defoliation, and sometimes even death of the plant (Gill & Kosztarab 1997; Kosztarab 1990). For soft scales, secondary impacts are caused by sooty mould development associated with honeydew secretion.

Scale insects can be serious pests of a long list of crops, as reviewed for soft scales in 'Soft scale insects: their biology, natural enemies and control' (volume 7B) edited by Ben-Dov and Hodgson (1997a) and for hard scales in 'Armored scale insects, their biology, natural enemies and control' (volume 4B) edited by Rosen (1990). Gill and Kosztarab (1997) estimated that soft scale pests probably caused a quarter of the total US\$5 billion annual economic loss worldwide by all the pests of the superfamily Coccoidea. Miller and Davidson (2005) indicated that the economic loss caused by hard scales would probably exceed US\$2 billion annually if the figure of US\$5 billion annual loss attributed to all scale insects estimated by Gill and Kosztarab (1997) was correct.

Many serious pests of scale insects are not yet present in Australia. For example, 23 of the 50 major soft scale pests of the world listed by Gill and Kosztarab (1997) are not yet present in Australia, including species in the genera of *Ceroplastes*, *Coccus*, *Eulecanium*, *Pulvinaria* and *Toumeyella*. Many species of Diaspididae listed by Miller et al. (2005) as being introduced into the United States are still exotic to Australia, such as *Aulacaspis yasumatsui*, *Fiorinia theae*, *Gymnaspis aechmeae*, *Mercetaspis hall* and *Unaspis euonymi* (Miller et al. 2005).

Scale insects feed on many host plants that are important agricultural and horticultural crops, and ornamental and forest plants. A single host plant species can be attacked by many scale insect pests (Table 2.5). Soft scales associated with many of those crops were documented in the monograph on Coccidae by Ben-Dov and Hodgson (1997a), including for avocado (Swirski, Wysoki & Ben-Dov 1997), citrus (Gill 1997a), deciduous fruit (Pfeiffer 1997), grapevine (Pellizzari 1997a), mango (Swirski, Ben-Dov & Wysoki 1997b), persimmon (Swirski, Ben-Dov & Wysoki 1997d) and various subtropical fruit (Swirski, Ben-Dov & Wysoki 1997c). Hard scales associated with important host plants were examined in the monograph on Diaspididae by Rosen (1990b), including Ben-Dov and Hodgson (1997a) for citrus (Rosen 1990b), deciduous fruit trees (Kozar 1990), sugar cane (Williams & Greathead 1990), tea (Nagarkatti & Sankaran 1990), tropical and subtropical crops such as avocado, banana, cocoa, coffee, mango, papaya and pineapple (Chua & Wood 1990), ornamental plants (Davidson & Miller 1990), conifers (Zahradnik 1990a) and non-conifer forests (Zahradnik 1990b).

On the other hand, a single scale insect species can be a pest for several or many host plants. Three-quarters of the soft scale species included in the pest categorisation table are either polyphagous or oligophagous (Table 8.1 of Appendix B). For example, *Ceroplastes cirripediformis*, exotic for Australia, is recorded on at least 152 species of 118 genera in 62 families of host plants, including banana, citrus, grapevine, mango, pineapples, passionfruit and pomegranate (García Morales et al. 2019). Similarly, the majority of the hard scale species included in the pest categorisation table are either polyphagous (37%) or oligophagous (47%) (Table 9.1 of Appendix C). For example, *Pseudoparlatoria parlatorioides* (Comstock), also exotic for Australia, is recorded on at least 209 species of 143 genera in 54 families of host plants, including avocado, banana, breadfruit, citrus, coconut, mango, pineapples, pine and tea (García Morales et al. 2019).

Australia has significant primary industries with many host crops which are subject to attack by scale insect pests. In 2017–2018, Australia's annual gross value of production (GVP)—the value of production at the point of sale was \$4,266 million for horticulture, including apples, bananas, citrus, pears, stone fruit and table grapes; \$4,096 million for vegetables, including beans, capsicum, cucumbers, lettuce and tomatoes; and \$521 million for cut-flowers (ABS 2019). It is

expected that the actual loss caused by a given pest would only be a portion and not the full extent of the GVP values for these industries.

Direct impact on other aspects of the environment

Impact score is estimated as **B**.

The direct impact of a scale insect pest on other aspects of the environment would be of minor significance at the local level, and indiscernible at the district, regional and national levels, which has an impact score of 'B'. This is because the pest may have a minor impact on native scale insects by competing for the same or similar resources locally with these organisms.

This impact score is consistent with those of eight of the 10 soft scales (with the other two species rated as A) and 20 of the 44 hard scales (other species as A, C or D) in the previous risk assessments conducted by Australia.

Indirect impact on eradication and control

Impact score is estimated as **D**.

The indirect impact of a scale insect pest on the basis of associated eradication and control activities would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'. This is because the impact would be expected to threaten economic viability through a large increase in costs for containment, eradication and control at a local level. Containment and eradication activities are costly, and would also cause significant disruption to agribusiness and associated trades at the district level. The costs associated with the initial response to an incursion and ongoing control of the introduced pest, including any additional research requirement, would be expected to be of minor significance at the regional level.

This impact score is consistent with those of 5 of the 10 soft scales (with the other four species rated as C, and one species as B) and 34 of the 44 hard scales (with the other species rated as C) in the previous risk assessments conducted by Australia.

In Australia, an exotic pest incursion will trigger an immediate response by Australian federal, state and territory governments and relevant industries, and there are costs involved with this response (Plant Health Australia 2020). The initial response includes consideration of the feasibility of eradication of the pest from Australia.

To date, there have apparently been no previous attempts to try to eradicate exotic scale insects in Australia, as when the pests were detected they had already established and spread to a wide area, and eradication was considered not feasible.

The difficulty of eradicating scale insect pests results from factors including their wide range of host plants, capacity for dispersal of crawlers by wind and through spread on infested plant material and commodities, as well as the commonly delayed period to detection.

Once an exotic pest become established and eradication is not considered possible, it is necessary to control and manage the pest on an ongoing basis. Control of scale insect pests usually involves cultural, physical, biological and chemical control methods. Chemical control is reserved for suppressing large pest population sizes when cultural, physical and/or biological

measures become ineffective. The relevant state departments and industries provide easily accessible information on their websites in assisting the management of existing scale insect pests. The available information includes 'Scale in citrus–Farmnote 243' by Department of Agriculture and Food, Western Australia (Broughton 2007), 'Scale insects: Hard and soft scales' jointly by Horticulture Innovation Australia, Nursery & Garden Industry Australia and Queensland Government (Manners 2016b), 'Scale insects, a difficult problem that can be managed' by Horticulture Innovation Australia, Nursery & Garden Industry Australia and Queensland Government (Manners 2016a).

The presence of a new pest in any agricultural and horticultural cropping system will likely require initial investigation and ongoing additional research to determine what modifications to existing management regimes are required, and to evaluate their effectiveness. In Australia, such research is often funded under shared government and industry arrangements and may take years to complete.

Indirect impact on International trade

Impact score is estimated as **D**.

The indirect impact of a scale insect pest on international trade would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'. This is because the impact would be expected to threaten economic viability through loss and/or disruption of trade and export markets at the local level. It is likely that trading partners would review their phytosanitary requirements for exported host commodities, and impose additional phytosanitary measures for a pest that is not currently present in their countries. Australia is a significant exporter of agricultural commodities. If additional measures are imposed, it would be expected to have a significant impact on affected industries at the district level. The relevant state or territory government would also have to expend resources to support affected industries and assist in regaining market access or in implementing the additional phytosanitary measures, which would have a minor impact at the regional level.

This impact score is consistent with those of three of the 10 soft scales (six other species rated as C, and one rated as B) and two of the 44 hard scales (all other species were assessed as having an impact score of C) in previous risk assessments conducted by Australia. It should be noted that the indirect impact of an exotic hard scale on international trade would be the same or similar to that of an exotic mealybug or soft scale as the trading partners are expected to take the same or similar phytosanitary measures for an soft or hard scale or a mealybug. It is therefore reasonable to rate their impact score consistently as D, as already assigned to mealybugs (Department of Agriculture and Water Resources 2019).

Although 88 species of soft scales and 262 species of hard scales have been recorded in Australia (García Morales et al. 2019), many recognised pest species in the pest categorisation tables (Appendix B and Appendix C) are not present in Australia. If introduced, they might have an impact on Australia's export markets in countries where these scale insect species currently do not occur.

Many countries require phytosanitary measures to mitigate the risk posed by their scale insect quarantine pests. Australia is a significant exporter of agricultural and horticultural

commodities, including hosts of scale insect pests. Should exotic scale insect pests become established on crops grown for export markets, Australia's trading partners may impose phytosanitary measures, typically inspection and treatment if scale insects are present, resulting in additional export costs and/or disruption to the existing trade.

Indirect impact on domestic trade

Impact score is estimated as **C**.

The indirect impact of a scale insect pest on domestic trade would be significant at the local level and of minor significance at the district level, which has an impact score of 'C'. This is because the impact would be expected to threaten economic viability through a moderate reduction of trade or loss of domestic markets at the local level. Biosecurity measures would be enforced to prevent the movement of infested plant material out of the initial incursion area, which would have significant economic impacts on plant industries and business at the local level. The introduction of a new pest to a district would be likely to disrupt intra- and/or interstate trade due to biosecurity restrictions on the domestic movement of affected commodities. This would be expected to be of minor significance at the district level.

This impact score is consistent with those of nine of the 10 soft scales (the other species rated as A) and 40 of the 44 hard scales (other species were assessed as B) in previous risk assessments conducted by Australia.

If an exotic scale insect species is detected in Australia, initially it is likely to be restricted to a relatively small area. Previous detections of scale insect incursions support this assertion, which has also been the case for pests in other groups such as papaya fruit fly (Cantrell, Chadwick & Cahill 2002). Quarantine measures would be enforced to prevent the movement of plant material out of the incursion area, and this would have an economic impact on plant industries and business.

Australian states and territories have their own domestic biosecurity restrictions for pests of concern for their jurisdictions. An intergovernmental body, the Subcommittee on Domestic Quarantine and Market Access (SDQMA), has been established to ensure that the development of domestic market access conditions for plants and plant products in Australia is technically justified, coordinated and harmonised, and consistent with Australia's international import and export conditions and policies (Plant Health Australia 2019). When an exotic pest is detected and its distribution is limited in area, this body can restrict intra- and/or inter-state movement of affected commodities to prevent the pest's spread. Such a restriction would clearly impact on domestic trade.

Indirect impact on environment

Impact score is estimated as **B**.

The indirect impact of a scale insect pest on the environment would be of minor significance at the local level, and indiscernible at the district, regional and national levels, which has an impact score of 'B'. This is because the introduction of a new scale insect pest may result in the additional use of pesticides for its control, and thus additional spray drift, causing minor damage to the local environment.

This impact score is consistent with those of nine of the 10 soft scales (the other species as A) and 43 of the 44 hard scales (the other species as A) in previous assessments conducted by Australia.

Increased pesticide use required to manage new scale insect species could affect the environment. Spray drift of pesticide application can result in soil toxicity, runoff and water system contamination (APVMA 2008; NSW DPI 2012). The Australian Pesticides and Veterinary Medicines Authority (APVMA) defines spray drift as the physical movement of spray droplets (and their dried remnants) through the air from the nozzle to any off-target site at the time of application or soon thereafter (APVMA 2008). Spray drift has been implicated with the decline of some butterflies in Australia (Sands & New 2002). Soil toxicity in agricultural systems is reported in the USA to inhibit germination and lead to elevated pesticide residues in plants (Dalvi & Salunkhe 1975), possibly leading to issues with maximum residue limits (MRLs) and saleability of crops. Runoff and leaching may affect biodiversity in aquatic ecosystems (NSW DPI 2012).

3.7 Unrestricted risk estimate (indicative)

Unrestricted risk estimate (URE) is the result of combining the overall likelihood of entry, establishment and spread (Table 3.3) with the estimate of consequences (Table 3.4). Likelihoods and consequences are combined using the risk estimation matrix in Table 7.5 of Appendix A. The unrestricted risk estimate (indicative), for a scale insect that is a quarantine pest for Australia, is given in Table 3.6, and is assessed as **Low**.

Table 3.6 Unrestricted risk estimate (indicative) for a scale insect quarantine pest

Risk component	Rating
Overall likelihood of entry (indicative), establishment and spread	Moderate
Consequences	Low
Unrestricted risk estimate (indicative)	Low

An unrestricted risk estimate (indicative) of Low does not achieve the ALOP for Australia. Therefore, risk management measures are required for the soft and hard scale quarantine pests when this indicative URE is verified in specific plant import pathway.

4 Viruses transmitted by soft and hard scales

4.1 Introduction

Following a comprehensive search of literature, no species in the family Diaspididae was found to transmit viruses or any other plant pathogen. However, some species in the family Coccidae were identified as being able to transmit viruses associated with grapevines (Herrbach et al. 2017; Maliogka et al. 2015; Perilla-Henao & Casteel 2016).

4.2 Viruses transmitted by soft scales

Viruses transmitted by soft scales are listed in Table 4.1. They are *Grapevine virus A* (GVA), *Grapevine leafroll-associated virus 1* (GLRaV-1), *Grapevine leafroll-associated virus 3* (GLRaV-3), *Grapevine leafroll-associated virus 4* (GLRaV-4) (Table 4.1). These viruses are proven to be transmitted by specific soft scale species and are currently the species recognised by the International Committee on Taxonomy of Viruses (ICTV 2016).

Substantiating virus-vector relationships was complicated in some cases due to revisions to the virus taxonomy. For example, the taxonomy of the virus family Closteroviridae, which includes a number of viruses transmitted by scale insects, has been revised (Martelli et al. 2012; Martelli et al. 2002) and approved by the ICTV (King et al. 2012; Martelli, Saldarelli & Minafra 2011). Accordingly, six previously recognised species of grapevine leafroll associated viruses, i.e. GLRaV-5, GLRaV-6, GLRaV-9, GLRaV-Pr, GLRaV-De and GLRaV-Car, are now considered as different strains of the same virus species of GVLRaV-4. Since these former taxa are now treated as a single species, the soft scale species, *Ceroplastes rusci*, identified as vector of the original virus (GLRaV-5) is assigned as vector to the new broader concept virus species (GVLRaV-4) (Table 4.1).

Soft scale species able to transmit virus are *Ceroplastes rusci*, *Coccus longulus*, *Neopulvinaria innumerabilis*, *Parasaissetia nigra*, *Parthenolecanium corni*, *Parthenolecanium persicae*, *Pulvinaria vitis* and *Saissetia* sp. (Table 4.1). The four viruses transmitted by these eight soft scale species are all present in Australia and thus are not quarantine pests.

Table 4.1 Viruses transmitted by soft scale insects

Virus	Acronym	Transmitted by	Virus present within Australia
<i>Grapevine virus A</i> [Betaflexiviridae: Vitivirus]	GVA	<i>Neopulvinaria innumerabilis</i> –tested from mixed infections with GLRaV-1 (Fortusini et al. 1997) <i>Parthenolecanium corni</i> –tested from mixed infections with GLRaV-1 and GVA (Hommay et al 2008) <i>Parthenolecanium persicae</i> –tested from mixed infections with GLRaV-3 (Habibi 2015)	Yes (Goszczynski & Habibi 2012; Habibi & Symons 2000)
<i>Grapevine leafroll-associated virus 1</i> [Closteroviridae: Ampelovirus]	GLRaV-1	<i>Neopulvinaria innumerabilis</i> (Fortusini et al. 1997) <i>Parthenolecanium corni</i> (Fortusini et al. 1997; Hommay et al. 2008; Sforza, Boudon-Padieu & Greif 2003)	Yes (Cameron and Pasqual 2004; Habibi et al. 1998)
<i>Grapevine leafroll-associated virus 3</i> [Closteroviridae: Ampelovirus]	GLRaV-3	<i>Coccus longulus</i> , <i>Parasaissetia nigra</i> , <i>Saissetia</i> sp. (Kruger & Douglas-Smit 2013) <i>Neopulvinaria innumerabilis</i> (Zorloni et al. 2006) <i>Parthenolecanium corni</i> (Bahder et al. 2013) <i>Parthenolecanium persicae</i> –tested from mixed infections with GVA (Habibi 2015) <i>Pulvinaria vitis</i> (Belli et al. 1994)	Yes (Habibi, Cameron & Randles 2009; Habibi et al. 1998; Habibi et al. 1995; Habibi & Nutter 1997; Habibi & Symons 2000)
<i>Grapevine leafroll-associated virus 4 (a)</i> [Closteroviridae: Ampelovirus]	GLRaV-4	<i>Ceroplastes rusci</i> –tested with GLRaV-5 (Mahfoudhi, Digiario & Dhouibi 2009)	Yes (Habibi et al. 1998; Habibi & Randles 2008; Habibi & Symons 2000)

a: Martelli et al. (2012) considered the previously recognised six species of GLRaV-5, GLRaV-6, GLRaV-9, GLRaV-Pr, GLRaV-De and GLRaV-Car as different strains of the same species of GLRaV-4. The virus–vector relationship between the species GLRaV-4 and *Ceroplastes rusci* was through the testing with GLRaV-5 strain. It is assumed that *Ceroplastes rusci* may also be able to transmit the other strains of GLRaV-4.

4.3 Conclusion

Four species of viruses (GVA, GLRaV-1, GLRaV-3 and GLRaV-4) are transmitted by eight species of soft scales (Table 4.1). These viruses are not quarantine pests because they are already present in Australia. Therefore, no further detailed pest risk assessments are required.

5 Key findings

5.1 Pest categorisation of soft and hard scales

The pest categorisation process determines whether a pest has the characteristics of a quarantine pest (FAO 2019b). Species were included in the categorisation based on the selection criteria presented in Table 2.1.

For soft scales, 266 species were identified as pests of potential biosecurity significance to Australia (Table 8.1). A total of 247 species were considered further in the pest risk assessment: 231 species were quarantine pests for Australia (Table 2.8); eight species are pests of regional concern for Western Australia (WA); and one species is pest of regional concern for New South Wales (NSW), South Australia (SA) and Victoria (Vic.); four species are virus vectors, although not quarantine pests; two species are both quarantine pests for Australia and virus vectors; and one species is pest of regional concern for WA and a virus vector (Table 2.8).

For hard scales, based on the selection criteria, 375 species were identified as pests of potential biosecurity significance to Australia (Table 9.1). A total of 331 species were considered further in the pest risk assessment (Table 2.9). Of these species 299 were quarantine pests for Australia; two species are pests of regional concern for Northern Territory (NT), 29 species for Western Australia (WA) and one species for NT, South Australia (SA) and WA (Table 2.9).

5.2 Viruses transmitted by soft and hard scales

No plant viruses of biosecurity concern are identified as being transmitted by soft and hard scale insects. The four viruses transmitted by eight species of soft scales are reported in Australia and thus are not quarantine pests.

5.3 Outcomes of pest risk assessments

Unrestricted risk estimate was calculated by combining their respective overall likelihoods of entry, establishment and spread, with an estimate of consequences, and are summarised in Table 5.1.

Table 5.1 Summary of unrestricted risk estimate (indicative) for scale insects

Risk Component	Soft and hard scale insects
Overall likelihood of entry (indicative), establishment and spread	Moderate
Consequences	Low
Unrestricted risk (indicative)	Low

The unrestricted risk estimate (indicative) for scale insect pests was assessed as Low (Table 5.1). An URE of Low does not achieve the ALOP for Australia. Therefore, risk management measures would be required for these pests in specific trade pathways when the indicative URE has been verified to be Low.

It is noted that previous assessments on individual species indicated that the URE for some species of soft scales and the majority of hard scales was 'Very Low' or 'Negligible', which achieved the ALOP for Australia. This change indicates that mitigation measures would now be

required for these species when their indicative URE of 'Low' is confirmed on the specific trade pathway.

In order to evaluate the potential impact on existing trade resulting from this change, all the previous PRA reports containing soft and hard scale quarantine pests have been reviewed. The review found that this change will not have any practical impact on existing trade, because the relevant plant import pathways already have requisite phytosanitary measures for other pests that are also adequate for soft and hard scale quarantine pests.

5.4 No regulatory changes to soft scales that transmit viruses

Since the viruses transmitted by soft scales are not quarantine pests for Australia, no additional risk management measures are required for the soft scale species that transmit these viruses. The non-quarantine soft scale pests that transmit viruses are therefore proposed to continue to be non-regulated.

6 Pest risk management

The Group PRA has identified soft and hard scale quarantine pests of biosecurity importance to Australia.

Imported commodities infested with soft and hard scale quarantine pests will be regulated to reduce the risk of establishment of these organisms in Australia. Regulation will be in accordance with this pest risk analysis and any other relevant commodity-based PRAs.

Measures are required to reduce the risk on such commodities to achieve the ALOP for Australia. Verification, such as inspection, will provide assurance that Australia's import conditions have been met and ALOP achieved.

This Section identifies measures for soft and hard scale quarantine pests and alternative risk management options that may be considered on a case-by-case basis when developing new import conditions for specific commodities, or reviewing existing import conditions for commodities that are currently traded.

6.1 Measures for soft and hard scale quarantine pests

Measures to ensure consignment freedom from soft and hard scale quarantine pests

Measures are required if the indicative unrestricted risk estimate of 'Low' provided in this Group PRA is verified for a specific commodity pathway.

Measures are applied to ensure that the risk posed by soft and hard scale quarantine pests are reduced to achieve the ALOP for Australia. Potential measures, as appropriate to the specific import pathway, include:

- Pre-export visual inspection and if found, remedial action (e.g. suitable treatment) to manage the identified pest, or
- Systems approach, or
- Treatment, or
- Area freedom

The measures, and any alternatives proposed to department for consideration, should be consistent relevant ISPMs as outlined in Section 6.2.

Note that the measures are presented in a modified format compared to previous Group PRA reports for thrips and mealybugs. This modified presentation is intended to improve clarity. The measures themselves are not practically different between the three Group PRAs.

Importers and/or NPPOs, as appropriate, are responsible for ensuring imported goods are presented that meet Australia's import conditions by applying the appropriate mitigation measures.

Imported goods that are frequently found to be infested with soft and hard scale quarantine pests may be subject to mandatory, pre-export treatment approved by Australia. Methyl bromide fumigation is an effective treatment currently used for soft and hard scale quarantine pests. Both the rate and duration of fumigation with methyl bromide are pest and/or commodity specific.

Any treatment applied to imported food must also meet Australia's food safety requirements.

Pre-export phytosanitary inspection by the exporting country

Pre-export phytosanitary inspection is required to provide assurance that Australia's import conditions have been met and ALOP achieved.

Pre-export inspection is used to verify that consignments are free from visually detectable quarantine pests and to issue a phytosanitary certificate.

Where pre-export inspection is a required import condition, it must be undertaken by the NPPO or under its authority in accordance with ISPM 23: *Guidelines for inspection* (FAO 2016d) and consistent with the principles of ISPM 31: *Methodologies for sampling of consignments* (FAO 2016e). The requirements for phytosanitary certificate are set out in ISPM 12: *Phytosanitary certificates* (FAO 2017b) and ISPM 7: *Phytosanitary certification system* (FAO 2016a).

On-arrival verification

The majority of fresh fruit, vegetables, cut-flowers and foliage imported into Australia are visually inspected by the department on arrival. This inspection verifies that imported goods comply with Australia's import conditions.

Consistent with the principles of ISPM 31: *Methodologies for sampling of consignments* (FAO 2016e), Australia's standard biosecurity sampling protocol requires inspection of 600 units for quarantine pests from systematically selected random samples from each homogeneous consignment or lot. If no pests are detected by the inspection, this size sample achieves a confidence level of 95% that not more than 0.5% of the units in the consignment are infested or infected. The level of confidence depends on each unit in the consignment having similar likelihood of being affected by a quarantine or regulated pest and the inspection technique being able to reliably detect all these pests in the sample. If no live pests are detected in the sample, the consignment is considered to be free from quarantine and regulated pests.

Consignments that do not comply with Australia's import conditions may be subject to remedial treatment, where an appropriate treatment is available, or the imported consignment will be destroyed or exported, as appropriate.

The department reserves the right to suspend imports and conduct an audit of the risk management system if consignments are repeatedly non-compliant. Imports will recommence only when the department is satisfied that appropriate corrective action has been undertaken.

Additional operational procedures

Additional operational procedures may be required on a case-by-case basis for specific plant import pathways, such as:

- A system of traceability to source, where the objective is to ensure that export commodities are of commercial quality, that export sources can be identified, and prospective corrective action can be targeted if live pests are intercepted.
- Registration of packing house and treatment providers and auditing of procedures, where the objective is to ensure that export commodities are sourced only from packing houses and

treatment providers processing commercial quality export commodities approved by the NPPO, and that treatment providers competently manage target pests.

- Packaging and labelling, where the objective is to ensure that export packing houses and treatment providers (where applicable) ensure packaging is suitable to maintain the phytosanitary status of the export consignment, and labelling is sufficient for the purposes of trace-back.
- Specific conditions for storage and movement, where the objective is to ensure that export commodities that have been treated and/or inspected are kept secure and segregated at all times from other commodities for domestic or other markets, and from untreated/non pre-inspected product, to prevent mixing or cross-contamination.

6.2 Alternative options

Import conditions are developed and reviewed on a case-by-case basis for specific plant import pathways.

Australia recognises the principle of equivalence, namely, *'the situation where, for a specified pest risk, different phytosanitary measures achieve a contracting party's Appropriate Level of Protection'* (FAO 2019b). ISPM 24 (FAO 2017c) provides *Guidelines for the determination and recognition of equivalence of phytosanitary measures*. Where formal recognition of equivalence is required, the NPPO of the exporting country must provide a technical submission detailing relevant evidence for the proposed measures.

A number of ISPMs provide guidance on pest risk management. These may be used as appropriate to achieve the objective of freedom from soft and hard scale quarantine pests.

- ISPM 4: Requirements for the establishment of pest free areas (FAO 2017a)
- ISPM 10: Requirements for the establishment of pest free places of production and pest free production sites (FAO 2016b)
- ISPM 14: The use of integrated measures in a systems approach for pest risk management (FAO 2019d)
- ISPM 18: Guidelines for the use of irradiation as a phytosanitary measure (FAO 2019e)
- ISPM 22: Requirements for the establishment of areas of low pest prevalence (FAO 2016c).

6.3 Review of policy

The department reserves the right to review this Group PRA for soft and hard scale insects on the plant import pathway if there is reason to believe that the pest or phytosanitary status of these organisms has changed, or is likely to change. Similarly, a review may be required, for example, where scientific evidence or other information subsequently becomes available which improves knowledge of, or decreases uncertainty in treatment efficacy and/or the equivalence of particular measures.

6.4 Conclusion

The findings of this group pest risk analysis for soft and hard scale insects are based on a comprehensive scientific analysis of relevant literature, and other avenues of enquiry.

The department considers that the risk management measures proposed in this report will provide an appropriate level of protection against identified soft and hard scale quarantine pests.

7 Appendix A: Group Pest Risk Analysis method

This section sets out the method used for the Group pest risk analysis (Group PRA) in this report.

The International Plant Protection Convention (IPPC) defines PRA as ‘the process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it’ (FAO 2019b). A pest is ‘any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products’ (FAO 2019b).

International Standard for Phytosanitary Measures (ISPM) 2: Framework for pest risk analysis (FAO 2019a), states that ‘organisms may ... be analysed individually, or in groups where individual species share common characteristics’. This is the basis for the Group PRA in which organisms are grouped if they have shared common characteristics (with reference to their biosecurity significance), similar likelihoods of entry, establishment and spread and comparable consequences.

This Group PRA is not linked to any specific market access request. It is intended to be a ‘building block’ that can be used to review existing trade pathways or it can be applied to prospective ones for which a specific PRA is required, as appropriate.

When linked to a specific trade pathway using the rules set out in the report, it will be consistent with the principles of the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: Framework for Pest Risk Analysis (FAO 2019a) and ISPM 11: Pest Risk Analysis for Quarantine Pests (FAO 2019c) and the requirements of the SPS Agreement (WTO 1995).

A glossary of the key terms used in this Group PRA is provided at the back of this report.

This Group PRA was undertaken in three consecutive stages: initiation, pest risk assessment and pest risk management.

Stage 1: Initiation

This group pest risk analysis was initiated by the department.

Initiation identifies the pest(s) and pathway(s) that are of potential quarantine concern and should be considered for risk analysis in relation to the identified PRA area.

This Group PRA considered all members of the two insect families Coccidae and Diaspididae that are associated with fresh fruit, vegetables and cut-flowers or foliage imported into Australia as commercial consignments from any country. These are referred to as the plant import pathway in this report. Members of Coccidae are commonly referred to as soft scales or coccids, being used interchangeably in this report. Likewise, species of Diaspididae are referred to as hard scales, diaspidids or armoured scales, also being used interchangeably.

The Group PRA also considers plant viruses transmitted by soft and hard scales.

For this risk analysis the ‘PRA area’ is defined as Australia for pests that are absent, or of limited distribution and under official control. For areas with regional freedom from a pest, the ‘PRA

area' may be defined on the basis of a state or territory of Australia or may be defined as a region of Australia consisting of parts of a state or territory or several states or territories.

Stage 2: Pest risk assessment

A pest risk assessment (for quarantine pests) is the 'evaluation of the probability of the introduction and spread of a pest and of the magnitude of associated potential economic consequences' (FAO 2019b).

In this Group PRA, the pest risk assessment was undertaken in several interrelated phases.

Pest Categorisation

The pest categorisation process identifies pests with the potential to be on the plant import pathway that are quarantine pests for Australia and as a result require pest risk assessment. A quarantine pest is 'a pest of potential economic importance to the area endangered thereby and not yet present there, or present and not widely distributed and officially controlled' (FAO 2019b).

Pest categorisation in the Group PRA was undertaken for soft scales (Appendix B) and hard scales (Appendix C), respectively.

Factors considered in the pest categorisation were:

- identity of the pest
- presence or absence of the pest in the PRA area
- regulatory status of the pest in the PRA area
- potential for pest establishment and spread in the PRA area
- potential for the pest to cause economic consequences (including environmental consequences) in the PRA area.

The results of pest categorisation are given in Table 2.7 for soft scales, and Table 2.8 for hard scales. The quarantine soft and hard scale pests identified during categorisation were carried forward for pest risk assessment.

Assessment of the likelihood of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2019c). The SPS Agreement (WTO 1995) uses the term likelihood rather than probability for these estimates. In qualitative PRAs, the Department of Agriculture, Water and the Environment uses the term 'likelihood' for the descriptors it uses for its estimates of the likelihood of entry, establishment and spread. The use of the term 'probability' is limited to the direct quotation of ISPM definitions.

A summary of this process is given in this section, followed by a description of the qualitative methodology used in this pest risk analysis.

This Group PRA initially considered the likelihood of entry (importation x distribution) in the terms of likely commercial conditions and procedures based on extensive contemporary and historic analysis of the plant import pathway. For this reason, the likelihood of entry in this Group PRA is indicative only and potentially subject to revision when all trade related factors

are known. Accordingly, these factors must be verified, on a case-by-case basis, as part of a specific market access request.

Factors considered in assessing the ratings for likelihood of establishment and of spread and the estimate of consequences are in effect generally independent of plant import pathway, being post-border and based on pest biology, environmental conditions and other commercial practices within Australia. Consequently, these ratings can be applied to all plant import pathways.

The Department of Agriculture, Water and the Environment recognises there may be exceptional circumstances where the likelihood of establishment and of spread and the estimate of consequences differs significantly from the default analysis. If technically justified, a specific risk assessment would be undertaken where such exceptions exist. The proposed approach is to confirm the applicability of this Group PRA when it is applied to a specific trade pathway.

Likelihood of entry

The likelihood of entry describes the likelihood that a quarantine pest will enter Australia as a result of trade associated with the plant import pathway, be distributed in a viable state in the PRA area and be transferred to a susceptible host.

Entry is defined as the movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2019b).

For the purpose of considering the likelihood of entry, the Department of Agriculture, Water and the Environment divides this step into two components:

- likelihood of importation—the likelihood that a pest will arrive in Australia when a given plant import pathway commodity is imported.
- likelihood of distribution—the likelihood that the pest will be distributed, as a result of the processing, sale or disposal of a plant import pathway commodity, in the PRA area and subsequently transfer to a susceptible part of a host.

The overall likelihood of entry is determined by combining the likelihood of importation with that of likelihood of distribution.

Factors considered in the likelihood of importation include:

- distribution and incidence of the pest in the source area
- occurrence of the pest in a life-stage that could be associated with the commodity
- mode of trade (for example, bulk, packed)
- volume and frequency of movement of the commodity along each pathway
- seasonal timing of imports
- pest management, cultural and commercial procedures applied at the place of origin
- speed of transport and conditions of storage compared with the duration of the life cycle of the pest
- vulnerability of the life-stages of the pest during transport or storage

- incidence of the pest likely to be associated with a consignment
- commercial procedures applied to consignments during transport and storage in the country of origin, and during transport to Australia.

Factors considered in the likelihood of distribution include:

- commercial procedures applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host
- whether the imported commodity is to be sent to a few or many destination points in the PRA area
- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity
- risks from by-products and waste.

Likelihood of establishment

Establishment is defined as the ‘perpetuation for the foreseeable future, of a pest within an area after entry’ (FAO 2019b). In order to estimate the likelihood of establishment of a pest, reliable biological information (for example, lifecycle, host range, epidemiology and survival) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it occurs and expert judgement used to assess the likelihood of establishment.

Factors considered in the likelihood of establishment include:

- availability of hosts, alternative hosts and vectors
- suitability of the natural and/or managed environment
- reproductive strategy and potential for adaptation
- minimum population needed for establishment
- cultural practices and control measures.

Likelihood of spread

Spread is defined as ‘the expansion of the geographical distribution of a pest within an area’ (FAO 2019b). The likelihood of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas. In order to estimate the likelihood of spread of the pest, reliable biological information is obtained from areas where the pest currently occurs. The situation in the PRA area is then compared with that in the areas where the pest currently occurs and expert judgement used to assess the likelihood of spread in the PRA area.

Factors considered in the likelihood of spread include:

- suitability of the natural and/or managed environment
- presence of natural barriers

- potential for movement with commodities, conveyances or by vectors
- intended end-use of the commodity
- potential vectors of the pest in the PRA area
- potential natural enemies of the pest in the PRA area.

Assigning likelihoods for entry, establishment and spread

Likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: High; Moderate; Low; Very low; Extremely low; and Negligible (Table 7.1). Descriptive definitions for these descriptors and their indicative ranges are given in Table 7.1. The indicative ranges are only provided to illustrate the boundaries of the descriptors and are not used beyond this purpose in qualitative PRAs. These indicative ranges provide guidance to the risk analyst and promote consistency between different pest risk assessments.

Table 7.1 Nomenclature for likelihoods

Likelihood	Descriptive definition	Indicative range
High	The event would be very likely to occur	0.7 < to ≤ 1
Moderate	The event would occur with an even likelihood	0.3 < to ≤ 0.7
Low	The event would be unlikely to occur	0.05 < to ≤ 0.3
Very low	The event would be very unlikely to occur	0.001 < to ≤ 0.05
Extremely low	The event would be extremely unlikely to occur	0.000001 < to ≤ 0.001
Negligible	The event would almost certainly not occur	0 < to ≤ 0.000001

Combining likelihoods

The likelihood of entry is determined by combining the likelihood that the pest will be imported into the PRA area and the likelihood that the pest will be distributed within the PRA area, using a matrix of rules (Table 7.2). This matrix is then used to combine the likelihood of entry and the likelihood of establishment, and the likelihood of entry and establishment is then combined with the likelihood of spread to determine the overall likelihood of entry, establishment and spread.

For example, if the likelihood of importation is assigned a descriptor of 'Low' and the likelihood of distribution is assigned a descriptor of 'Moderate', then they are combined to give a likelihood of 'Low' for entry. The likelihood for entry is then combined with the likelihood assigned for establishment of 'High' to give likelihood for entry and establishment of 'Low'. The likelihood for entry and establishment is then combined with the likelihood assigned for spread of 'Very low' to give the overall likelihood for entry, establishment and spread of 'Very low'. This can be summarised as:

$$\begin{aligned} \text{Importation x distribution} &= \text{entry [E]} & \text{Low x Moderate} &= \text{Low} \\ \text{[E] x establishment} &= \text{[EE]} & \text{Low x High} &= \text{Low} \\ \text{[EE] x spread} &= \text{[EES]} & \text{Low x Very low} &= \text{Very low} \end{aligned}$$

Table 7.2 Matrix of rules for combining likelihoods

	High	Moderate	Low	Very low	Extremely low	Negligible
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate		Low	Low	Very low	Extremely low	Negligible
Low			Very low	Very low	Extremely low	Negligible
Very low				Extremely low	Extremely low	Negligible
Extremely low					Negligible	Negligible
Negligible						Negligible

Time and volume of trade

One factor affecting the likelihood of entry is the volume and duration of trade. If all other conditions remain the same, the overall likelihood of entry will increase as time passes and the overall volume of trade increases.

The department normally considers the likelihood of entry on the basis of the estimated volume of one year's trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only one year's volume of trade is being considered. This difference reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

The use of a one year volume of trade has been taken into account when setting up the matrix that is used to estimate the risk and therefore any policy based on this analysis does not simply apply to one year of trade. Policy decisions that are based on the Department of Agriculture, Water and the Environment method that uses the estimated volume of one year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing quarantine protection. Of course if there are substantial changes in the volume and nature of the trade in specific commodities then the Department of Agriculture, Water and the Environment has an obligation to review the risk analysis and, if necessary, provide updated policy advice.

In assessing the volume of trade in this risk analysis the department assumed that a substantial volume of trade will occur.

Assessment of potential consequences

The objective of the consequences assessment is to provide a structured and transparent analysis of the potential consequences if the pests were to enter, establish and spread in Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2019b) and ISPM 11 (FAO 2019c).

Direct pest effects are considered in the context of the effects on:

- plant life or health

- other aspects of the environment

Indirect pest effects are considered in the context of the effects on:

- eradication, control
- international trade
- domestic trade
- environment

For each of these six criteria, the consequences were estimated over four geographic levels, defined as:

Local: an aggregate of households or enterprises (a rural community, a town or a local government area).

District: a geographically or geopolitically associated collection of aggregates (generally a recognised section of a state or territory, such as 'Far North Queensland').

Regional: a geographically or geopolitically associated collection of districts in a geographic area (generally a state or territory, although there may be exceptions with larger states such as Western Australia).

National: Australia wide (Australian mainland states and territories and Tasmania).

For each criterion, the magnitude of the potential consequences at each of these levels was described using four categories, defined as:

Indiscernible: pest impact unlikely to be noticeable.

Minor significance: expected to lead to a minor increase in mortality/morbidity of hosts or a minor decrease in production but not expected to threaten the economic viability of production. Expected to decrease the value of non-commercial criteria but not threaten the criterion's intrinsic value. Effects would generally be reversible.

Significant: expected to threaten the economic viability of production through a moderate increase in mortality/morbidity of hosts, or a moderate decrease in production. Expected to significantly diminish or threaten the intrinsic value of non-commercial criteria. Effects may not be reversible.

Major significance: expected to threaten the economic viability through a large increase in mortality/morbidity of hosts, or a large decrease in production. Expected to severely or irreversibly damage the intrinsic 'value' of non-commercial criteria.

The estimates of the magnitude of the potential consequences over the four geographic levels were translated into a qualitative impact score (A–G) using Table 7.3.

Table 7.3 Decision rules for determining consequences impact score

Description of magnitude	Impact scores for geographic scales			
	Local level	District level	Regional level	National level
Indiscernible	A	A	A	A
Minor significance	B	C	D	E
Significant	C	D	E	F
Major significance	D	E	F	G

Note: In earlier qualitative PRAs, the scale for the impact scores went from A to F and did not explicitly allow for the rating 'indiscernible' at all four levels. This combination might be applicable for some criteria. In this report, the impact scale of A to F has been changed to become B to G and a new lowest category A ('indiscernible' at all four levels) was added. The rules for combining impacts in Table 7.4 were adjusted accordingly.

Table 7.4 Decision rules for determining the overall consequences rating for each pest

Rule	The impact scores for consequences of direct and indirect criteria	Overall consequences rating
1	Any criterion has an impact of 'G'; or more than one criterion has an impact of 'F'; or a single criterion has an impact of 'F' and each remaining criterion an 'E'.	Extreme
2	A single criterion has an impact of 'F'; or all criteria have an impact of 'E'.	High
3	One or more criteria have an impact of 'E'; or all criteria have an impact of 'D'.	Moderate
4	One or more criteria have an impact of 'D'; or all criteria have an impact of 'C'.	Low
5	One or more criteria have an impact of 'C'; or all criteria have an impact of 'B'.	Very Low
6	One or more but not all criteria have an impact of 'B', and all remaining criteria have an impact of 'A'.	Negligible

The overall consequences for each pest is achieved by combining the qualitative impact scores (A–G) for each direct and indirect consequences using a series of decision rules (Table 7.4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

Estimation of the unrestricted risk

Once the assessments of the likelihood of entry, establishment and spread and potential consequences are completed, the unrestricted risk can be determined for each group of pests. This is determined by using a risk estimation matrix (Table 7.5) to combine the estimates of the likelihood of entry, establishment and spread and the overall consequences of pest establishment and spread. Therefore, risk is the product of likelihood and consequences.

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (for example, Low, Moderate, High) but the vertical axis refers to likelihood and the horizontal axis refers to consequences. Accordingly, a 'Low' likelihood combined with 'High' consequences, is not the same as a 'High' likelihood combined with 'Low' consequences—the matrix is not symmetrical. For example, the former combination would give an unrestricted risk rating of 'Moderate', whereas, the latter would be rated as a 'Low' unrestricted risk.

Table 7.5 Risk estimation matrix

Likelihood of pest entry, establishment and spread	Consequences of pest entry, establishment and spread					
	Negligible	Very low	Low	Moderate	High	Extreme
High	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Moderate	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Low	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk	High risk
Very low	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk
Extremely low	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk
Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk

Appropriate level of protection (ALOP) for Australia

The SPS Agreement defines the concept of an ‘appropriate level of sanitary or phytosanitary protection (ALOP)’ as the level of protection deemed appropriate by the WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Like many other countries, Australia expresses its ALOP in qualitative terms. The ALOP for Australia reflects community expectations through government policy, and is currently expressed as providing a high level of sanitary or phytosanitary protection aimed at reducing risk to a Very low level, but not to zero. The band of cells in Table 7.5 marked ‘Very low risk’ represents the ALOP for Australia.

Stage 3: Pest risk management

Pest risk management describes the process of identifying and implementing phytosanitary measures to manage risks to achieve the ALOP for Australia, while ensuring that any negative effects on trade are minimised.

The conclusions from pest risk assessments are used to decide whether risk management is required and if so, the appropriate measures to be used. Where the unrestricted risk estimate does not achieve the ALOP for Australia, risk management measures are required to reduce this risk to a Very low level. The guiding principle for risk management is to manage risk to achieve Australia’s ALOP. The effectiveness of any proposed phytosanitary measure (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure the restricted risk achieves the ALOP for Australia.

ISPM 11 (FAO 2019c) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the likelihood of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

- options for consignments, include inspection or testing for freedom from pests, prohibition of parts of the host, a pre-entry or post-entry quarantine system, specified conditions on preparation of the consignment, specified treatment of the consignment, restrictions on end-use, distribution and periods of entry of the commodity
- options preventing or reducing infestation in the crop, including treatment of the crop, restriction on the composition of a consignment so it is composed of plants belonging to resistant or less susceptible species, harvesting of plants at a certain age or specified time of the year, production in a certification scheme
- options ensuring that the area, place or site of production or crop is free from the pest, including pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways, including consider natural spread, measures for human travellers and their baggage, cleaning or disinfestation of contaminated machinery
- options within the importing country, including surveillance and eradication programs
- prohibition of commodities, if no satisfactory measure can be found

Risk management measures are identified for each quarantine pest where the unrestricted risk estimate does not achieve the ALOP for Australia. These are presented in the 'Pest Risk Management' section of this report.

8 Appendix B: Pest categorisation of Coccidae (soft scales)

Pest categorisation was undertaken in each column as described:

Column 1 indicates the identity of the pest. The most recent valid scientific name is used, and some junior synonyms are also indicated when information related to the synonym is commonly found in the literature.

Column 2 gives the reason(s) why the species is included within the categorisation table, based on the selection criteria set out in Table 2.1.

Column 3 provides a global distribution for the species, mainly based on the ScaleNet database (García Morales et al. 2019).

Column 4 assesses species absence or presence and its regulatory status within the PRA area. Absence or presence status is mostly based on the ScaleNet database (García Morales et al. 2019). Regulatory status in Australia was based on publicly available information from plant quarantine legislations and manuals by the states and territories.

Column 5 includes host plants, plant parts affected and/or previous pathway assessment(s). Information for host plants includes the number of genera and families and is mainly based on García Morales et al. (2019). The terms monophagous, oligophagous, polyphagous and highly polyphagous are used to describe the scale species. Monophagous is defined as feeding on one genus, oligophagous on two to 10 genera, polyphagous on 11 or more genera and highly polyphagous on 50 or more families of host plants. Plant parts affected by the pest are included, when information is available. Species assessed as on specific commodity pathway in previous PRAs are indicated. Species identified by Australian industries as a high priority pest in relevant industry biosecurity plans are also indicated in this column.

Column 6 summarises interception events from Australia and other countries, when information is available.

Column 7 identifies species requiring further assessment as a quarantine pest or virus vector. If the pest is not present in Australia or present but under official control, or is a vector of viruses, it is considered further.

Table 8.1 Pest categorisation of Coccidae (soft scales)

Abbreviation of Australian states or territories: ACT–Australian Capital Territory, NSW–New South Wales, NT–Northern Territory, Qld–Queensland, SA–South Australia, Tas–Tasmania, Vic–Victoria and WA–Western Australia

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Alecanium hirsutum</i> Morrison	4	Malaysia and Singapore	No record found (García Morales et al. 2019)	Oligophagous, on six genera in six families of host plants, including cocoa tree, sugar apple and water cherry (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Alecanochiton arborescens</i> (Laing)	4	Nine countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Coffea</i> , <i>Tabernaemontana</i> and <i>umubungo</i> (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Alecanochiton marquesi</i> Hempel	4	Brazil, and French Guiana	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in five families of host plants, including coffee and <i>Gossypium</i> (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Anapulvinaria pistaciae</i> (Bodenheimer)	4	16 countries in Central Asia, Europe, the Middle East and Turkey	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including common walnut, <i>Pistacia vera</i> and <i>Tamarix</i> (García Morales et al. 2019)	—	Yes	No
<i>Anopulvinaria cephalocarinata</i> Fonseca	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Annona</i> of family Annonaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Anthococcus keravatae</i> Williams & Watson	4	Papua New Guinea	No record found (García Morales et al. 2019)	Oligophagous, on six genera in six families of host plants, including <i>Citrus</i> , cocoa tree, jackfruit, soursop and water cherry (Campbell 1997; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes actiniformis</i> Green	5	Nine countries in Asia, Africa, South America	No record found (García Morales et al. 2019)	Polyphagous, on 17 genera in 13 families of host plants, including <i>Annona</i> , citrus, coconut, and grape vine, guava, mango and sugarcane (Carnegie 1997; Chua 1997a; García Morales et	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019) and the Middle East	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastes ajmerensis</i> (Avasthi & Shafee)	4	India	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including citrus, guava and golden rain tree (<i>Cassia fistula</i>) (García Morales et al. 2019)	—	Yes	No
<i>Ceroplastes bergi</i> Cockerell	4	Argentina	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including bitter orange (García Morales et al. 2019; Gill 1997a)	—	Yes	No
<i>Ceroplastes brevicauda</i> Hall	4	23 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 31 genera in 18 families of host plants, including African oil palm, bitter orange, <i>Coffea</i> and pigeon pea (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Ceroplastes campinensis</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on <i>Psidium guajava</i> of family Myrtaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Ceroplastes ceriferus</i> (Fabricius)	1, 4, 5	44 countries in Africa, Oceania, the Americas, Asia and Europe	Yes, NSW, Qld, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018)	Further assessment is not required	—	No	No
<i>Ceroplastes cirripediformis</i> (Comstock)	1, 4	28 countries in the Americas Europe, South-East Asia and the Caribbean	No record found (García Morales et al. 2019)	Highly polyphagous, on 118 genera in 62 families of host plants including, <i>Annona</i> , avocado, banana, <i>Citrus</i> , <i>Solanum</i> , <i>Chrysanthemum</i> , <i>Diospyros</i> , <i>Ilex</i> , mango, pomegranate, grapevine and passionfruit (García Morales et al. 2019; Gill 1997a; Kosztarab 1997c; Swirski, Ben-Dov & Wysoki 1997b, d; Swirski, Wysoki & Ben-Dov 1997)	Intercepted 26 times (1995-2012) in the United States on a variety of host plants from China, Colombia, Hawaii, Jamaica, Mexico, Montserrat, Nicaragua, Puerto Rico and Tonga (Miller et al. 2014a) Additional interceptions in the USA on; <i>Citrus</i> , <i>Codiaeum</i> , <i>Duranta</i> , <i>Hibiscus</i> spp., <i>Pittosporum</i> spp. and	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastes cistudiformis</i> (Cockerell)	4	Six countries in Europe, Central America, North America and the Caribbean	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in 13 families of host plants, including avocado, <i>Chrysanthemum</i> and <i>Passiflora</i> (García Morales et al. 2019; Swirski, Wysoki & Ben-Dov 1997)	<i>Russelia</i> from Bermuda, <i>Brassia</i> , <i>Citrus</i> , <i>Chrysanthemum</i> , <i>Musa</i> , <i>Persea</i> , <i>Psidium</i> spp. and <i>Rosa</i> spp. from Mexico, and on <i>Ardisia</i> , <i>Calocarpum</i> , <i>Codiaeum</i> and <i>Vanda</i> from The Philippines (Miller et al. 2014a)	Yes	No
<i>Ceroplastes deodorensis</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including custard apple and weeping fig (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes depressus</i> Cockerell	4	Cuba and Jamaica	No record found (García Morales et al. 2019)	Monophagous, on <i>Bursera simaruba</i> (turpentine tree) of family Burseraceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Ceroplastes destructor</i> Newstead	4, 5	18 countries in Africa, Oceania and South Asia	Yes, Qld, NSW, WA, Vic, ACT (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastes diospyros</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including Japanese persimmon, pink peppercorn and pomegranate (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997d)	—	Yes	No
<i>Ceroplastes dugesii</i> Lichtenstein	4	Nine countries in the Americas and the Caribbean	No record found (García Morales et al. 2019)	Polyphagous, on 15 genera in 13 families of host plants, including <i>Annona</i> , <i>Ficus</i> , oleander and pink peppercorn (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes eugeniae</i> Hall	4	Comoros, Mozambique, Zimbabwe and Algeria	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in seven families of host plants, including guava, European crab apple, quince and soursop (García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Ceroplastes ficus</i> Newstead	4	Eight countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on 10 genera in eight families of host plants, including <i>Annona</i> , <i>Ficus</i> and poinsettia (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes floridensis</i> Comstock	1, 4, 5, 6	71 countries in Africa, Europe, the Americas, East Asia, the Caribbean, and the Middle East	Yes, NSW, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 152 genera in 67 families of host plants including <i>Anacardium occidentale</i> , <i>Actinidia deliciosa</i> , <i>Annona</i> , <i>Annona muricata</i> , <i>Artocarpus altilis</i> , <i>Artocarpus heterophyllus</i> , Barbados cherry, <i>Camellia sinensis</i> , <i>Citrus</i> , <i>Coffea arabica</i> , <i>Diospyros discolor</i> , <i>Diospyros</i> , <i>Malus</i> , <i>Ficus</i> , <i>Mangifera indica</i> , <i>Musa</i> , pear, quince, <i>Persea americana</i> , <i>Persea borbonia</i> , <i>Persica vulgaris</i> , <i>Prunus armeniaca</i> , <i>Prunus salicina</i> , <i>Psidium cattleianum</i> , <i>Psidium guajava</i> , <i>Psidium littorale</i> and <i>Theobroma cacao</i> (García Morales et al. 2019; Greathead 1997b; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d, c; Swirski, Wysoki & Ben-Dov 1997)	Intercepted 108 times (1995-2012) in the USA on a variety of host plants from the Bahamas, China, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, France, Greece, Guatemala, Haiti, Honduras, India, Israel, Italy, Jamaica, Jordan, Lebanon, Mexico, The Philippines, Portugal, Puerto Rico, Thailand, Tunisia, Turkey, The U.S. Virgin Islands, and Vietnam (Miller et al. 2014a) Additional interceptions in the USA on <i>Anthurium</i> , <i>Citrus</i> , <i>Dieffenbachia</i> , <i>Diospyros</i> , <i>Gardenia</i> and <i>Ixora</i> , <i>Mangifera</i> , <i>Myrtus</i> ,	Yes (WA)	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
				On leaves, stems, twigs, branches (Kosztarab 1997b, c)	<i>Nymphaea</i> , <i>Psidium</i> , <i>Rhizophora</i> and <i>Tabebuia</i> from the Caribbean; on <i>Aralia</i> , <i>Chamaedorea</i> , fern, <i>Ficus</i> , <i>Gardenia</i> , <i>Mangifera</i> , <i>Schefflera</i> , <i>Terminalia</i> , <i>Yucca</i> and <i>Zingiber</i> from Central America; on <i>Citrus</i> , <i>Ixora</i> and <i>Laurus</i> from South America; on <i>Citrus</i> , <i>Euonymus</i> , <i>Hedera</i> and <i>Laurus</i> from Europe; on <i>Eugenia</i> from India; on <i>Banksia</i> , <i>Citrus</i> , <i>Euonymus</i> , <i>Monstera</i> and <i>Myrtus</i> from Israel; on <i>Citrus</i> from South Africa; and on <i>Chrysophyllum</i> from The Philippines (Miller et al. 2014a)		
<i>Ceroplastes flosculoides</i> Matile-Ferrero	4	Brazil and Peru	No record found (García Morales et al. 2019)	Oligophagous, on two genera of host plants including guava, in family Myrtaceae (García Morales et al. 2019)	—	Yes	No
<i>Ceroplastes galeatus</i> Newstead	4	Uganda	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Coffea</i> of family Rubiaceae (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Ceroplastes grandis</i> Hempel	4	Argentina and Brazil	No record found (García Morales et al. 2019)	Polyphagous, on 26 genera in 16 families of host plants, including <i>Citrus</i> , guava, pear, <i>Diospyros</i> , <i>Eucalyptus</i> and pomegranate (García Morales et al. 2019; Gill 1997a; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d)	—	Yes	No
<i>Ceroplastes janeirensis</i> (Gray)	4	Argentina, Brazil and Colombia	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in nine families of host plants, including guava, pomegranate and Surinam cherry (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Ceroplastes japonicus</i> Green	1, 4, 5	16 countries in Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 42 genera in 29 families of host plants, including <i>Actinidia chinensis</i> , <i>Annona</i> , apple, cherry laurel, Chinese pear, guava, <i>Diospyros</i> , holly leaved barberry, Japanese apricot, lemon, loquat, southern magnolia,	Intercepted 29 times (1995-2012) in the United States on a variety of host plants from Armenia, France, Georgia, Germany, Greece, Italy, Russia, South Korea, Thailand,	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
				nectarine, peach, tea and yoshino cherry (García Morales et al. 2019; Greathead 1997b; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997d, c)	Turkey and Yugoslavia (Miller et al. 2014a) Additional interceptions in the United States on <i>Paeonia</i> from China; on <i>Diospyros</i> and <i>Laurus</i> from Europe; and on <i>Aralia</i> , <i>Aspidistra</i> , <i>Azalea</i> , <i>Buxus</i> , <i>Camellia</i> , <i>Cercidophyllum</i> , <i>Chaenomeles</i> , <i>Citrus</i> , <i>Cotoneaster</i> , <i>Diospyros</i> , <i>Euonymus</i> , <i>Eurya</i> , <i>Fatsia</i> , <i>Ilex</i> , <i>Ophiopogon</i> , <i>Paeonia</i> , <i>Pittosporum</i> , <i>Prunus</i> , <i>Punica</i> , <i>Pyrus</i> , <i>Rhododendron</i> , <i>Tamarix</i> and <i>Taxus</i> from Japan (Miller et al. 2014a)		
<i>Ceroplastes lamborni</i> Newstead	4	Seven countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including cocoa tree and soursop (Campbell 1997; García Morales et al. 2019)	—	Yes	No
<i>Ceroplastes macgregori</i> Sampedro & Butze	4	Mexico	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including lemon and hog plum (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes magnificus</i> (Green)	4	Indonesia	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including kuwini, malay apple and water cherry (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes martinae</i> Mosquera	4	Colombia	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Ceroplastes murrayi</i> Froggatt	4	Papua New Guinea, Hong Kong and mainland China	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Mangifera</i> of family Anacardiaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastes nakaharai</i> Gimpel	4	USA and Cuba	No record found (García Morales et al. 2019)	Oligophagous, on five genera in five families of host plants, including American mistletoe, gateado, <i>Uromyrtus neomyrtoides</i> and yayah hutan (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes personatus</i> Newstead	4	22 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in 9 families of host plants, including bitter orange, <i>Coffea</i> , mango, <i>Syzygium</i> and <i>Uapaca kirkiana</i> (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Ceroplastes pseudoceriferus</i> Green	4, 5, 6	Eight countries in Asia, and Oceania	No record found (García Morales et al. 2019)	Polyphagous, on 95 genera in 49 families of host plants, including avocado, <i>Citrus</i> , guava, Ilex, jackfruit, Japanese persimmon, mango, peach, potato and tea (García Morales et al. 2019; Greathead 1997b; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d; Swirski, Wysoki & Ben-Dov 1997)	—	Yes	No
<i>Ceroplastes quadrilineatus</i> Newstead	4	Côte d'Ivoire, Uganda and Zimbabwe	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in seven families of host plants, including cocoa tree, <i>Ficus</i> , nectarine, peach, <i>Salvia</i> and soursop (Campbell 1997; García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes rubens</i> Maskell	1, 4, 5	46 countries in Africa, Oceania, Europe, Asia, the USA, Caribbeans, South America and the Middle East	Yes, Qld, NSW, NT, WA ACT, Qld, Vic (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastes rusci</i> (Linnaeus)	1, 2, 4, 5	57 countries in Africa, Asia, Europe, the Americas, Caribbean, and the Middle East	Yes, NT (ABRS 2018; Plant Health Australia 2018) and WA (Government of Western Australia 2018)	Polyphagous, on 74 genera in 46 families of host plants, including <i>Actinidia deliciosa</i> , <i>Annona</i> , avocado pear, <i>Citrus</i> , <i>Cocos nucifera</i> , <i>Diospyros</i> , <i>Ficus</i> , <i>Litchi chinensis</i> , <i>Mangifera indica</i> , <i>Persea americana</i> , <i>Piper nigrum</i> , <i>Prunus dulcis</i> , <i>Psidium cattleianum</i> , <i>Psidium guajava</i> , <i>Pyrus communis</i> and <i>Vitis vinifera</i> (Chua 1997a; García Morales et al. 2019; Gill 1997a; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d, c; Swirski, Wysoki & Ben-Dov 1997)	Intercepted in Australia on fresh fruit and nursery stock Intercepted 67 times (1995-2012) in the USA on a variety of host plants from Anguilla, Barbados, Costa Rica, Dominican Republic, Ecuador, Germany, Greece, Hawaii, Israel, Italy, Jamaica, Jordan, Lebanon, The Netherlands, Peru, Portugal, Puerto Rico, South Africa, Syrian Arab Republic, and Vietnam (Miller et al. 2014a) Additional interceptions in the USA on <i>Asplundia</i> and <i>Ficus</i> from Africa; on Cocos, Ficus, Phoenix, and <i>Terminalia</i> from the Caribbeans; on <i>Pistacia</i> , <i>Ficus</i> , and <i>Terminalia Strelitzia</i> , <i>Myrtus</i> , <i>Nerium</i> and <i>Vitis</i> from Europe; and on <i>Cyperus</i> , <i>Ficus</i> , and <i>Myrtus</i> from the Middle East (Miller et al. 2014a) Intercepted once (2007-2011) in South Korea on an unidentified host from Israel (Suh, Yu & Hong 2013)	No	Yes (Mahfoudhi, Digiario & Dhouibi 2009)
<i>Ceroplastes sinensis</i> Del Guercio	1, 4, 5	37 countries in Africa, Europe, the Americas, Oceania, Asia and the Middle East	Yes, ACT, NSW, Qld, WA, NT, Norfolk Island (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastes singularis</i> Newstead	4	Angola, Democratic Republic of the Congo and Uganda	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including African oil palm and guava (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Ceroplastes stellifer</i> (Westwood) [Syn: <i>Vinsonia stellifera</i> (Westwood)]	1, 4, 5	54 countries in Africa, the Americas, Caribbean, Europe, Asia, and Oceania	Yes, NT (García Morales et al. 2019) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, found on 41 genera in 22 families of host plants including <i>Anacardium occidentale</i> , <i>Annona</i> , <i>Artocarpus integer</i> , <i>Chrysalidocarpus</i> , <i>Citrus aurantium</i> , <i>Cocos nucifera</i> , <i>Coffea</i> , <i>Diospyros discolor</i> , <i>Ficus</i> , <i>Garcinia mangostana</i> , <i>Garcinia tinctoria</i> , <i>Mangifera indica</i> , <i>Manilkara zapota</i> , <i>Persea americana</i> , <i>Psidium guajava</i> , <i>Syzygium aqueum</i> , <i>Syzygium cumini</i> , <i>Syzygium jambos</i> , <i>Syzygium malaccensis</i> (García Morales et al. 2019; Murphy 1997; Suh, Yu & Hong 2013; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d, c) Normally on leaves and fleshy stems (Kosztarab 1997b, c)	Intercepted 1803 times (1995-2012) in the USA on a variety of host plants from a number of countries (Miller et al. 2014a) Additional interceptions in the USA on <i>Anthurium</i> , <i>Begonia</i> , <i>Bifrenaria</i> , <i>Brassia</i> , <i>Broughtonia</i> , <i>Cattleya</i> , <i>Citrus</i> , <i>Epidendrum</i> , <i>Eugenia</i> , <i>Garcinia</i> , <i>Gardenia</i> , <i>Gongora</i> , <i>Laurus</i> , <i>Lycaste</i> , <i>Mangifera</i> , <i>Musa</i> , <i>Neobenthamia</i> , <i>Oncidium</i> , <i>Peperomia</i> , <i>Phalaenopsis</i> , <i>Pimenta</i> , <i>Psidium</i> and <i>Stanhopea</i> from Caribbeans, on <i>Asplenium</i> , <i>Chamaedorea</i> , <i>Cinnamomum</i> , <i>Epidendrum</i> , <i>Laelia</i> , <i>Lindleyella</i> , <i>Lycaste</i> , <i>Oncidium</i> , <i>orchid</i> , <i>palm</i> , <i>Peristeria</i> , <i>Schinus</i> , <i>Stanhope</i> , <i>Trigonidium</i> and <i>Zingiber</i> from Central America; on Bromeliads, <i>Cattleya</i> , <i>Cycnoches</i> , <i>Epidendrum</i> , <i>Garcinia</i> , <i>Gardenia</i> , <i>Heliconia</i> , orchid and <i>Stanhopea</i> from South America; on <i>Ixora</i> from Indonesia, on <i>Paphiopedilum</i> from Malaysia; on <i>Garcinia</i> from Singapore; on <i>Vanda</i> from Sri Lanka; on <i>Cypripedium</i> , <i>Garcinia</i> and <i>Schefflera</i> from Thailand; and on	Yes (WA)	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastes theobromae</i> Newstead	4	Cameroon, Democratic Republic of the Congo, Côte d'Ivoire and Uganda	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including cocoa tree, <i>Ficus</i> and soursop (Campbell 1997; García Morales et al. 2019)	— Alyxia from Tonga (Miller et al. 2014a) Intercepted once (2007-2011) in South Korea on <i>Chrysalidocarpus</i> spp. from Malaysia (Suh, Yu & Hong 2013)	Yes	No
<i>Ceroplastes toddaliae</i> Hall	4	Eight countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 21 genera in 17 families of host plants, including <i>Annona</i> , <i>Citrus</i> , cocoa tree and <i>Ficus</i> (Campbell 1997; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes trochezi</i> Mosquera	4	Colombia	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Ceroplastes utilis</i> Cockerell	4	Cuba, Haiti, Peru, Turks and Caicos Islands, USA	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including <i>Avicennia marina</i> , box-leaved maytenus and <i>Uromyrtus neomyrtoides</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastes vinsonioides</i> Newstead	4	Nine countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Citrus</i> , <i>Coffea</i> and guava (García Morales et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Ceroplastodes bahiensis</i> Bondar	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on cocoa tree (<i>Theobroma cacao</i>) of family Malvaceae (Campbell 1997; García Morales et al. 2019)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ceroplastodes ritchiei</i> Laing	4	Côte d'Ivoire, Sierra Leone and Tanzania	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Annona</i> of family Annonaceae including soursop (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Ceroplastodes zavattarii</i> Bellio	4	Seven countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on five genera in three families of host plants, including <i>Bambusa</i> and pigeon pea (Carnegie 1997; García Morales et al. 2019)	—	Yes	No
<i>Coccus africanus</i> (Newstead)	4	Angola, Eritrea, Kenya and Nigeria, Uganda	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including coffee, common guava and lemon (García Morales et al. 2019; Greathead 1997b; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Coccus almoraensis</i> Avasthi & Shafee	5	India	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) in family Anacardiaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Coccus alpinus</i> De Lotto	4	11 countries in Africa and South America	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including coffee, common guava, lemon and tea (García Morales et al. 2019; Greathead 1997b; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Coccus brasiliensis</i> Fonseca	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Coffea</i> of family Rubiaceae, including <i>Coffea arabica</i> (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Coccus capparidis</i> (Green)	1, 4, 5	14 countries in Asia, Central America, USA, Oceania, the Caribbean and the Middle East	No record found (García Morales et al. 2019)	Polyphagous, on 32 genera in 21 families of host plants, including bitter orange, breadfruit, <i>Citrus</i> , persimmon, <i>Lantana camara</i> and plantain (García Morales et al. 2019; Gill 1997a; Swirski, Ben-Dov & Wysoki 1997c) Assessed as on pathway for island cabbage from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu (DAFF 2013b)	Intercepted 10 times (1995-2012) in the USA on a variety of host plants from Dominican Republic, Haiti, India, Jamaica, Mexico, Puerto Rico, and St. Lucia (Miller et al. 2014a) Additional interceptions in the USA on <i>Citrus</i> , <i>Codiaeum</i> , <i>Passiflora</i> and <i>Schefflera</i> from the Caribbean; on <i>Codiaeum</i> and <i>Graptophyllum</i> from Hawaii; on <i>Codiaeum</i> from	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Coccus celatus</i> De Lotto	4	16 countries in Africa, Oceania, South America and South-East Asia	No record found (García Morales et al. 2019)	Polyphagous, on 17 genera in 10 families of host plants, including <i>Coffea</i> , guava, java apple and soursop (García Morales et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c)	Honduras; on <i>Citrus</i> from Hong Kong; on <i>Codiaeum</i> , <i>Cypripedium</i> and <i>Dendrobium</i> from India; and on <i>Murraya</i> from Sri Lanka (Miller et al. 2014a)	Yes	No
<i>Coccus colemani</i> Kannan	4, 5	India	No record found (García Morales et al. 2019)	Oligophagous, on 10 genera in seven families of host plants, including <i>Citrus</i> , guava, coffee, <i>Ficus</i> , jackfruit and mango (García Morales et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Coccus discrepans</i> (Green)	4, 5	Seven countries in Asia	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in nine families of host plants, including <i>Citrus</i> , coconut, jujube, mango, plantain and tea (Chua 1997a; García Morales et al. 2019; Gill 1997a; Greathead 1997b; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Coccus elatensis</i> Ben-Dov	4	Israel	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Coccus formicarii</i> (Green)	1, 4, 5	Eight countries in Asia and Madagascar	No record found (García Morales et al. 2019)	Polyphagous, on 44 genera in 30 families of host plants, including avocado, camphor laurel, guava, <i>Durio</i> , <i>Garcinia</i> , jackfruit, Japanese persimmon, <i>Lagerstroemia</i> , langsat, mango, olive, <i>Prunus</i> , tea and velvet apple (Evans & Dooley 2013; García Morales et al. 2019; Greathead 1997b; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a;	Intercepted 13 times (1995-2012) in the USA on a variety of host plants from Cambodia, India, Malaysia, Thailand and Vietnam (Miller et al. 2014a)	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Coccus guerinii</i> (Signoret)	4	Mauritius	No record found (García Morales et al. 2019)	Swirski, Ben-Dov & Wysoki 1997d, c; Swirski, Wysoki & Ben-Dov 1997) Monophagous, on sugarcane (<i>Saccharum officinarum</i>) of family Poaceae (Carnegie 1997; García Morales et al. 2019)	—	Yes	No
<i>Coccus hesperidum</i> Linnaeus	1, 4, 5	141 countries in Africa, the Americas, Asia, Europe, Oceania, the Caribbean, and the Middle East	Yes, Vic, NT, NSW, WA, SA, ACT, Qld (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No
<i>Coccus kosztarabi</i> Avasthi & Shafee	4, 5	India	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Coccus latioperculatum</i> (Green)	4, 5	India, Sri Lanka and Laos	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Anacardiaceae, including cashew and mango (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b, c)	—	Yes	No
<i>Coccus longulus</i> (Douglas)	1, 2, 4, 5	69 countries in Africa, the Americas, Europe, Asia, Oceania, the Caribbean and the Middle East	Yes, Qld, NT, NSW, WA, SA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018)	Highly polyphagous, on 139 genera in 54 families of host plants, including <i>Ananas comosus</i> , <i>Annona</i> , <i>Annona montana</i> , <i>Annona reticulata</i> , <i>Artocarpus altilis</i> , <i>Artocarpus heterophyllus</i> , avocado pear, <i>Bambusa</i> , <i>Citrus</i> , <i>Cocos nucifera</i> , <i>Coffea arabica</i> , custard apple, <i>Ficus</i> , <i>Mangifera indica</i> , <i>Persea americana</i> , <i>Persea borbonia</i> , <i>Psidium guajava</i> , <i>Saccharum officinarum</i> , <i>Theobroma cacao</i> and <i>Vitis vinifera</i> (Chua 1997a; García Morales et al. 2019; Kosztarab 1997b; Suh, Yu & Hong 2013; Swirski, Ben-Dov & Wysoki	Intercepted in Australia on live plant material and unidentified goods Intercepted 32 times (1995-2012) in the USA on a variety of host plants from Australia, Belize, Cook Islands, Costa Rica, Cote D'Ivoire, El Salvador, Ghana, Grenada, Guatemala, Hawaii, Honduras, Jamaica, Mexico, The Netherlands, The Philippines, South Africa,	No	Yes (Le Maguet et al. 2012)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
				1997a; Swirski, Ben-Dov & Wysoki 1997c; Swirski, Wysoki & Ben-Dov 1997) Females on branches, and leaves (Kosztarab 1997b)	Thailand, the UK, and Vietnam (Miller et al. 2014a) Additional interceptions in the USA on <i>Codiaeum</i> and <i>Laurus</i> from Bermuda; on <i>Aglaonema</i> , <i>Annona</i> , <i>Caladium</i> , <i>Codiaeum</i> , <i>Epidendrum</i> , <i>Erythroxylon</i> , <i>Mangifera</i> , <i>Monstera</i> , <i>Spathiphyllum</i> and <i>Vitis</i> from multiple Caribbean and American nations and territories; on <i>Litchi</i> from mainland China; on <i>Ricinus</i> from England; on <i>Anthurium</i> , <i>Codiaeum</i> , <i>Hibiscus</i> , and <i>Rubus</i> from Hawaii; on <i>Musa</i> from India; on <i>Anthurium</i> and <i>Codiaeum</i> from Japan; on <i>Codiaeum</i> and <i>Rosa</i> from the Philippines; on <i>Casuarina</i> from Samoa; on <i>Cassia</i> from Sri Lanka; on <i>Durio</i> and <i>Mangifera</i> from Thailand; and on an unknown host from Nigeria (Miller et al. 2014a) Intercepted once (2007-2011) in South Korea on <i>Ficus</i> from Malaysia (Suh, Yu & Hong 2013)		
<i>Coccus moestus</i> De Lotto	1, 4	18 countries in Africa, Asia, Oceania, South America and the Caribbean	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in eight families of host plants, including avocado, breadfruit, cashew, <i>Hibiscus</i> , mango, <i>Nephelium</i> and <i>Prunus</i> (Evans & Dooley 2013; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b, c; Swirski, Wysoki & Ben-Dov 1997)	Intercepted 14 times (1995-2012) in the United States on a variety of host plants from Costa Rica, Ecuador, Grenada, Honduras, Jamaica, and Puerto Rico (Miller et al. 2014a) Additional interceptions in the USA on <i>Bactris</i> from the Dominican Republic; on <i>Artocarpus</i> from Jamaica; and on <i>Mangifera</i> from	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Coccus ophiorrhizae</i> (Green)	4	India and Sri Lanka	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including green ebony persimmon (<i>Diospyros chloroxylon</i>) and <i>Ophiorrhiza pectinata</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997d)	Puerto Rico and Trinidad (Miller et al. 2014a) —	Yes	No
<i>Coccus pseudhesperidum</i> (Cockerell)	1, 4	Seven countries in the Americas, and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in two families of host plants, including <i>Cattleya</i> , <i>Iris</i> , <i>Papilionanthe teres</i> , two-edged laelia and <i>Vanilla</i> (García Morales et al. 2019; Kosztarab 1997c) On leaves and stems (Kosztarab 1997c)	Intercepted seven times (1995-2012) in the USA on a variety of host plants from Belize and Hawaii (Miller et al. 2014a) Additional interceptions in the USA on <i>Cattleya</i> , <i>Laelia</i> and <i>Octomeria</i> from Brazil; on <i>Aerides</i> from France; on <i>Cattleya</i> from Guatemala, <i>Vanda</i> from Indonesia; on <i>Oncidium</i> from Panama; and on <i>Cattleya</i> , <i>Cymbidium</i> and <i>Dendrobium</i> from the UK (Miller et al. 2014a)	Yes	No
<i>Coccus pseudomagnoliarum</i> (Kuwana)	4	20 countries in Asia, Europe, the USA, Oceania, and the Middle East	Yes, ACT, NSW, SA, WA, Vic (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No
<i>Coccus subacutus</i> (Newstead)	4	Uganda	No record found (García Morales et al. 2019)	Monophagous, on <i>Coffea canephora</i> of family Rubiaceae (García Morales et al. 2019; Murphy 1997)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Coccus subhemisphaericus</i> (Newstead)	4	Seven countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including <i>Coffea</i> and <i>Syzygium caryophyllatum</i> (García Morales et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Coccus takanoi</i> Takahashi	4	Taiwan	No record found (García Morales et al. 2019)	Monophagous, on sugarcane (<i>Saccharum officinarum</i>) of family Poaceae (Carnegie 1997)	—	Yes	No
<i>Coccus viridis</i> (Green)	1, 4, 5	93 countries in Africa, the Americas, Europe, Asia, Oceania, the Caribbean and the Middle East	Yes, NSW, NT, Qld, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No
<i>Coccus viridulus</i> De Lotto	4	Kenya and Uganda	No record found (García Morales et al. 2019)	Monophagous, on <i>Coffea arabica</i> in family Rubiaceae (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Cryptinglisia lounsburyi</i> Cockerell	4	Argentina, Italy, South Africa and Zimbabwe	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including grape vine and ivyleaf geranium (García Morales et al. 2019; Mani 1964) Induces galls in the roots of <i>Vitis vinifera</i> (Mani 1964)	—	Yes	No
<i>Cryptostigma inquilinum</i> (Newstead)	4	11 countries in Central and South Americas, and the Caribbean	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants including <i>Coffea</i> , <i>Ficus citrifolia</i> and <i>Psidium</i> (García Morales et al. 2019; Murphy 1997)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Cryptostigma silveirai</i> (Hempel)	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Vitis</i> of family Vitaceae (García Morales et al. 2019; Pellizzari 1997a)	—	Yes	No
<i>Crystallotesta fagi</i> (Maskell)	4, 5	New Zealand	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Fagus</i> and red beach (García Morales et al. 2019)	—	Yes	No
<i>Dicyphococcus castilloae</i> (Green)	4, 5	India and Sri Lanka	No record found (García Morales et al. 2019)	Oligophagous, on six genera in five families of host plants, including the rubber tree, <i>Solanum</i> and tea (García Morales et al. 2019; Greathead 1997b)	—	Yes	No
<i>Didesmococcus koreanus</i> Borchsenius	4, 5	China and South Korea	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Prunus</i> of family Rosaceae (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Didesmococcus unifasciatus</i> (Archangelskaya)	4	11 countries in Asia and the Middle East	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including apple, <i>Armeniaca</i> , fig, peach and sweet almond (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Discochiton cocophyllae</i> Banks	4	Malaysia and Philippines	No record found (García Morales et al. 2019)	Oligophagous, on six genera in two families of host plants, including coconut and <i>Dillenia philippinensis</i> (Chua 1997a; García Morales et al. 2019)	—	Yes	No
<i>Discochiton expansum</i> (Green) (syn. <i>Paralecanium expansum</i> (Green))	4, 6	12 countries in Asia and Oceania	Yes, NSW, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of	Polyphagous, on 17 genera in 13 families of host plants, including <i>Citrus</i> , <i>Dalbergia pseudo-sissoo</i> , <i>Dendrotrophe frutescens</i> , <i>Ficus macrocarpa</i> , <i>Morella rubra</i> and <i>Myristica fragrans</i> (García Morales et al. 2019; Gill 1997a)	—	Yes (WA)	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
			Western Australia 2018)				
<i>Discochiton metallicum</i> (Green)	4, 5	Indonesia, Malaysia, Philippines, Singapore and Thailand	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including durian, nutmeg and soursop (García Morales et al. 2019)	—	Yes	No
<i>Discochiton milleri</i> (Takahashi)	4	Brunei, Indonesia, Malaysia and Vietnam	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including coconut, mango and soursop (Chua 1997a; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b, c) Attacking coconut leaves (Chua 1997a)	—	Yes	No
<i>Drepanococcus cajani</i> (Maskell)	4	Six countries in Asia	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in six families of host plants, including tea, guava, holy basil, jujube and pigeon pea (García Morales et al. 2019; Greathead 1997b; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Drepanococcus chiton</i> (Green)	4, 5	12 countries in Oceania and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 20 genera in 14 families of host plants, including cocoa tree, <i>Dimocarpus</i> , eggplant, <i>Garcinia</i> , key lime, <i>Lansium</i> , <i>Nephelium</i> , papaya, pigeon pea, soursop and tea (Campbell 1997; Evans & Dooley 2013; García Morales et al. 2019; Greathead 1997b; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Drepanococcus virescens</i> (Green)	4	Singapore and Sri Lanka	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Artocarpus</i> , cocoa tree and <i>Gardenia</i> (Campbell 1997; García Morales et al. 2019)	—	Yes	No
<i>Edwallia rugosa</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on Brazilian grapetree (<i>Plinia cauliflora</i>) of family Myrtaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Ericerus pela</i> (Chavannes)	4, 5	Brazil, China, Japan, Russia and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Oleaceae, including <i>Chionanthus</i> , <i>Fraxinus</i> , <i>Ligustrum</i> and <i>Syringa</i> (García Morales et al. 2019; Kosztarab 1997b) Females and males on twigs (Kosztarab 1997b)	—	Yes	No
<i>Eucalymnatus hempeli</i> Costa Lima	4	Brazil and Guatemala	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including abiu and mango (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Eucalymnatus magarinosi</i> Costa Lima	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Eucalymnatus spinosus</i> Costa Lima	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Eucalymnatus tessellatus</i> (Signoret)	1, 4, 5, 6	74 countries in Africa, the Americas, the Caribbean, Europe, Asia, Oceania and the Middle East	Yes, Norfolk Island, NSW, NT, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 110 genera of 55 families of host plants including <i>Annona</i> spp., <i>Annona squamosa</i> , Avocado, avocado pear, <i>Camellia sinensis</i> , <i>Cinnamomum</i> , <i>Citrus</i> , <i>Cocos nucifera</i> , Cucurbits, <i>Ficus</i> , <i>Ilex</i> , <i>Jasminum</i> , <i>Litchi chinensis</i> , <i>Mangifera indica</i> , <i>Musa paradisiaca</i> , <i>Pandanus</i> and <i>Plumeria</i> , <i>Persea borbonia</i> , <i>Psidium guajava</i> , <i>Syzygium</i> , <i>Theobroma cacao</i> and <i>Zingiber officinale</i> (García Morales et al. 2019; Greathead 1997b; Kosztarab 1997c; Swirski, Ben-Dov & Wysoki 1997c; Swirski, Wysoki & Ben-Dov 1997) On leaves often underside along leaf veins and on stems (Kosztarab 1997c)	Intercepted 77 times (1995-2012) in the USA on a variety of host plants from Australia, the Americas, South Pacific, South East Asia, India and Italy (Miller et al. 2014a) Additional interceptions in the USA on <i>Anthurium</i> and <i>Gardenia</i> from Australia; on <i>Laurus</i> , <i>Pimenta</i> from Barbados; on <i>Laurus</i> , <i>Nerium</i> , <i>Pimenta</i> , <i>Roystonea</i> from Bermuda; on palm from Brazil; on <i>Alyxia</i> from Cook Island; on orchid from Costa Rica; on <i>Musa</i> from Cuba; on <i>Anthurium</i> , <i>Cinnamomum</i> and <i>Corpha</i> from Dominica; on palm from England; on <i>Mangifera</i> from Haiti, Martinique and Tahiti; on <i>Alyxia</i> , <i>Cocos</i> and <i>Litchi</i> from Hawaii; on <i>Fatsia</i> and <i>Gardenia</i>	Yes (WA)	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
					from Italy, <i>Kentia</i> from Jamaica; on <i>Aspidistra</i> and <i>Rhapis</i> from Japan; on <i>Caryota</i> , <i>Cocos</i> , <i>Codiaeum</i> , <i>Chamaedorea</i> and <i>Gardenia</i> from Mexico; on <i>Alpinia</i> from Pago Pago; on palm from Portugal; on <i>Caryota</i> and <i>Psidium</i> from Puerto Rico; on <i>Alyxia</i> from Rarotonga; on <i>Caryota</i> from St. Lucia; on <i>Iriartea</i> from Surinam; and on an unknown host from Hong Kong (Miller et al. 2014a)		
<i>Eulecanium alnicola</i> Chen	4	China (García Morales et al. 2019)	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including Japanese plum, <i>Pyrus</i> and weeping willow (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Eulecanium caryae</i> (Fitch)	4, 5	Canada and USA	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in five families of host plants, including American elm, American sycamore, <i>Malus</i> , peach and pear (García Morales et al. 2019; Pfeiffer 1997) Crawlers and nymphs on leaves and twigs, respectively (Pfeiffer 1997)	—	Yes	No
<i>Eulecanium cerasorum</i> (Cockerell)	4, 5	USA, China, Japan and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in eight families of host plants, including <i>Acer</i> , English oak, <i>Juglans</i> , mokryeon, <i>Prunus</i> and sour cherry (García Morales et al. 2019; Kosztarab 1997b; Pfeiffer 1997) First instars on the underside of leaves and second instars and females on twigs and the trunk (Kosztarab 1997b)	—	Yes	No
<i>Eulecanium ciliatum</i> (Douglas)	4	18 countries in Europe, Asia,	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in eight families of host plants, including <i>Alnus</i> , <i>Betula</i> , walnut, English oak, <i>Fagus</i> , <i>Malus</i> , <i>Prunus</i> , <i>Salix</i> , tatarian	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		and the Middle East		maple, <i>Ulmus</i> and white poplar (García Morales et al. 2019; Kosztarab 1997b; Pfeiffer 1997) First instars on the underside of leaves, second instars and females on twigs (Kosztarab 1997b)			
<i>Eulecanium douglasi</i> (Šulc)	4	13 countries in Asia, Europe, and North America	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in five families of host plants, including English oak, red currant, <i>Rosa</i> , white poplar and willow (García Morales et al. 2019)	—	Yes	No
<i>Eulecanium excrescens</i> (Ferris)	4, 5	USA and UK	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including walnut and <i>Wisteria</i> (García Morales et al. 2019)	—	Yes	No
<i>Eulecanium franconicum</i> (Lindinger)	4	15 countries in Asia and Europe	No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including European blueberry, heathers and Korean rosebay (García Morales et al. 2019; Kosztarab 1997b) Nymphs and adults located on twigs (Kosztarab 1997b)	—	Yes	No
<i>Eulecanium giganteum</i> (Shinji)	4, 5	China, Japan and Russia	No record found (García Morales et al. 2019)	Polyphagous, on 18 genera in 11 families of host plants, including apricot, armenian plum, <i>Rosa</i> , boxelder maple, walnut, jujube and large fruited elm (García Morales et al. 2019)	—	Yes	No
<i>Eulecanium kunoense</i> (Kuwana)	4, 5, 6	USA, China, Japan and South Korea	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in five families of host plants, including walnut, almond, <i>Malus</i> , sour cherry, peach, Japanese plum, and quince (García Morales et al. 2019; Pfeiffer 1997) Crawlers on leaves, second- instar nymphs and adults on wood (Pfeiffer 1997)	—	Yes	No
<i>Eulecanium lespedezae</i> Danzig	4	Russia	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in nine families of host plants, including apple, walnut, <i>Acer</i> , <i>Betula</i> , <i>Corylus</i> , <i>Lespedeza bicolor</i> , <i>Populus</i> , <i>Prunus</i> and <i>Ulmus</i> (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Eulecanium nocivum</i> Borchsenius	4	Georgia and Turkey	No record found (García Morales et al. 2019)	Oligophagous, on 10 genera in five families of host plants, including <i>Acer</i> , Japanese persimmon, <i>Malus</i> , peach and quince (García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997d)	—	Yes	No
<i>Eulecanium perinflatum</i> (Cockerell)	4	Argentina and Uruguay	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in five families of host plants, including <i>Citrus</i> , guava, <i>Ipomoea</i> and <i>Solanum</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Eulecanium rugulosum</i> (Archangelskaya)	4	Eight countries in Asia and the Middle East including Turkey	No record found (García Morales et al. 2019)	Polyphagous, on 16 genera in nine families of host plants, including apple, walnut, nectarine, peach, <i>Pyrus</i> , quince and <i>Ulmus</i> (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Eulecanium sericeum</i> (Lindinger)	4	10 countries in Europe and Russia	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Abies</i> and <i>Picea</i> of family Pinaceae, including Caucasian fir, European silver fir, Greek fir, <i>Picea</i> and Sicilian fir (García Morales et al. 2019; Kosztarab 1997a) Nymphs on needles, and adult females on twigs (Kosztarab 1997a)	—	Yes	No
<i>Eulecanium tiliae</i> (Linnaeus)	1, 4	41 countries in Asia, Europe, North America and the Middle East	Yes, Tas, WA (ABRS 2018; Government of Western Australia 2018; Plant Health Australia 2018)	Polyphagous, on 34 genera of 16 families of host plants including <i>Acer</i> , <i>Cydonia oblonga</i> , <i>Ficus</i> , <i>Juglans regia</i> , <i>Malus</i> , <i>Populus</i> , <i>Prunus persica</i> , <i>Pyrus communis</i> , <i>Quercus</i> , <i>Rosa</i> and <i>Vitis vinifera</i> (García Morales et al. 2019; Pfeiffer 1997) Nymphs on leaves, adults on twigs (Kosztarab 1997b; Pfeiffer 1997)	—	No	No
<i>Eulecanium transcausicum</i> Borchsenius	4	Armenia and Georgia	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including quince and elm (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No

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<i>Filippia follicularis</i> (Targioni Tozzetti)	4	14 countries in Africa, Europe and the Middle East	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in eight families of host plants, including laurustinus, mastic tree, olive and plum (García Morales et al. 2019; Pellizzari 1997b) First instars on leaves, second-instar females move onto twigs and moult, second-instar males move from leaves to large branches or tree trunk, adult females move back to the underside of leaves after mating Pellizzari 1997	—	Yes	No
<i>Hemilecanium cacao</i> (Hodgson)	4	Nigeria	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Theobroma</i> of family Malvaceae (Campbell 1997; García Morales et al. 2019)	—	Yes	No
<i>Hemilecanium imbricans</i> (Green)	4	India	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in seven families of host plants, including <i>Coffea</i> , Indian date and oak (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Hemilecanium mangiferae</i> Kondo & Williams	5	Thailand	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (García Morales et al. 2019)	—	Yes	No
<i>Hemilecanium theobromae</i> Newstead	4	Angola, Cameroon, South Africa and Zimbabwe	No record found (García Morales et al. 2019)	Oligophagous, on six genera in five families of host plants, including cocoa tree and <i>Nerium oleander</i> (Campbell 1997; García Morales et al. 2019)	—	Yes	No
<i>Inglisia theobromae</i> Newstead	4	Cameroon, Uganda and Zambia	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including cocoa tree (Campbell 1997; García Morales et al. 2019)	—	Yes	No
<i>Kilifia acuminata</i> (Signoret)	1, 4, 5	36 countries in Asia, Oceania, the Americas, the Caribbean, Europe and	No record found (García Morales et al. 2019)	Polyphagous, on 53 genera in 35 families of host plants, including <i>Annona</i> , <i>Anthurium</i> , avocado, avocado pear, breadfruit, cashew, <i>Psidium guajava</i> , <i>Diospyros</i> , <i>Gardenia</i> , <i>Ilex</i> , mango, pineapple, <i>Plumeria</i> , red bay and strawberry guava (<i>Psidium cattleianum</i>) (García Morales et al. 2019; Kosztarab 1997c; Swirski, Ben-Dov &	Intercepted 54 times (1995-2012) in the United States on a variety of host plants from Colombia, Cook Islands, Costa Rica, Dominica, Egypt, Fiji, French Polynesia, India, Jamaica, Malaysia, Mexico, Nigeria, Puerto Rico, St. Lucia, Tahiti,	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		the Middle East		Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d, c; Swirski, Wysoki & Ben-Dov 1997) On leaves (Kosztarab 1997c)	Taiwan, Thailand and Vietnam (Miller et al. 2014a) Additional interceptions in the USA on <i>Camellia</i> , <i>Chamaedorea</i> , <i>Cinchona</i> , <i>Dieffenbachia</i> , <i>Eugenia</i> , <i>Gardenia</i> , <i>Ixora</i> , <i>Jasminum</i> , <i>Mangifera</i> , <i>Musa</i> , <i>Persea</i> , <i>Philodendron</i> and <i>Syzygium</i> from the Caribbean; on <i>Anthurium</i> , <i>Cinchona</i> , <i>Cinnamomum</i> , <i>Clusia</i> , <i>Coriandrum</i> , fern, <i>Gardenia</i> , <i>Ixora</i> , <i>Laurus</i> and <i>Pimenta</i> from Central America; on <i>Alyxia</i> , <i>Chrysanthemum</i> and <i>Hevea</i> from Oceania; on orchids from Thailand; and on unknown host plants from Argentina and Brazil (Miller et al. 2014a)		
<i>Kilifia americana</i> Ben-Dov	1	Mexico, USA and mainland China	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in six families of host plants, including <i>Coffea</i> , mango, lemon and pomelo (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	Intercepted 17 times (1995-2012) in the USA on a variety of host plants from Costa Rica, Mexico, and Puerto Rico (Miller et al. 2014a) Additional interceptions in the USA on <i>Citrus</i> from Costa Rica, Panama and Honduras; and on <i>Chamaedorea</i> , <i>Citrus</i> , <i>Coffea</i> , <i>Ervatamia</i> and <i>Gardenia</i> from Mexico (Miller et al. 2014a)	Yes	No
<i>Kilifia deltooides</i> De Lotto	1, 4	Eight countries in Africa, and Asia	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in five families of host plants, including <i>Camellia</i> , cashew, <i>Cinnamomum</i> , common guava and mango (Evans & Dooley 2013; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c)	Intercepted three times (1995-2012) in the USA on a variety of host plants from Guam, India and Philippines (Miller et al. 2014a)	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Lagosinia aristolochiae</i> (Newstead)	4	Ghana, South Africa and Zimbabwe	No record found (García Morales et al. 2019)	Oligophagous, on five genera in five families of host plants, including cocoa tree and custard apple (Campbell 1997; García Morales et al. 2019)	— Additional interceptions in the USA on <i>Ixora</i> from Guam (Miller et al. 2014a)	Yes	No
<i>Lagosinia strachani</i> (Cockerell)	4	12 countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in seven families of host plants, including <i>Annona</i> and mango (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b, c)	—	Yes	No
<i>Lichtensia carissae</i> (Brain)	4	Namibia, South Africa and Zimbabwe	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including natal plum and round-leaved navel-wort (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Lichtensia viburni</i> Signoret	4	28 countries in Europe and the Middle East	No record found (García Morales et al. 2019)	Polyphagous, on 18 genera in 15 families of host plants, including common ivy, jasmine, mastic tree and olive (Evans & Dooley 2013; García Morales et al. 2019; Pellizzari 1997b) Male nymphs on the underside of leaves, third-instar females on young twigs or shoots, adult females on the underside of leaves after mating (Pellizzari 1997b)	—	Yes	No
<i>Luzulaspis australis</i> (Maskell)	4	Australia and Indonesia	Yes, NSW, SA, Vic, WA (García Morales et al. 2019)	Further assessment is not required	—	No	No
<i>Maacoccus bicruciatu</i> s (Green)	4, 5	Six countries in Africa and Asia	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in seven families of host plants, including <i>Citrus</i> and mango (García Morales et al. 2019; Gill 1997a; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Maacoccus piperis</i> (Green)	4	Sri Lanka	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Piper</i> and <i>Psychotria</i> (García Morales et al. 2019)	—	Yes	No
<i>Maacoccus watti</i> (Green)	4	India	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Citrus</i> and tea (García Morales et al. 2019; Gill 1997a; Greathead 1997b)	—	Yes	No
<i>Mametia louisieae</i> Matile-Ferrero	4	Comoros	No record found (García Morales et al. 2019)	Monophagous, on clove (<i>Syzygium aromaticum</i>) of family Myrtaceae (García Morales et al. 2019)	—	Yes	No
<i>Mariacoccus marianus</i> (Cockerell)	4	Brazil	No record found (García Morales et al. 2019)	Oligophagous on two genera in two families of host plants, including <i>Coffea</i> and <i>Maytenus</i> (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Marsipococcus marsupialis</i> (Green)	4	Tanzania, India, Malaysia, Sri Lanka and Thailand	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in seven families of host plants, including <i>Annona</i> , black pepper, <i>Capsicum</i> and coconut (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Marsipococcus proteae</i> (Brain)	1	South Africa	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Protea</i> of family Proteaceae, including <i>Protea caffra</i> , <i>Protea cynaroides</i> and <i>Protea neriifoli</i> (García Morales et al. 2019)	Intercepted eight times (1995-2012) in the USA, mostly on <i>Protea</i> and <i>Leucadendron</i> leaves from Netherlands and South Africa (Miller et al. 2014a)	Yes	No
<i>Megalocryptes bambusicola</i> (Green)	4	Indonesia and Vietnam	No record found (García Morales et al. 2019)	Monophagous, on <i>Bambusa multiplex</i> of family Poaceae (Carnegie 1997; García Morales et al. 2019)	—	Yes	No
<i>Megalocryptes buteae</i> Takahashi	4	Thailand and mainland China	No record found (García Morales et al. 2019)	Oligophagous, on six genera in five families of host plants, including <i>Bambusa</i> , jujube and mango (Carnegie 1997; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Megapulvinaria burkilli</i> (Green)	4	India	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including jujube and purging croton (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Megapulvinaria maxima</i> (Green)	1, 4	Nine countries in Asia and Oceania	No record found (García Morales et al. 2019)	Polyphagous, on 24 genera in 15 families of host plants, including <i>Annona</i> , <i>Citrus</i> , <i>Coffea</i> , <i>Mangifera</i> , rubber tree and tea (Chua 1997b; García Morales et al. 2019; Gill 1997a; Greathead 1997b; Swirski, Ben-Dov & Wysoki 1997c)	Intercepted twice (1995-2012) in the USA on a variety of host plants from Indonesia and Thailand (Miller et al. 2014a)	Yes	No
<i>Mesolecanium nigrofasciatum</i> (Pergande)	4, 5	Canada, USA and Argentina	No record found (García Morales et al. 2019)	Polyphagous, on 15 genera in 11 families of host plants, including <i>Acer</i> , American sycamore, <i>Magnolia</i> , <i>Malus</i> , olive, peach, pear, red bay, sassafras (García Morales et al. 2019; Kosztarab 1997b; Pfeiffer 1997) Crawlers on the underside of leaves; adult females move to branches after mating (Kosztarab 1997b; Pfeiffer 1997)	—	Yes	No
<i>Metaceronema japonica</i> (Maskell)	4	Six countries in Asia	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including tea (García Morales et al. 2019; Greathead 1997b)	—	Yes	No
<i>Millericoccus costalimai</i> (Bondar)	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on cocoa tree (<i>Theobroma cacao</i>) of family Malvaceae (Campbell 1997; García Morales et al. 2019)	—	Yes	No
<i>Milviscutulus ciliatus</i> Williams & Watson	1, 4	Fiji, Papua New Guinea and Western Samoa	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in four families of host plants, including common guava and Melaleuca (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Milviscutulus mangiferae</i> (Green)	1, 4, 5	61 countries in Africa, Asia, Oceania, the Americas, the Caribbean and	Yes, NT, WA, Qld (García Morales et al. 2019; Government of Western	Further assessment is not required		No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		the Middle East	Australia 2018; Plant Health Australia 2018)				
<i>Milviscutulus pilosus</i> Williams & Watson	4	Papua New Guinea and Solomon Islands	No record found (García Morales et al. 2019)	Oligophagous, on six genera in six families of host plants, including bluebell, coconut and <i>Ficus</i> (Chua 1997a; García Morales et al. 2019)	—	Yes	No
<i>Milviscutulus spiculatus</i> Williams & Watson	4	Indonesia, Papua New Guinea and Solomon Islands	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in seven families of host plants, including avocado, <i>Ficus</i> and mango (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Wysoki & Ben-Dov 1997)	—	Yes	No
<i>Neolecanium cornuparvum</i> (Thro)	4	USA	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Magnolia</i> of family Magnoliaceae, including <i>Magnolia grandiflora</i> (Kosztarab 1997b) On twigs and branches (Kosztarab 1997b)	—	Yes	No
<i>Neolecanium craspeditae</i> Morrison	4	Panama and Trinidad and Tobago	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Cordia</i> and mango (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Neoplatylecanium adersi</i> (Newstead)	5	India and Zanzibar	No record found (García Morales et al. 2019)	Monophagous, on mango (<i>Mangifera indica</i>) of family Anacardiaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b)	—	Yes	No
<i>Neopulvinaria innumerabilis</i> (Rathvon)	2, 4, 5	11 countries in Europe, North America and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 48 genera in 27 families of host plants, including <i>Acer</i> , <i>Alnus</i> , walnut, <i>Cornus</i> , <i>Cydonia</i> , hickory, Japanese persimmon, peach, plum, red bay, <i>Ribes</i> , <i>Salix</i> , <i>Tilia</i> and <i>Vitis</i> (García Morales et al. 2019; Kosztarab 1997b, c; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997d) Nymphs on the underside of leaves, adult females on twigs (Kosztarab 1997b, c)	—	Yes	Yes (Cseh et al. 2008)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Neosaissetia triangularum</i> (Morrison)	4	Philippines	No record found (García Morales et al. 2019)	Monophagous, on coconut (<i>Cocos nucifera</i>) of family Arecaceae (Chua 1997a; García Morales et al. 2019)	—	Yes	No
<i>Nipponpulvinaria horii</i> (Kuwana)	4, 5	France, Greece, Japan and UK	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in five families of host plants, including <i>Acer</i> , Chinese pear, <i>Citrus</i> , common fig and konara (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Palaeolecanium bituberculatum</i> (Signoret)	4	35 countries in Asia, Europe and The Middle East	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in four families of host plants, including apple, walnut, hazel, hawthorn, medlar, peach, plum, <i>Pyrus</i> and quince (García Morales et al. 2019; Kosztarab 1997b; Pfeiffer 1997) Nymphs on leaves, and adults on small branches (Kosztarab 1997b)	—	Yes	No
<i>Palaeolecanium kosswigi</i> (Bodenheimer)	4	Turkey	No record found (García Morales et al. 2019)	Oligophagous, on two genera of the family Rosaceae, including <i>Prunus elaeagnifolia</i> and <i>Pyrus</i> (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Paralecanium album</i> Takahashi	4	Malaysia	No record found (García Morales et al. 2019)	Monophagous, on durian (<i>Durio zibethinus</i>) of family Malvaceae (Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Parasaissetia nigra</i> (Nietner)	1, 2, 4, 5	125 countries in Africa, the Americas, Europe, Asia, Oceania, the Caribbean and the Middle East	Yes, Qld, NSW, NT, Vic, WA SA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Highly polyphagous, on 260 genera in 95 families of host plants including <i>Abutilon</i> , <i>Agave americana</i> , <i>Anacardium occidentale</i> , <i>Ananas comosus</i> , <i>Annona</i> , <i>Artocarpus altilis</i> , <i>Artocarpus heterophyllus</i> , avocado pear, Bamboo, <i>Camellia sinensis</i> , <i>Citrus</i> , <i>Cocos nucifera</i> , <i>Codiaeum</i> , <i>Coffea arabica</i> , <i>Ficus</i> , <i>Hevea brasiliensis</i> , <i>Hibiscus</i> , <i>Litchi chinensis</i> , mango, <i>Musa acuminata</i> , <i>Nerium</i> , papaya, <i>Passiflora edulis</i> , <i>Plumeria</i> , <i>Psidium cattleianum</i> , <i>Psidium guajava</i> , <i>Psidium littorale</i> , <i>Rosa</i> , <i>Salix</i> , <i>Solanum melongena</i> , <i>Terminalia</i> , <i>Theobroma cacao</i> , <i>Vitis vinifera</i> and <i>Zingiber officinale</i> (Campbell 1997; Carnegie	Eggs, nymphs and adults intercepted in Australia on nursery stock Intercepted 220 times (1995-2012) in the USA on a variety of host plants from multiple African, Middle Eastern, South East Asian nations, Caribbean and US territories (Miller et al. 2014a) Additional interceptions in the USA on wood material from the	No	Yes (Suh, Yu & Hong 2013)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Parthenolecanium corni</i> (Bouché)	1, 2, 4, 5, 6	51 countries in Asia, Europe, Oceania, the Americas, and the Middle East	Yes, Vic, Tas (ABRS 2018; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	1997; Chua 1997b; García Morales et al. 2019; Kosztarab 1997b, c; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c; Swirski, Wysoki & Ben-Dov 1997) On leaves and twigs, branches and fruits (Kosztarab 1997b) Polyphagous, on 105 genera in 48 families of host plants, including <i>Actinidia deliciosa</i> , apple, apricot, <i>Asparagus</i> , avocado, avocado pear, blackberry, cherry, <i>Corylus americana</i> , currant, <i>Diospyros</i> , gooseberry, <i>Magnolia grandiflora</i> , pear, plum, <i>Prunus persica</i> , <i>Psidium guajava</i> , raspberry, <i>Ribes nigrum</i> , <i>Solanum tuberosum</i> , <i>Ulmus americana</i> and <i>Ziziphus jujuba</i> (García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d, c; Swirski, Wysoki & Ben-Dov 1997) First instars on leaves, second instars and adults on twigs (Kosztarab 1997b) ; Crawlers settle on leaf underside, 2nd instars move to old branches and trunks to overwinter, 2nd instars move to young branches after winter and continue to develop (1 generation per year), 2nd instars move to leaf petioles, grape-stalks and berries in summer or old branches in winter (2 generations per year) (Pellizzari 1997a)	Caribbean region (Meissner et al. 2009; Miller et al. 2014a) Intercepted once in South Korea on <i>Citrus</i> (2007-2011) from Thailand (Suh, Yu & Hong 2013) Eggs intercepted in Australia on fresh fruit Intercepted 15 times (1995-2012) in the USA on a variety of host plants from China, Czech Republic, France, Germany, Mexico, The Netherlands and the UK (Miller et al. 2014a) Additional interceptions in the USA on <i>Acer</i> , <i>Aesculus</i> , <i>Alnus</i> , <i>Buxus</i> , <i>Caragana</i> , <i>Celtis</i> , <i>Cornus</i> , <i>Corylus</i> , <i>Crataegus</i> , <i>Fraxinus</i> , <i>Juglans</i> , <i>Laurus</i> , <i>Ligustrum</i> , <i>Lonicera</i> , <i>Malus</i> , <i>Magnolia</i> , <i>Philadelphus</i> , <i>Prunus</i> , <i>Rhododendron</i> , <i>Ribes</i> , <i>Robinia</i> , <i>Rosa</i> , <i>Rosmarinus</i> , <i>Rubus</i> , <i>Sorbus</i> , <i>Spiraea</i> , <i>Tilia</i> , <i>Viburnum</i> and <i>Vitis</i> from Europe; on <i>Acer</i> and <i>Cornus</i> from Canada; on <i>Vitis</i> from Chile; on <i>Diospyros</i> , <i>Prunus</i> and <i>Wisteria</i> from Japan; and on <i>Condalia</i> from Mexico (Miller et al. 2014a)	Yes (WA)	Yes (Hommay et al. 2008)
<i>Parthenolecanium fletcheri</i> (Cockerell)	4, 5	23 countries in Asia, Europe and North America	No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including <i>Cupressus</i> , red cedar, <i>Taxus</i> and <i>Thuja</i> (García Morales et al. 2019; Kosztarab 1997a, c) On leaves and shoots (Kosztarab 1997c)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Parthenolecanium glandi</i> (Kuwana)	4	Mainland China, Japan and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on six genera in five families of host plants, including apple, European crab apple, oriental pear and Japanese zelkova (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Parthenolecanium jabolicabae</i> (Hempel)	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on Brazilian grapetree (<i>Plinia cauliflora</i>) of family Myrtaceae (García Morales et al. 2019)	—	Yes	No
<i>Parthenolecanium orientale</i> Borchsenius	4, 5	Mainland China, North Korea and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including Chinese wisteria (<i>Wisteria sinensis</i>), <i>Prunus</i> , <i>Ribes</i> and <i>Salix</i> (García Morales et al. 2019; Pfeiffer 1997) Associated with leaves, stems and fruit (Biosecurity Australia 2011a) Assessed as on pathway for table grapes from China; originally assessed under the superseded name of <i>Parthenolecanium orientalis</i> (Biosecurity Australia 2011a)	—	Yes	No
<i>Parthenolecanium perlatum</i> (Cockerell)	4	6 countries in Europe and South America	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Citrus</i> , hare's foot fern and silver elkhorn (García Morales et al. 2019; Gill 1997a)	—	Yes	No
<i>Parthenolecanium persicae</i> (Fabricius)	2, 4, 5	57 countries in Africa, the Americas, Europe, Oceania, Asia, and the Middle East	Yes, Qld, NSW, Vic, SA, Tas, ACT, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Polyphagous, on 54 genera of 32 families of host plants, including <i>Annona</i> , <i>Berberis</i> , <i>Citrus</i> , <i>Diospyros kaki</i> , <i>Hydrangea macrophylla</i> , <i>Malus</i> , <i>Mangifera indica</i> , <i>Persea americana</i> , <i>Prunus</i> , <i>Psidium guajava</i> , <i>Rosa</i> , <i>Vitis vinifera</i> and <i>Wisteria sinensis</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d, c) First instars settle on undersurface of leaves, other instars on branches (Kosztarab 1997c); third instars move to wood and moult before overwintering (Pfeiffer 1997)	—	No	Yes (Herrbach et al. 2017)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Parthenolecanium pruinatum</i> (Coquillett) [Syn: <i>Elucanium pruniosum</i> (Coquillett)]	4, 5	Six countries in Central and North Americas, Europe, and Oceania	Yes, NSW, SA, Tas, Vic, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No
<i>Parthenolecanium putmani</i> (Philips)	4	Canada	No record found (García Morales et al. 2019)	Polyphagous, on seven genera in six families of host plants, including <i>Juglans nigra</i> , <i>Prunus</i> , <i>Sassafras albidum</i> and Japanese plum (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Parthenolecanium quercifex</i> (Fitch)	4	Canada, Mexico and USA	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including American sycamore, <i>Chrysolepis</i> , common persimmon and oak (García Morales et al. 2019; Kosztarab 1997b; Swirski, Ben-Dov & Wysoki 1997d) Females on twigs and branches, males form cocoons on the underside of leaves (Kosztarab 1997b)	—	Yes	No
<i>Parthenolecanium rufulum</i> (Cockerell)	4	27 countries in Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 15 genera in nine families of host plants, including <i>Carpinus betulus</i> , <i>Castanea</i> , hawthorn, hazel, Japanese persimmon oak, mango, <i>Robinia</i> and <i>Rosa</i> (García Morales et al. 2019; Kosztarab 1997b; Swirski, Ben-Dov & Wysoki 1997d) First instars on the underside of leaves, second instars and adult females on branches (Kosztarab 1997b)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pendularia pendens</i> Fonseca	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on Brazilian grapetree (<i>Plinia cauliflora</i>) of family Myrtaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Phalacrocooccus howertoni</i> Hodges & Hodgson	1, 4	USA, Barbados, Guadeloupe and Guatemala	No record found (García Morales et al. 2019)	Polyphagous, on 63 genera in 34 families of host plants, including avocado, guava, longan, mango and soursop (García Morales et al. 2019)	Intercepted eight times (1995-2012) in the USA on a variety of host plants from Puerto Rico and U.S. Virgin Islands (Miller et al. 2014a) Intercepted in Florida in 2008 on unspecified commodities from the Caribbean (Stocks 2013)	Yes	No
<i>Philephedra broadwayi</i> (Cockerell)	1, 4	Eight countries in South America and the Caribbean	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including cocoa tree, eggplant, mango, soursop and <i>Spondias</i> (Campbell 1997; Evans & Dooley 2013; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b, c)	Intercepted 16 times (1995-2012) in the USA on a variety of host plants from Antigua and Barbuda, Dominica, Grenada, Puerto Rico, and Tortola (Miller et al. 2014a) Additional interceptions in the USA on <i>Annona</i> , <i>Mangifera</i> , <i>Musa</i> , <i>Pimenta</i> and <i>Theobroma</i> from the Caribbean; and on <i>Mangifera</i> from Colombia (Miller et al. 2014a)	Yes	No
<i>Philephedra lutea</i> (Cockerell)	1, 4	Mexico, USA and Guatemala	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including avocado, <i>Ficus</i> and <i>Magnolia</i> (García Morales et al. 2019; Swirski, Wysoki & Ben-Dov 1997)	Intercepted six times (1995-2012) in the USA on a variety of host plants from Guatemala, Mexico and Puerto Rico (Miller et al. 2014a) Additional interceptions in the USA on <i>Acuba</i> from Puerto Rico; and on <i>Ananas</i> , <i>Carica</i> , <i>Codiaeum</i> , <i>Ficus</i> and <i>Magnolia</i> from Central America (Miller et al. 2014a)	Yes	No
<i>Philephedra tuberculosa</i> Nakahara & Gill)	1, 4	13 countries in the Americas and the Caribbean	No record found (García Morales et al. 2019)	Polyphagous, on 53 genera in 25 families of host plants, including avocado, <i>Citrus</i> , guava, <i>Ficus</i> , <i>Hibiscus</i> , papaya, soursop and <i>Zingiber</i> (García	Intercepted eight times (1995-2012) in the USA from the Dominican Republic, El Salvador, Guyana,	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
				Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c) On fruit, leaves and stems (Swirski, Ben-Dov & Wysoki 1997c)	Honduras, Jamaica, and Puerto Rico (Miller et al. 2014a) Additional interceptions in the USA on <i>Annona</i> , <i>Anthurium</i> , <i>Carica</i> and <i>Codiaeum</i> from the Caribbean; on <i>Acacia</i> , <i>Carica</i> , <i>Codiaeum</i> , <i>Diffenbachia</i> , <i>Euphorbia</i> , <i>Ipomoea</i> and <i>Mangifera</i> from Central America; on <i>Annona</i> , <i>Carica</i> , <i>Codiaeum</i> , <i>Cliricida</i> and <i>Gosypium</i> from South America; and on <i>Bursera</i> , <i>Carica</i> , <i>Codiaeum</i> and <i>Schinus</i> from Florida (Miller et al. 2014a)		
<i>Physokermes hemicryphus</i> (Dalman)	4	25 countries in Asia, Europe and North America	No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including <i>Abies</i> , <i>Juniperus</i> , <i>Picea</i> and <i>Tsuga canadensis</i> (García Morales et al. 2019; Kosztarab 1997a, c) Females underneath bud scales, males on the underside of needles (Kosztarab 1997a, c)	—	Yes	No
<i>Physokermes inopinatus</i> Danzig & Kozár	4	Six countries in Europe	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Pinaceae, including Greek fir (<i>Abies cephalonica</i>) and Norway spruce (<i>Picea abies</i>) (García Morales et al. 2019) Females develop at the base of annual shoots and the base of needles (García Morales et al. 2019)	—	Yes	No
<i>Physokermes piceae</i> (Schrank)	4	27 countries in Asia and Europe	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Abies</i> and <i>Picea</i> of family Pinaceae (García Morales et al. 2019; Kosztarab 1997a, c) Females underneath bud scales; males on the underside of needles (Kosztarab 1997a, c)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Physokermes taxifoliae</i> Coleman	4	Canada and USA	No record found (García Morales et al. 2019)	Monophagous, on <i>Pseudotsuga menziesii</i> of family Pinaceae (García Morales et al. 2019; Kosztarab 1997a) On shoots (Kosztarab 1997a)	—	Yes	No
<i>Platinglisia noacki</i> Cockerell	4	Brazil	No record found (García Morales et al. 2019)	Oligophagous, on 10 genera in 10 families of host plants, including <i>Annona</i> , avocado, egg magnolia, <i>Ilex</i> , <i>Myrtaceae</i> , silk oak and <i>Thymelaeaceae</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c; Swirski, Wysoki & Ben-Dov 1997)	—	Yes	No
<i>Platylecanium cocotis</i> Laing	4	Indonesia, Papua New Guinea, Solomon Islands and Vanuatu	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including coconut and red ginger (<i>Alpinia purpurata</i>) (Chua 1997a; García Morales et al. 2019)	—	Yes	No
<i>Platysaissetia armata</i> (Takahashi)		Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including cheese trees (<i>Glochidion</i>) and rose apple (<i>Syzygium jambos</i>) (García Morales et al. 2019)	—	Yes	No
<i>Prococcus acutissimus</i> (Green)	1, 5	22 countries in Africa, USA, Oceania and Asia (García Morales et al. 2019)	No record found (García Morales et al. 2019)	Polyphagous, on 42 genera in 29 families of host plants, including <i>Artocarpus</i> , <i>Litchi</i> , avocado, coconut, common guava, cashew, mango and <i>Musa</i> (Chua 1997a; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c; Swirski, Wysoki & Ben-Dov 1997)	Intercepted 15 times (1995-2012) in the USA on a variety of host plants from Antigua and Barbuda, Dominican Republic, Hawaii, India, Jamaica, Puerto Rico, The U.S. Virgin Islands, and Vietnam (Miller et al. 2014a) Additional interceptions in the USA on <i>Magnolia</i> from China; on <i>Gardenia</i> from Guatemala; on <i>Rhododendron</i> from Malaysia; and on <i>Amomis</i> , <i>Cycas</i> , <i>Dacryodes</i> ,	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Protopulvinaria longivalvata</i> Green	1, 4	15 countries in Asia, Oceania, South America and the Caribbean	No record found (García Morales et al. 2019)	Polyphagous, on 20 genera in 14 families of host plants, including <i>Citrus</i> , avocado, <i>Cinnamomum</i> , <i>Coffea</i> , guava, frangipani, mango, <i>Morinda</i> , pepper, <i>Camellia</i> and <i>Schefflera</i> (Evans & Dooley 2013; García Morales et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Wysoki & Ben-Dov 1997)	<i>Eucalyptus</i> , <i>Ficus</i> and <i>Pimenta</i> from the Caribbean (Miller et al. 2014a) Intercepted 95 times (1995-2012) in the USA on a variety of host plants from Argentina, Barbados, Belgium, Brazil, Colombia, Costa Rica, Dominica, Dominican Republic, Grenada, Guatemala, Hawaii, Jamaica, Peru, Puerto Rico, Suriname, Thailand, Trinidad and Tobago (Miller et al. 2014a) Additional interceptions in the USA on <i>Acerola</i> , <i>Cinnamomum</i> , <i>Codiaeum</i> , <i>Gardenia</i> , <i>Ixora</i> , <i>Malpighia</i> , <i>Myristica</i> , <i>Peperomia</i> , <i>Piper</i> and <i>Psidium</i> from the Caribbean; on <i>Anthurium</i> , <i>Antidesma</i> , <i>Chamaedorea</i> , <i>Dracaena</i> , <i>Gardenia</i> , <i>Heliconia</i> , <i>Ixora</i> , <i>Malus</i> and <i>Schefflera</i> from Central America; on <i>Cattleya</i> , <i>Dieffenbachia</i> , <i>Gardenia</i> and <i>Ixora</i> from South America; on <i>Ficus</i> and <i>Lansium</i> from the Philippines; on <i>Gardenia</i> and <i>Jasminum</i> from Tahiti; and on <i>Piper</i> from Thailand (Miller et al. 2014a). Most of the 200 interceptions in the USA (1985-2010) from Antigua and Barbuda, Dominica, Jamaica, St. Vincent and the Grenadines, and Trinidad and Tobago were on <i>Citrus</i> , <i>Schefflera</i> and <i>Mangifera indica</i> (Stocks 2013)	Yes	No
<i>Protopulvinaria pyriformis</i> (Cockerell)	1, 4, 5	42 countries in Africa, the	Yes, only WA (García Morales	Polyphagous, found on 59 genera of 36 families of host plants including <i>Annona</i> , <i>Artocarpus</i>	—	Yes (NSW, SA, Vic)	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		Americas, Europe, Oceania, the Caribbean, the Middle East and Africa	et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018) Host plants grown in WA regulated by NSW (NSW DPI 2016), Qld (Queensland Government 2018), SA (PIRSA 2017) and Vic (DEDJTR 2016)	<i>heterophyllus</i> , <i>Carica papaya</i> , <i>Cinnamomum</i> , <i>Citrus aurantium</i> , <i>Codiaeum</i> , <i>Ficus</i> , <i>Gardenia</i> , <i>Hedera</i> , <i>Ilex</i> , <i>Mangifera indica</i> , <i>Persea americana</i> , <i>Persea borbonia</i> , <i>Passiflora</i> , <i>Plumeria rubra</i> and <i>Psidium guajava</i> (García Morales et al. 2019; Gill 1997a; Kosztarab 1997c; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c) Underside of leaves (Kosztarab 1997c; Swirski, Wysoki & Ben-Dov 1997)			
<i>Pseudocribrolectanium andersoni</i> (Newstead)	4	12 countries in Africa and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 17 genera in 15 families of host plants, including avocado, <i>Citrus</i> , cocoa, guava, <i>Litchi chinensis</i> , mango, passionfruit and rubber (Campbell 1997; García Morales et al. 2019; Gill 1997a; Swirski, Wysoki & Ben-Dov 1997)	—	Yes	No
<i>Pseudokermes nitens</i> (Cockerell)	4	Argentina and Brazil	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in three families of host plants, including abaracaatinga and guava (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Pseudokermes vitreus</i> (Cockerell)	1, 4	16 countries in the Americas, and the Caribbean	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in nine families of host plants, including <i>Annona</i> , grape vine, orchids, pigeon pea and red bay (García Morales et al. 2019; Swirski, Wysoki & Ben-Dov 1997)	Intercepted 16 times (1995-2012) in the USA on a variety of host plants from Colombia, Costa Rica, the Dominican Republic, Puerto Rico and St. Lucia (Miller et al. 2014a) Additional interceptions in the USA on <i>Annona</i> , <i>Begonia</i> , <i>Dieffenbachia</i> and orchids from the Caribbean;	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pseudophilippia lanigera</i> (Hempel)	4	Argentina (Corrientes) and Brazil	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Citrus</i> (García Morales et al. 2019; Gill 1997a)	— and on <i>Laurus</i> and <i>Thymelacaceae</i> from Brazil (Miller et al. 2014a)	Yes	No
<i>Pseudophilippia quaintancii</i> Cockerell	4	USA	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae, including <i>Pinus echinata</i> , <i>P. palustris</i> and <i>P. taeda</i> (García Morales et al. 2019; Kosztarab 1997a) Females on shoots at the base of needles (Kosztarab 1997a)	—	Yes	No
<i>Pulvinaria acericola</i> (Walsh & Riley)	4	Canada and USA	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in five families of host plants, including <i>Acer</i> , <i>Cornus</i> , <i>Diospyros</i> , <i>Ilex</i> , <i>Nyssa</i> , <i>Persea</i> , sassafras and red bay (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997d; Swirski, Wysoki & Ben-Dov 1997) First instars and females on underside of leaves and second instars on twigs and branches (Kosztarab 1997b)	—	Yes	No
<i>Pulvinaria aethiopica</i> (De Lotto)	4	Angola, Cape Verde, South Africa, Zambia and Zimbabwe	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including bitter orange and coffee (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Pulvinaria amygdali</i> Cockerell	4	USA	No record found (García Morales et al. 2019)	Monophagous, on peach (<i>Prunus persica</i>) of family Rosaceae (García Morales et al. 2019; Pfeiffer 1997) Crawlers on twigs and the underside of leaves; adult females on twigs (Pfeiffer 1997)	—	Yes	No
<i>Pulvinaria aurantii</i> Cockerell	4, 5	Seven countries in Asia and the Middle East	No record found (García Morales et al. 2019)	Polyphagous, on 15 genera in 13 families of host plants, including <i>Citrus</i> , guava, <i>Diospyros</i> , loquat, <i>Musa</i> and tea (García Morales et al. 2019; Gill	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pulvinaria avasthii</i> Yousuf & Shafee	4	Andaman Islands	No record found (García Morales et al. 2019)	1997a; Greathead 1997b; Swirski, Ben-Dov & Wysoki 1997d) Oligophagous, on three genera in three families of host plants, including guava, <i>Hibiscus</i> and mango (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Pulvinaria bambusicola</i> (Tang)	4	China	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> in family Poaceae (Carnegie 1997; García Morales et al. 2019)	—	Yes	No
<i>Pulvinaria cacao</i> Williams & Watson	4	Indonesia and Papua New Guinea	No record found (García Morales et al. 2019)	Monophagous, on <i>Theobroma cacao</i> of family Malvaceae (Campbell 1997; García Morales et al. 2019)	—	Yes	No
<i>Pulvinaria citricola</i> (Kuwana)	4, 5	Japan	No record found (García Morales et al. 2019)	Polyphagous, on 19 genera in 15 families of host plants, including camphor laurel, Chinese pear, <i>Citrus</i> , <i>Diospyros</i> , <i>Hibiscus</i> , <i>Ilex</i> , <i>Pyrus pyrifolia</i> , tea and <i>Zelkova</i> (García Morales et al. 2019; Gill 1997a; Kosztarab 1997c; Swirski, Ben-Dov & Wysoki 1997d) On leaves and twigs (Kosztarab 1997c)	—	Yes	No
<i>Pulvinaria delottoi</i> Gill	4	South Africa, UK and the USA	No record found (García et al. 2018)	Oligophagous, on six genera in two families of host plants, including <i>Carpobrotus edulis</i> , <i>Cheiridopsis glomerata</i> , <i>Crassula muscosa</i> , <i>Lampranthus</i> , <i>Mesembryanthemum</i> and <i>Sedum</i> (García Morales et al. 2019; Miller et al. 2005; Miller & Miller 2003)	—	Yes	No
<i>Pulvinaria elongata</i> Newstead	4	28 countries in Africa, the Americas, Europe, Oceania, the Caribbean and	Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018)	Further assessment is not required	—	No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019) the Middle East	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pulvinaria ericicola</i> McConnell	4	USA	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Ericaceae, including farkleberry (<i>Vaccinium arboretum</i>), <i>Lyonia</i> and pinkster flower (<i>Rhododendron periclymenoides</i>) (García Morales et al. 2019; Kosztarab 1997b)	—	Yes	No
<i>Pulvinaria eugeniae</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on <i>Plinia cauliflora</i> of family Myrtaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Pulvinaria ficus</i> Hempel	4, 5	Brazil	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in 11 families of host plants, including avocado, <i>Citrus</i> , guava, <i>Ficus</i> and mango (García Morales et al. 2019; Gill 1997a; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Pulvinaria flavescens</i> Brethes in Massini & Brethes	4	Argentina and Brazil	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including bitter orange, <i>Ilex</i> , lemon, mandarin and orange (García Morales et al. 2019; Gill 1997a)	—	Yes	No
<i>Pulvinaria floccifera</i> (Westwood)	1, 4, 6	50 countries in Asia and Europe	Yes, NSW, SA, Vic (ABRS 2018; García Morales et al. 2019) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 53 genera in 37 families of host plants including <i>Anthurium</i> , <i>Avocado</i> , <i>avocado pear</i> , <i>Camellia sinensis</i> , <i>Citrus</i> , <i>Eriobotrya japonica</i> , <i>Euonymus</i> , <i>Ilex</i> , <i>Jasminum</i> , <i>Magnolia</i> , <i>Mimosa</i> , <i>Psidium guajava</i> , <i>Rhododendron</i> and <i>Taxus</i> (García Morales et al. 2019; Gill 1997a; Kosztarab 1997b, c; Swirski, Ben-Dov & Wysoki 1997c; Swirski, Wysoki & Ben-Dov 1997) On leaves and stems (Kosztarab 1997b)	Intercepted 3 times (1995-2012) in the United States from Costa Rica, France and St. Lucia (Miller et al. 2014a) Additional interceptions in the USA on <i>Anthurium</i> , <i>Brassia</i> , <i>Camellia</i> , <i>Chamaedorea</i> , <i>Epidendrum</i> , <i>Cypripedium</i> , <i>Ilex</i> , <i>Lycaste</i> , <i>Miltonia</i> , <i>Odontoglossum</i> , and <i>Oncidium</i> from Caribbean and American nations and territories; and on <i>Ansellia</i> , <i>Camellia</i> , <i>Cattleya</i> , <i>Codiaeum</i> , <i>Cymbidium</i> , <i>Cypripedium</i> , <i>Dendrobium</i> , <i>Hoya</i> , <i>Ilex</i> , <i>Laurus</i> ,	Yes (WA)	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pulvinaria fujisana</i> Kanda	4	Japan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Prunus</i> of family Rosaceae, including East Asian cherry (<i>Prunus serrulata</i>) and Fuji cherry (<i>Prunus incisa</i>) (García Morales et al. 2019; Pfeiffer 1997)	<i>Miltonia</i> , <i>Odontonia</i> , <i>Oncidium</i> , <i>Phalaenopsis</i> , <i>Pittosporum</i> , <i>Taxus</i> , and <i>Vanda</i> from Belgium, Czech Republic, France, Italy, The Netherlands, Portugal and the UK (Miller et al. 2014a)	Yes	No
<i>Pulvinaria hydrangeae</i> Steinweden	1, 4, 5, 6	22 countries in Europe, North America, Asia and Oceania	Yes, ACT, NSW, Qld, Tas, Vic (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA Government of WA, 2018 (Government of Western Australia 2018)	Polyphagous, found on 54 genera in 29 families of host plants, including <i>Acer</i> , <i>Actinidia deliciosa</i> , <i>Actinidia chinensis</i> , cherry, <i>Diospyros</i> , <i>Hydrangea macrophylla</i> , <i>Prunus avium</i> , <i>Pyrus</i> (García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997d, c)	Intercepted once (1995-2012) in the USA on an unidentified commodity from Japan. Additional interceptions in the USA on <i>Acer</i> from France and <i>Camellia</i> from Japan (Miller et al. 2014a)	Yes (WA)	No
<i>Pulvinaria iceryi</i> (Signoret)	4, 5, 6	13 countries in Africa, South America, South Asia and the Caribbean	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in two families of host plants, including mango and sugarcane (Carnegie 1997; García Morales et al. 2019)	—	Yes	No
<i>Pulvinaria idesiae</i> Kuwana	4	Japan	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including Japanese horse chestnut and Japanese persimmon (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997d)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pulvinaria ixorae</i> Green	1, 5	India and Sri Lanka	No record found (García Morales et al. 2019)	Monophagous, on scarlet jungleflame (<i>Ixora coccinea</i>) of family Rubiaceae (García Morales et al. 2019)	Intercepted eight times (1995-2012) in the USA on a variety of host plants from India (Miller et al. 2014a) Additional interceptions in the USA on <i>Murraya</i> from India (Miller et al. 2014a)	Yes	No
<i>Pulvinaria kuwacola</i> Kuwana	4	Hong Kong and Japan	No record found (García Morales et al. 2019)	Oligophagous, on five genera in five families of host plants, including <i>Diospyros</i> , sweet viburnum, white mulberry and yoshino cherry (García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997d)	—	Yes	No
<i>Pulvinaria mammeae</i> Maskell	4	Admiralty Islands	No record found (García Morales et al. 2019)	Oligophagous, on 10 genera in 10 families of host plants, including <i>Citrus aurantium</i> , avocado, pomegranate, bitter orange, <i>Coffea</i> , <i>Ficus</i> , <i>Litchi chinensis</i> , mango, pomegranate and <i>Prunus</i> (García Morales et al. 2019; Gill 1997a; Murphy 1997; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Wysoki & Ben-Dov 1997)	—	Yes	No
<i>Pulvinaria occidentalis</i> Cockerell	4	Canada and USA	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in six families of host plants, including <i>Alnus</i> , <i>Prunus</i> , <i>Pyrus</i> , <i>Ribes</i> , <i>Rosa</i> and white poplar (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Pulvinaria okitsuensis</i> Kuwana	4, 5	China and Japan	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including hardy orange and tea (García Morales et al. 2019; Gill 1997a; Greathead 1997b)	—	Yes	No
<i>Pulvinaria ornata</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Citrus</i> of family Rutaceae (García Morales et al. 2019; Gill 1997a)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pulvinaria peregrina</i> (Borchsenius)	4	Azerbaijan, China and Georgia	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in eight families of host plants, including <i>Acer</i> , common pear, <i>Citrus</i> , <i>Hibiscus</i> , Japanese persimmon, quince and <i>Rosa</i> (García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997d)	—	Yes	No
<i>Pulvinaria persicae</i> Newstead	4	UK	No record found (García Morales et al. 2019)	Monophagous, on peach (<i>Prunus persica</i>) of family Rosaceae (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Pulvinaria polygonata</i> Cockerell	1, 4, 5, 6	13 countries in Asia and Oceania	Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on ten genera in seven families of host plants including <i>Chrysophyllum cainito</i> , <i>Citrus aurantium</i> , <i>Citrus limon</i> , <i>Citrus reticulata</i> , <i>Hydrangea</i> , <i>Mangifera indica</i> and <i>Plumeria rubra</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c) Sucks sap from twigs, secondary infection of sooty mould on leaves (Swirski, Ben-Dov & Wysoki 1997b)	Adults intercepted in Australia on fresh fruit and nursery stock Intercepted three times (1995-2012) in the United States on a variety of host plants from China and Vietnam (Miller et al. 2014a) Additional interceptions in the USA on <i>Murraya</i> from India and Sri Lanka; and on <i>Citrus</i> from Thailand (Miller et al. 2014a)	Yes (WA)	No
<i>Pulvinaria portblairensis</i> Yousuf & Shafee	4	Andaman Islands	No record found (García Morales et al. 2019)	Monophagous, on guava (<i>Psidium guajava</i>) of family Myrtaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Pulvinaria pruni</i> Hunter	4	USA	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Prunus</i> of family Rosaceae (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Pulvinaria psidii</i> Maskell	1, 4, 5	97 countries in Africa, the Americas, Asia, Europe, Oceania, the Caribbean and	Yes, Qld, NT, NSW, ACT, SA, WA (ABRS 2018; García Morales et al. 2019; Government of Western	Further assessment is not required		No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		the Middle East	Australia 2018; Plant Health Australia 2018)				
<i>Pulvinaria regalis</i> Canard	4	Seven countries in Europe	No record found (García Morales et al. 2019)	Polyphagous, on 30 genera in 21 families of host plants, including <i>Acer</i> , common walnut, <i>Ilex aquifolium</i> , <i>Magnolia</i> and <i>Prunus</i> (García Morales et al. 2019)	—	Yes	No
<i>Pulvinaria rhois</i> Ehrhorn	4, 5	USA	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including <i>Malus</i> , Pacific poison oak, peach, plum, <i>Ribes</i> and setose blackberry (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Pulvinaria salicicola</i> Borchsenius	4	China, Tajikistan, Turkey and Turkmenistan	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Populus</i> and <i>Salix</i> of family Salicaceae, including corkscrew willow and <i>Populus</i> (García Morales et al. 2019)	—	Yes	No
<i>Pulvinaria simulans</i> Cockerell	4	Mexico, Guyana and Trinidad and Tobago	No record found (García Morales et al. 2019)	Monophagous, on avocado (<i>Persea americana</i>) of family Lauraceae (Swirski, Wysoki & Ben-Dov 1997)	—	Yes	No
<i>Pulvinaria taiwana</i> Takahashi	4, 5	Taiwan	No record found (García Morales et al. 2019)	Monophagous, on <i>Mangifera indica</i> of family Anacardiaceae (Swirski, Ben-Dov & Wysoki 1997b) Assessed as on pathway for mangoes from Taiwan (Biosecurity Australia 2006c)	—	Yes	No
<i>Pulvinaria tenuivalvata</i> (Newstead)	4	Nine countries in Africa and the Middle East	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in family Poaceae, including corn, rice, sorghum and sugarcane (García Morales et al. 2019)	—	Yes	No
<i>Pulvinaria urbicola</i> Cockerell	1, 4	55 countries in Africa, the Americas, Asia, Oceania,	Yes, NSW, NT, Qld, WA (ABRS 2018; García Morales et al.	Further assessment is not required	—	No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pulvinaria vitis</i> (Linnaeus)	2, 4, 5	the Caribbean and the Middle East 52 countries in the Americas, Asia, Europe, and the Middle East	2019; Government of Western Australia 2018; Plant Health Australia 2018)	Polyphagous, on 30 genera in 14 families of host plants, including <i>Acer</i> , <i>Alnus</i> , apple, <i>Betula</i> , <i>Carpinus</i> , <i>Citrus</i> , <i>Corylus</i> , <i>Crataegus</i> , <i>Cydonia oblonga</i> , <i>Fagus</i> , <i>Juglans regia</i> , <i>Malus</i> , <i>Populus</i> , <i>Prunus persica</i> , <i>Pyrus communis</i> , quince, pear, <i>Prunus</i> , <i>Ribes</i> , <i>Salix</i> , and <i>Vitis vinifera</i> (García Morales et al. 2019; Gill 1997a; Kosztarab 1997b, c; Pellizzari 1997a; Pfeiffer 1997) Crawlers on underside of leaves and young twigs, adult females on twigs, canes and branches (Kosztarab 1997b, c; Pellizzari 1997a; Pfeiffer 1997) Assessed as on pathway for table grapes from China (Biosecurity Australia 2011a)	—	Yes	Yes (Herrbach et al. 2017)
<i>Pulvinariella mesembryanthemi</i> (Vallot)	1, 4	28 countries in Africa, Europe, Oceania, the USA, South America and the Middle East	Yes, NSW, Qld, SA, Tas, Vic, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No
<i>Pulvinarisca inopheron</i> (Laing)	4	Uganda and Zimbabwe	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in 10 families of host plants, including <i>Annona</i> , <i>Erythrina</i> , <i>Ficus</i> and <i>Hibiscus</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Pulvinaria jacksoni</i> (Newstead)	4	15 countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on 12 genera in seven families of host plants, including cocoa tree, cotton, custard apple, <i>Annona</i> , <i>Ficus</i> and granadilla (Campbell 1997; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Rhodococcus sariuoni</i> Brochsenius	5	China and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Rosaceae, including <i>Malus</i> and <i>Prunus</i> (García Morales et al. 2019)	—	Yes	No
<i>Rhodococcus turanicus</i> (Archangelskaya)	4	12 countries in Asia, Europe and the Middle East	No record found (García Morales et al. 2019)	Polyphagous, on 13 genera in seven families of host plants, including quince, apple, plum, common pear, amygdalus, apricot, walnut, nectarine and <i>Ribes</i> (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Saccharolecanium fujianense</i> Tang	4	China	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Sasa</i> of family Poaceae (Carnegie 1997; García Morales et al. 2019)	—	Yes	No
<i>Saccharolecanium krugeri</i> (Zehntner)	4	Indonesia, India, Malaysia and Sri Lanka	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Saccharum</i> of family Poaceae including sugarcane (Carnegie 1997; García Morales et al. 2019)	—	Yes	No
<i>Saissetia anonae</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Annona</i> of family Annonaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Saissetia chitonoides</i> De Lotto	4	Tanzania	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Annona</i> of family Annonaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Saissetia coffeae</i> (Walker)	1, 4, 5	118 countries in Africa, the Americas, the Caribbean, Asia, Europe, Oceania and	Yes, Qld, NSW, NT, Tas, WA, SA, ACT, Vic (ABRS 2018; García Morales et al. 2019; Government of	Further assessment is not required	—	No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		the Middle East	Western Australia 2018; Plant Health Australia 2018)				
<i>Saissetia discoides</i> (Hempel)	4	Brazil	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including guava (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Saissetia hurae</i> (Newstead)	4	Guyana	No record found (García Morales et al. 2019)	Monophagous, on sandbox tree (<i>Hura crepitans</i>) of family Euphorbiaceae (García Morales et al. 2019)	—	Yes	No
<i>Saissetia miranda</i> (Cockerell & Parrott)	1, 4, 5	35 countries in Africa, the Americas, Europe, Asia, Oceania, the Caribbean and the Middle East	Yes, Qld, NT, WA (ABRS 2018; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No	No
<i>Saissetia neglecta</i> De Lotto	1, 4, 6	20 countries in the Americas, Asia, Oceania and the Caribbean	Yes, Qld (Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 57 genera in 34 families of host plants, including avocado, <i>Agave</i> , <i>Citrus</i> , guava, coffee, <i>Ficus</i> , mango, <i>Musa</i> and soursop (García Morales et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997d, c; Swirski, Wysoki & Ben-Dov 1997)	Intercepted 126 times (1995-2012) in the USA on a variety of host plants from the Azores, Bahamas, Belize, Brazil, British Virgin Islands, Cayman Islands, China, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Guyana, Honduras, India, Italy, Jamaica, Malaysia, Mexico, The Netherlands, Nigeria, Puerto Rico, St. Lucia, Taiwan, Thailand, US Virgin Islands and Vietnam (Miller et al. 2014a)	Yes (WA)	No
<i>Saissetia oleae</i> (Olivier)	1, 4, 5	104 countries in Africa, the Americas, the	Yes, Vic, NSW, Qld, Tas, SA, WA, NT (ABRS 2018; García	Further assessment is not required	—	No	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		Caribbean Asia, Europe, Oceania, and the Middle East	Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)				
<i>Saissetia persimilis</i> (Newstead)	4	6 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 20 genera in 15 families of host plants, including <i>Ficus</i> , <i>Hibiscus</i> , nectarine, oleander, peach and <i>Vitis</i> (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Saissetia privigna</i> De Lotto	4, 5, 6	15 countries in Africa, Europe, South Asia and the Middle East	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in 10 families of host plants, including bitter orange, coffee, olive, cotton, <i>Hibiscus fuscus</i> , mango, potato and squash (García Morales et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997b) Assessed as on pathway for mangoes from Pakistan (Biosecurity Australia 2011b)	—	Yes	No
<i>Saissetia socialis</i> Hempel	4	Brazil	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including quince (García Morales et al. 2019; Pfeiffer 1997)	—	Yes	No
<i>Saissetia somereni</i> (Newstead)	4	Nine countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 18 genera in 11 families of host plants, including bitter orange, guava and <i>Ficus</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Saissetia vivipara</i> Williams & Watson	1	Papua New Guinea, Solomon Islands and Hong Kong	No record found (García Morales et al. 2019)	Oligophagous, on six genera in six families of host plants, including <i>Ficus</i> , island lychee and native mulberry (García Morales et al. 2019)	Nymphs and adults intercepted in Australia on fresh fruit	Yes	No
<i>Saissetia zanzibarensis</i> Williams	4	Kenya and Zanzibar	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in 12 families of host plants, including avocado, coconut, <i>Coffea</i> , guava and mango (Chua 1997a; García Morales	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Sphaerolecanium prunastri</i> (Boyer de Fonscolombe)	4, 5	33 countries in Asia, Europe, USA and the Middle East	No record found (García Morales et al. 2019)	et al. 2019; Murphy 1997; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Wysoki & Ben-Dov 1997) Oligophagous, on nine genera in five families of host plants, including fig, pear, <i>Malus</i> , <i>Prunus</i> and <i>Vitis</i> (García Morales et al. 2019; Kosztarab 1997b, c; Pfeiffer 1997) Nymphs and adult females on the underside of twigs and branches (Kosztarab 1997b)	—	Yes	No
<i>Stictolecanium ornatum</i> (Hempel)	4	Brazil	No record found (García Morales et al. 2019)	Monophagous, on Brazilian grapetree (<i>Plinia cauliflora</i>) of family Myrtaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Takahashia japonica</i> (Cockerell)	4, 5	China, Japan, and South Korea	No record found (García Morales et al. 2019)	Polyphagous, on 16 genera in 13 families of host plants, including <i>Citrus</i> , common walnut, Japanese persimmon and Japanese plum (García Morales et al. 2019; Pfeiffer 1997; Swirski, Ben-Dov & Wysoki 1997d)	—	Yes	No
<i>Tillancoccus mexicanus</i> Ben-Dov	1	Mexico and Guatemala	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Tillandsia</i> of family Bromeliaceae, including <i>Tillandsia concolor</i> and <i>Tillandsia juncea</i> (García Morales et al. 2019)	Intercepted 18 times (1995-2012) in the USA on host plants from Honduras and Mexico (Miller et al. 2014a) Additional interceptions in the USA on <i>Tillandsia</i> from Mexico (Miller et al. 2014a)	Yes	No
<i>Tillancoccus tillandsiae</i> Ben-Dov	1	Mexico, Guatemala and Honduras	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Tillandsia</i> of family Bromeliaceae (García Morales et al. 2019)	Intercepted in the USA frequently during the 1980's and early 1990's. Not intercepted in the USA between 1995 and 2012 (Miller et al. 2014a) Additional interceptions in the USA on Bromeliads and <i>Tillandsia</i> from Guatemala; on Bromeliads from Honduras; and on <i>Aechmea</i> and	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Toumeyella cubensis</i> Heidel & Köhler	4	Cuba	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including <i>Citrus</i> , coffee and laurel (García Morales et al. 2019; Gill 1997a; Murphy 1997)	— <i>Tillandsia</i> from Mexico (Miller et al. 2014a)	Yes	No
<i>Toumeyella liriodendri</i> (Gmelin)	4	USA and Cuba	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in eight families of host plants, including southern magnolia, avocado, red bay and <i>Populus</i> (García Morales et al. 2019; Swirski, Wysoki & Ben-Dov 1997)	—	Yes	No
<i>Toumeyella parvicornis</i> (Cockerell)	4	Six countries in North America, Europe and the Caribbean	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae (García Morales et al. 2019; Kosztarab 1997a) Nymphs on needles, females on stems (Kosztarab 1997a)	—	Yes	No
<i>Toumeyella pini</i> (King)	4	Canada and the USA	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae, including black pine (<i>Pinus nigra</i>), mountain pine (<i>Pinus mugo</i>) and scots pine (<i>Pinus sylvestris</i>) (García Morales et al. 2019; Kosztarab 1997a) Females on new shoots, at the base of cones and occasionally on twigs (Kosztarab 1997a)	—	Yes	No
<i>Toumeyella virginiana</i> Williams & Kosztarab	4	USA	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae including caribbean pine (<i>Pinus caribaea</i>), longleaf pine (<i>Pinus palustris</i>) and Virginia pine (<i>Pinus virginiana</i>) (García Morales et al. 2019; Kosztarab 1997a) Females on twigs and stems, often under bark (Kosztarab 1997a)	—	Yes	No
<i>Trijuba oculata</i> (Brain)	4	Seven countries in	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in seven families of host plants, including <i>Annona</i> , common grape	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
		Africa and South Asia		vine and Ficus (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)			
<i>Udinia catoris</i> (Green)	1, 4	Nine countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 18 genera in 14 families of host plants, including avocado, <i>Citrus</i> , cocoa tree, <i>Cola</i> , guava, <i>Ficus</i> , mango and star apple (Campbell 1997; Evans & Dooley 2013; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997b; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c)	Intercepted 49 times (1995-2012) in the USA on a variety of host plants from Africa and India (Miller et al. 2014a) Additional interceptions in the USA on <i>Cola</i> from Ghana; on <i>Annona</i> , <i>Cola</i> and <i>Mangifera</i> from Nigeria; and on <i>Mangifera</i> from Senegal, Sierra Leon, Côte d'Ivoire and Zambia (Miller et al. 2014a)	Yes	No
<i>Udinia farquharsoni</i> (Newstead)	1, 4, 5	13 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 21 genera in 14 families of host plants, including clove, cocoa tree, <i>Coffea</i> , <i>Citrus</i> , durian, <i>Ficus</i> , <i>Gardenia</i> and <i>Syzygium caryophyllatum</i> (Campbell 1997; Evans & Dooley 2013; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	Intercepted three times (1995-2012) in the USA on a variety of host plants from Guinea, Kenya, and Nigeria (Miller et al. 2014a) Additional interceptions in the USA on <i>Cola</i> from Democratic Republic of the Congo; on <i>Mangifera</i> from Morocco; and on <i>Theobroma</i> from Nigeria (Miller et al. 2014a)	Yes	No
<i>Udinia glabra</i> De Lotto	4	Uganda	No record found (García Morales et al. 2019)	Monophagous on <i>Coffea canephora</i> of family Rubiaceae (García Morales et al. 2019; Murphy 1997)	—	Yes	No
<i>Udinia newsteadi</i> Hanford	4	Côte d'Ivoire, Democratic Republic of the Congo, Ghana and Tanzania	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including <i>Diospyros mannii</i> , <i>Durio zibethinus</i> and <i>Ficus</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Udinia paupercula</i> De Lotto	4	Six countries in Africa	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in six families of host plants, including <i>Coffea</i> , mango, rambutan	—	Yes	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest	Virus vector
<i>Udinia pterolobina</i> (De Lotto)	4	Côte d'Ivoire and Kenya	No record found (García Morales et al. 2019)	and <i>Syzygium caryophyllatum</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c) Oligophagous, on two genera in two families of host plants, including camp siege (<i>Pterolobium hexapetalum</i>) and guava (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Udinia setigera</i> (Newstead)	4	Cameroon, Côte d'Ivoire and Uganda	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including guava (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a)	—	Yes	No
<i>Umwinsia nitidula</i> (De Lotto)	4	Kenya	No record found (García Morales et al. 2019)	Monophagous, on wild custard apple (<i>Annona senegalensis</i>) of family Annonaceae (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Vitrococcus conchiformis</i> (Newstead)	4	10 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in six families of host plants, including <i>Annona</i> , carambola, cocoa tree, guava, mamey sapote and pigeon pea (Campbell 1997; García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997a; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Waxiella subdenudata</i> (Newstead)	4	South Africa and Uganda	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including <i>Acacia</i> , <i>Albizia</i> and <i>Annona</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Waxiella subsphaerica</i> (Newstead)	4	10 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in four families of host plants, including <i>Albizia</i> , <i>Annona</i> , <i>Berlinia</i> , <i>Brachystegia</i> and <i>Manilkara mochisia</i> (García Morales et al. 2019; Swirski, Ben-Dov & Wysoki 1997c)	—	Yes	No
<i>Xenolecanium mangiferae</i> Takahashi	5	Thailand (García Morales et al. 2019)	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Mangifera</i> of family Anacardiaceae, including <i>Mangifera indica</i> (García Morales et al. 2019)	—	Yes	No

9 Appendix C: Pest categorisation of Diaspididae (hard scales)

Pest categorisation was undertaken in each column as described:

Column 1 indicates the identity of the pest. The most recent valid scientific name is used, and some junior synonyms are also indicated when information related to the synonym is commonly found in the literature.

Column 2 gives the reason(s) why the species is included within the categorisation table, based on the selection criteria set out in Table 2.1.

Column 3 provides a global distribution for the species, mainly based on the ScaleNet database (García Morales et al. 2019).

Column 4 assesses species absence or presence and its regulatory status within the PRA area. Absence or presence status is mostly based on the ScaleNet database (García Morales et al. 2019). Regulatory status in Australia was based on publicly available information from plant quarantine legislations and manuals by the states and territories.

Column 5 includes host plants, plant parts affected and/or previous pathway assessment(s). Information for host plants includes the number of genera and families and is mainly based on García Morales et al. (2019). The terms monophagous, oligophagous, polyphagous and highly polyphagous are used to describe the scale species. Monophagous is defined as feeding on one genus, oligophagous on two to 10 genera, polyphagous on 11 or more genera and highly polyphagous on 50 or more families of host plants. Plant parts affected by the pest are included, when information is available. Species assessed as on specific commodity pathway in previous PRAs are indicated. Species identified by Australian industries as a high priority pest in relevant industry biosecurity plans are also indicated in this column.

Column 6 summarises interception events from Australia and other countries, when information is available.

Column 7 identifies species requiring further assessment as a quarantine pest. If the pest is not present in Australia or present but under official control, it is considered further.

Table 9.1 Pest categorisation of Diaspididae (hard scales)

Abbreviation of Australian states or territories: ACT–Australian Capital Territory, NSW–New South Wales, NT–Northern Territory, Qld–Queensland, SA–South Australia, Tas–Tasmania, Vic–Victoria, WA–Western Australia

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Acanthomytilus intermittens</i> (Hall)	4	13 countries in Asia, Africa and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 10 genera of family Poaceae, including <i>Arundo</i> , the widely distributed Bermuda grass <i>Cynodon dactylon</i> , <i>Imperata</i> , <i>Phragmites</i> and sugarcane (García Morales et al. 2019; Watson 2018) On stems or under the leaf sheaths (Watson 2018)	—	Yes
<i>Acanthomytilus sacchari</i> (Hall)	4	13 countries in Asia, Africa and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in two families of host plants, mainly in the family Poaceae, including genus <i>Dasyilirion</i> of family Asparagaceae, sugarcane and sorghum (García Morales et al. 2019) On stems under the leaf sheaths (Watson 2018) and also on rhizome of sorghum (Doganlar et al. 2010) during vegetative, flowering and fruiting stages of the host plants (Watson 2018)	—	Yes
<i>Acutaspis albopicta</i> (Cockerell)	1, 4	Nine countries in North and South Americas	No record found (García Morales et al. 2019)	Polyphagous on 14 genera in 13 families of host plants, including avocado, Bromeliads, coconut, <i>Musa</i> , persimmon and <i>Gardenia</i> (García Morales et al. 2019) (Ferris 1941) On fruits and leaves of avocado (Waterworth et al. 2012)	Intercepted in California, USA on avocados from Mexico (Millar et al. 2012; Morse et al. 2009; Stocks & Evans 2017)	Yes
<i>Acutaspis paulista</i> (Hempel)	1, 4	Argentina and Brazil	No record found (García Morales et al. 2019)	Polyphagous, on 29 genera in 23 families of host plants, including <i>Annona</i> , bay laurel, banana, <i>Begonia</i> , <i>Camellia</i> , <i>Citrus</i> , guava, mango, olive and <i>Rosa</i> (García Morales et al. 2019) On leaves and young branches of the plant at vegetative, flowering and fruiting stage (Watson 2018)	Intercepted in the USA on unnamed commodities from Peru (Watson 2018)	Yes
<i>Acutaspis perseae</i> (Comstock)	1, 4	Eight countries in North and Central	No record found (García Morales et al. 2019)	Polyphagous, on 19 genera in 14 families of host plants including anthurium, avocado, cacti, coconut, <i>Citrus</i>	Intercepted in the USA on avocados (Stocks & Evans 2017)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
		America, Europe, and the Caribbean Islands		olive, pine, <i>Citrus</i> and orchids (García Morales et al. 2019) On leaves during the vegetative, flowering and fruiting stages of the plant (Watson 2018)		
<i>Acutaspis scutiformis</i> (Cockerell)	1, 4	Six countries in North and South Americas	No record found (García Morales et al. 2019)	Polyphagous, on 10 genera in eight families of host plants including avocado, breadfruit, banana (Chua & Wood 1990), <i>Citrus</i> , <i>Ficus</i> and sweet bay (García Morales et al. 2019) On leaves (Ferris 1941)	Intercepted in the USA on <i>Aglaonema</i> from Costa Rica (Evans & Dooley 2013) and on avocado seeds from Guatemala (Sasscer 1918)	Yes
<i>Acutaspis umbonifera</i> (Newstead)	1, 4	Six countries in North and South Americas	No record found (García Morales et al. 2019)	Oligophagous, on five genera in five families of host plants, including anthurium, <i>Attalea</i> and cactus, and <i>Heliconia</i> (Ferris 1941) On leaves (Ferris 1941)	Intercepted in the USA on various plants from Mexico, Central and South America (Evans & Dooley 2013)	Yes
<i>Adiscodiaspis ericicola</i> (Marchal)	4	Seven countries in Europe	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Erica</i> of family Ericaceae (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Andaspis hawaiiensis</i> (Maskell)	1, 4, 5	22 countries in Africa, North and South America and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 36 genera in 23 families of host plants, including citrus, <i>Eugenia</i> , <i>Hydrangea</i> , <i>Jasminum</i> , lychees, mango, persimmons, pomegranate, <i>Rosa</i> and <i>Solanum</i> (García Morales et al. 2019) On the bark underneath the epidermis and occasionally on leaves and fruits (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for Unshu mandarin from Japan (Biosecurity Australia 2009)	Introduced to USA from Oceania or Asia, possibly on <i>Litchi</i> or other fruits (Miller & Davidson 2005)	Yes
<i>Andaspis numerata</i> Brimblecombe	1, 4	Oceania and India	Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Anzaspis cordylinidis</i> (Maskell)	4	Australia and New Zealand	Health Australia 2018) Yes, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aonidia lauri</i> (Bouché)	4	31 countries in Europe, the Americas and Africa	No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including bay laurel and fig (García Morales et al. 2019) On stems branches and leaves (Malumphy 1997a)	—	Yes
<i>Aonidia oleae</i> Leonardi	4	Eritrea	No record found (García Morales et al. 2019)	Monophagous, on <i>Olea europaea</i> of family Oleaceae (García Morales et al. 2019)	—	Yes
<i>Aonidiella aurantii</i> (Maskell)	1, 3, 4, 5	Worldwide in 87 countries	Yes, NSW, NT, Qld, SA, TAS, Vic, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aonidiella citrina</i> (Coquillett)	1, 3, 4, 5	53 countries worldwide	Yes, NSW, SA, Vic, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aonidiella comperei</i> McKenzie	1, 5	23 countries in Asia, Pacific islands and Central and South Americas	Health Australia 2018) Yes, WA, NT, Qld (Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aonidiella inornata</i> McKenzie	1, 5	25 countries in Oceania, Asia, Caribbean Islands, North and South Americas and Africa	Yes, Qld, NT, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aonidiella orientalis</i> (Newstead)	1, 5	36 countries in Africa, Asia, Oceania, Caribbean Islands and North and South America	Yes, Qld, NT, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aonidiella replicata</i> (Lindinger)	4	Seven countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 10 genera in 10 families of host plants, including cacao, camphor, manihot and pink cedar (García Morales et al. 2019) On leaves (McKenzie 1946)	—	Yes
<i>Aonidiella taxus</i> Leonardi	1, 4	12 countries in the Americas, Asia and Europe	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of coniferous host plants, including <i>Cephalotaxus</i> , <i>Podocarpus</i> , and <i>Taxus</i> (García Morales et al. 2019) On the undersides of leaves/needles, and occasionally on twigs (Davidson & Miller 1990; Watson 2018)	Intercepted in Croatia on <i>Podocarpus macrophilus</i> and <i>Taxus</i> spp. from Asia (Masten Milek, Simala & Pintar 2016)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aonidomytilus albus</i> (Cockerell)	3, 4, 5	45 countries in Africa, the Americas, Caribbean Islands and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 16 genera in 12 families of host plants, including cassava, <i>Croton</i> , <i>Chrysanthemum</i> , <i>Jatropha</i> , mango, manihot, papaya, <i>Sechium</i> , <i>Solanum</i> , <i>Rosa</i> and <i>Sida</i> (Bellotti et al. 2012; García Morales et al. 2019) On lower stems, side shoots, petioles and ventral surfaces of leaves, underground bulbs, tubers and rhizomes; affecting host plants during the vegetative, flowering, fruiting and post-harvest stages (CABI 2018d; Watson 2018) Assessed as on pathway for mangoes from Taiwan (Biosecurity Australia 2006c)	—	Yes
<i>Aspidiella agalegae</i> Mamet	4	Agalega islands	No record found (García Morales et al. 2019)	Monophagous, on banana (<i>Musa x paradisiaca</i>) of family Musaceae (García Morales et al. 2019)	—	Yes
<i>Aspidiella hartii</i> (Cockerell)	1, 3, 4, 5	21 countries in Africa, Pacific islands, Caribbean islands and South East Asia	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in eight families of host plants, including <i>Colocasia</i> , <i>Dioscorea</i> , <i>Ipomea</i> , <i>Turmeric</i> and <i>Zingiber</i> (García Morales et al. 2019) On tubers/yams, roots and occasionally on the aerial parts of the plant (Watson 2018); affecting host plants during the vegetative, reproductive and post harvest stages (Watson 2018); A pest of yams in the field as well as in storage (Chua & Wood 1990) Assessed as on pathway for ginger from Fiji (DAFF 2013a); identified as a high priority pest for the ginger industry by Plant Health Australia	Adults intercepted in Australia on fresh ginger Intercepted in the USA on fresh <i>Dioscorea</i> and <i>Zingiber</i> roots from Africa, Barbados, Haiti, Thailand and Vietnam (Evans & Dooley 2013; Miller & Davidson 1990)	Yes
<i>Aspidiella sacchari</i> (Cockerell)	4, 5	37 countries in Africa, the Americas, Pacific islands, Caribbean islands and South East Asia	Yes, Qld, NT, WA (Plant Health Australia 2018); (Government of Western Australia 2018)	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aspidiotus atomarius</i> (Hall)	4	Kenya and Zaire	No record found (García Morales et al. 2019)	Monophagous, on tea plant (Nagarkatti & Sankaran 1990) of family Theaceae On the undersurface of leaves (Munting 1971)	—	Yes
<i>Aspidiotus capensis</i> (Newstead)	1, 4	South Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including <i>Cycas</i> and <i>Encephalartos</i> (García Morales et al. 2019)	Intercepted in the USA on <i>Encephalartos</i> and cycads from South Africa (Evans & Dooley 2013)	Yes
<i>Aspidiotus chinensis</i> Kuwana & Muramatsu	1, 4	China and Japan	No record found (García Morales et al. 2019)	Oligophagous, on <i>Caryopteris incana</i> of family Lamiaceae and <i>Cymbidium faberi</i> of family Orchidaceae (Suh 2008)	Intercepted in South Korea on <i>Cymbidium</i> from China and Japan (Suh 2016a)	Yes
<i>Aspidiotus coryphae</i> Cockerell & Robinson	1, 4, 5	Philippines	No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including banana (Sugimoto 1994), <i>Cocos</i> , <i>Corypha</i> , <i>Cycas</i> and <i>Roystonea</i> (García Morales et al. 2019) Assessed as on pathway for mature hard green banana from the Philippines (Biosecurity Australia 2008b)	Intercepted in South Korea on <i>Cocos</i> from the Philippines (Suh 2016a). Intercepted in Japan on banana from the Philippines (Sugimoto 1994)	Yes
<i>Aspidiotus cryptomeriae</i> Kuwana	4	USA, Russia, Japan, mainland China, South Korea and Taiwan	No record found (García Morales et al. 2019)	Polyphagous, on 13 genera in four families of host plants, including conifers such as <i>Abies</i> , <i>Cedrus</i> , <i>Cephalotaxus</i> , <i>Chamaecyparis</i> , <i>Juniperus</i> , <i>Picea</i> , <i>Pinus</i> , <i>Taxus Tsuga</i> , and <i>Torreya</i> (García Morales et al. 2019) On the undersides of needles covered with a thin layer of host cuticle (Miller & Davidson 2005)	—	Yes
<i>Aspidiotus destructor</i> Signoret	1, 4, 5	93 countries worldwide	Yes, Qld, NT, NSW, Vic, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aspidiotus elaeidis</i> Marchal	4	14 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 15 genera in 12 families of host plants, including cacao, <i>Bridelia</i> , <i>Diospyros</i> , olive, coconut, <i>Elaeis guineensis</i> , manihot, mistletoes, and plums (García Morales et al. 2019) On leaves and fruits (Chua & Wood 1990)	—	Yes
<i>Aspidiotus excisus</i> Green	1, 4, 5	47 countries in the Americas, Pacific islands, Caribbean islands and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 27 genera in 24 families of host plants, including annona, <i>Aglaonema</i> , banana, <i>Citrus</i> , coconut, grapevine, <i>Ipomea</i> , orchids, papaya, <i>Piper</i> , <i>Rhus</i> , <i>Rhododendron</i> (García Morales et al. 2019) On leaves and green stems. May form gall-like folds on leaves during heavy infestations (Miller & Davidson 2005) Assessed as on pathway for mature hard green banana from the Philippines (Biosecurity Australia 2008b)	Adult females intercepted in Taiwan from mainland China on <i>Garcinia mangostana</i> (Chen, Wong & Wu 2014). Intercepted in South Korea on <i>Anana</i> from the Philippines, <i>Picea</i> from Canada, <i>Vitis</i> from Chile and <i>Musa</i> from China, Ecuador, Guatemala, Malaysia, Mexico, Mozambique, Peru, the Philippines, Sri Lanka and Thailand (Suh 2016a). Intercepted in Japan on banana from the Phillipines (Sugimoto 1994)	Yes
<i>Aspidiotus kellyi</i> Brain	4	South Africa and India	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Poaceae, including <i>Diheteropogon amplexens</i> and sugarcane (García Morales et al. 2019)	—	Yes
<i>Aspidiotus nerii</i> Bouché	1, 4, 5	73 countries worldwide	Yes, NSW, Qld, SA, Vic, TAS, WA, NT (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aspidiotus rigidus</i> Reyne	4	Indonesia, Palau and the Philippines	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in three families of host plants including, coconut, banana and mangosteen (García Morales et al. 2019; Reyne 1947) On lower leaf surfaces (Molet 2015)	—	Yes
<i>Aspidiotus tafiranus</i> Lindinger	4	Canary Islands	No record found (García Morales et al. 2019)	Monophagous, on olive (<i>Olea europaea</i>) of family Oleaceae (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Aulacaspis actinidiae</i> Takagi	4	Taiwan	No record found (García Morales et al. 2019)	Monophagous, on kiwi fruit (<i>Actinidia callosa</i>) of family Actinidiaceae (García Morales et al. 2019)	—	Yes
<i>Aulacaspis australis</i> Brimblecombe	4, 5	Australia, Papua New Guinea and India	Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aulacaspis bambusae</i> (Green)	4	Sri Lanka	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019) On stems and branches (Varshney 2002)	—	Yes
<i>Aulacaspis cinnamomorum</i> Takagi	4	Malaysia	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Cinnamomum</i> of family Lauraceae, including <i>Cinnamomum impressicostatum</i> and <i>Cinnamomum scortechinii</i> (García Morales et al. 2019) On leaves (Takagi 2014)	—	Yes
<i>Aulacaspis citri</i> Chen	1, 4	China	No record found (García Morales et al. 2019)	Oligophagous, on five genera in five families of host plants, including <i>Citrus</i> , <i>Cinnamomum</i> (Camphor), and <i>Smilax</i> (García Morales et al. 2019) On leaves, fruits and young branches (Danzig & Pellizzari 1998)	Intercepted in South Korea on <i>Citrus</i> from China (Suh 2016a) Adult females intercepted in Taiwan on <i>Cymbopogon citratus</i> from Vietnam (Chen, Wong & Wu 2014)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aulacaspis crawii</i> (Cockerell)	1, 4	17 countries in Africa, Asia, Australasia and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 15 genera in 12 families of host plants, including <i>Citrus</i> , <i>Castor</i> , <i>Cymbidium</i> orchid, tea, and <i>Ziziphus</i> (García Morales et al. 2019) On leaves and branches (Danzig & Pellizzari 1998)	Intercepted in the USA on <i>Citrus</i> , <i>Cymbidium</i> , <i>Hibiscus</i> , <i>Murraya</i> and <i>Poincirus</i> from China, and on orchids from Asia and El Salvador (Evans & Dooley 2013). Intercepted in South Korea on <i>Cymbidium</i> from China (Suh 2016a). Intercepted in England and Wales on fresh mango fruit from Kenya in 1965 (Malumphy 1996)	Yes
<i>Aulacaspis depressa</i> (Zehntner)	4	China, India, Indonesia and the Philippines	No record found (García Morales et al. 2019)	Monophagous, on munj sweetcane (<i>Saccharum bengalense</i>) of family Poaceae (García Morales et al. 2019) On stalks and under the leaf sheaths (Williams & Greathead 1990)	—	Yes
<i>Aulacaspis hedyotidis</i> (Green)	4	Seven countries in South East Asia	No record found (García Morales et al. 2019)	Oligophagous, on six genera in four families of host plants, including durian, <i>Hedyotis</i> , mango, <i>Mallotus</i> , <i>Oldenlandia</i> and <i>Pleiocraterium</i> (García Morales et al. 2019) On leaves (Varshney 2002)	—	Yes
<i>Aulacaspis ima</i> Scott	1	China	No record found (García Morales et al. 2019)	Monophagous, on <i>Lindera communis</i> of family Lauraceae (Scott 1952) On leaves (Danzig & Pellizzari 1998)	Intercepted in the USA on <i>Cinnamomum</i> from India (Evans & Dooley 2013)	Yes
<i>Aulacaspis longanae</i> Chen, Wu & Su	5	China	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including guatemalan avocado (<i>Machilus nanmu</i>) and longan (<i>Dimocarpus longan</i>) (García Morales et al. 2019) On leaves (DAFF 2004a)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aulacaspis madiunensis</i> (Zehntner)	1, 3	21 countries in Africa, Australasia and Asia	Yes, Qld, SA, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018). The record of this species in Victoria in ScaleNet database (García Morales et al. 2019) is uncertain. The record cites Wright 1971 as basis. There appear to be three records of this species from Victoria located in the QDPC according to APPD. However, there are no exact locality details for these records (just "Victoria"). Apparently, these specimens were collected on sugarcane but there is no sugarcane industry in	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aulacaspis mali</i> Borchsenius	4	Russia	Victoria. There are no specimens of this species in the VAIC. No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including hop (<i>Humulus</i>), Korean mountain ash (<i>Sorbus alnifolia</i>), mountain/Chinese hawthorn (<i>Crataegus pinnatifida</i>), and Manchurian crab apple (<i>Malus mandshurica</i>) (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Aulacaspis neospinosa</i> Tang	1, 4	China	No record found (García Morales et al. 2019)	Oligophagous on two orchid genera <i>Chloraea</i> and <i>Cymbidium</i> and (García Morales et al. 2019)	Adult females intercepted in South Korea on <i>Cymbidium</i> from China (Suh 2016a)	Yes
<i>Aulacaspis rosae</i> (Bouché)	1, 4, 5	74 countries worldwide	Yes, NSW, TAS, SA, Vic, WA (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aulacaspis rosarum</i> Borchsenius	1	11 countries in Australasia and Asia	Yes, Qld (ABRS 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aulacaspis spinosa</i> (Maskell)	1	Japan, mainland China and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including China root (<i>Smilax china</i>) <i>Machilus</i> and <i>Rhapis</i> (lady palm) (García Morales et al. 2019) On stems and branches, occasionally on the underside of leaves (Danzig & Pellizzari 1998)	Adult females intercepted in South Korea on <i>Cymbidium</i> from China (Suh 2016a)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aulacaspis takarai</i> Takagi	3	Ryukyu Islands	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Poaceae, including <i>Bambusa</i> , <i>Miscanthus</i> and <i>Pleioblastus</i> and sugarcane (García Morales et al. 2019)	—	Yes
<i>Aulacaspis tegalensis</i> (Zehntner)	3, 4, 6	18 countries in Africa and Asia	Yes, Qld (Thursday Island/Torres Strait) (Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Oligophagous, on seven genera in six families of host plants, including Chinese windmill palm, <i>Cymbidium</i> , Indian pluchea, <i>Smilax china</i> , sorghum, and sugarcane (García Morales et al. 2019) On stems (under the leaf sheaths, near the nodes) and occasionally on leaves (Watson 2018) during vegetative growing, flowering and fruiting stages (Watson 2018)	—	Yes (WA)
<i>Aulacaspis tubercularis</i> (Newstead)	1, 3, 4, 5	72 countries in the Americas, Africa, Asia and Oceania	Yes, Qld, NT, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Aulacaspis vitis</i> (Green)	1, 5	Seven countries in Asia	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in 12 families of host plants, including banana, durian, grapevines, jackfruit, <i>Kandelia</i> (a mangrove), <i>Machilus</i> , mango, and <i>Mallotus</i> (García Morales et al. 2019) On leaves during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for mango from Taiwan (Biosecurity Australia 2006c)	Intercepted in South Korea on <i>Durio</i> from Thailand and on <i>Musa</i> from Peru (Suh 2016a)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Aulacaspis yasumatsui</i> Takagi	1, 3, 4	36 countries in North America, Carriibbean islands, Asia, Europe, Côte d'Ivoire, Pacific islands	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in three families of host plants, including <i>Bowenia</i> , <i>Cycas</i> , <i>Dioon</i> , <i>Encephalartos</i> , <i>Macrozamia</i> , <i>Microzamia</i> , <i>Microcycas</i> , <i>Stangeria</i> , and <i>Zamia</i> (García Morales et al. 2019) Mainly on the undersides of fronds/pinnae, but in heavy infestations both surfaces of the fronds and all aerial parts become infested (Watson 2018); sometimes even the roots of heavily infested plants are covered with scales and can occur as deep as 60cm in soil (Miller & Davidson 2005)	Intercepted in South Korea on <i>Cycas</i> from mainland China, Malaysia, the Philippines, Taiwan and Vietnam (Suh, Yu & Hong 2013; Suh 2016a). Intercepted in the USA (Florida) on cycads imported from Southeast Asia (Howard et al. 1999) Intercepted in the UK on cycads from Vietnam and in Netherlands on cycads from Vietnam Taiwan and Costa Rica (Germain & Hodges 2007). Intercepted in France on cycads from Vietnam and on cut foliage of cycad from Ivory Coast (Germain & Hodges 2007)	Yes
<i>Carulaspis juniperi</i> (Bouché)	4	43 countries in the Americas, Oceania, Europe and Africa	Yes, TAS (García Morales et al. 2019; Plant Health Australia 2018)	Further assessment is not required		No
<i>Carulaspis minima</i> (Signoret)	1, 4	46 countries in Africa, Hawaiian Islands, North and South Americas, Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 13 genera in four families of coniferous host plants, including Atlas cedar, cypress, juniper, pines, plum yew, redwood conifers and spruce (García Morales et al. 2019) On needles/leaves, and sometimes on cones/fruit (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	Intercepted in South Korea on <i>Juniperus</i> (conifer) plants from the USA (Suh 2016a). Intercepted in New Zealand on conifer material of unspecified origin (Berry 2014)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Childaspis asiatica</i> (Archangelskaya)	4	Nine countries in Europe and Asia	No record found (García Morales et al. 2019)	Oligophagous, on five genera in two families of host plants, including quince, apple, almonds, apricot, blackthorn, crabapple, cherry, grapes, peach, pear, plums and quince (García Morales et al. 2019) On the bark of the branches and twigs all year, spreads to leaves in summer (both surfaces), and sometimes to fruits during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Chionaspis alnus</i> Kuwana	4	China, Japan, Mongolia, Russia and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Betulaceae, including alder, birch, Japanese white birch and Manchurian alder (García Morales et al. 2019) Females on trunk and twigs, males on twigs and leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Chionaspis americana</i> Johnson	4	The USA	No record found (García Morales et al. 2019)	Oligophagous, on 10 genera in eight families of host plants, including elm, hawthorn, hornbeam, <i>Ligustrum</i> , mulberry, oak, plums, sycamore, and willow (García Morales et al. 2019) Infesting branches and leaves; females mainly on the bark of stems and branches, while males preferring the underside of leaves (Miller & Davidson 2005)	—	Yes
<i>Chionaspis caryae</i> Cooley	4	The USA	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including black walnut, black tupelo and hickory (García Morales et al. 2019) Inflicting damage to young hickory trees in the USA, malforming branches and twigs (García Morales et al. 2019)	—	Yes
<i>Chionaspis corni</i> Cooley	4	Canada and the USA	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including 11 species of dogwoods, <i>Lindera</i> and <i>Ribes</i> (García Morales et al. 2019) On bark (Miller & Davidson 2005)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Chionaspis etrusca</i> Leonardi	4	26 countries in North America, Central America, South Asia, Europe and Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including <i>Myricaria</i> , oak and <i>Tamarix</i> (García Morales et al. 2019) On stems and branches (Danzig & Pellizzari 1998)	—	Yes
<i>Chionaspis furfura</i> (Fitch)	4, 5	Canada, the USA and the UK	No record found (García Morales et al. 2019)	Polyphagous, on 19 genera in nine families of host plants, including annona, apple, asiatic apple, buckthorn, crab apple, black cherry, hawthorn, nectarines, plums, peaches, sweet cherry, pear and walnut (García Morales et al. 2019) On bark, preferably of lower branches, but during heavy infestations scales may spread to new growth and fruit; inflicting red repressions on apples (Miller & Davidson 2005); causing spots and pits on the bark of twigs (García Morales et al. 2019)	—	Yes
<i>Chionaspis heterophyllae</i> (Cooley)	4	Canada, Mexico and the USA	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Pinaceae, including fir, pine trees and spruce (García Morales et al. 2019) On needles (Miller & Davidson 2005)	—	Yes
<i>Chionaspis pinifoliae</i> (Fitch)	4	10 countries in Europe and North and South America	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in three families of host plants, including cedar, cypress, douglas-firs, fir, hemlocks, juniper, pine, spruce, tamarack, <i>Taxus</i> and <i>Torreya</i> (García Morales et al. 2019) On needles (Zahradnik 1990a)	—	Yes
<i>Chionaspis salicis</i> (Linnaeus)	4, 5	49 countries in North America, Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 48 genera in 25 families of host plants, including alder, apples, brooms, dogwood, downy birch, edible currants, elm, european blackberry, grapevine, hazel, jasmine, maple, myrtle, oak, pear, rhododendrons, sweetgum, willow and white ash (García Morales et al. 2019) On trunks, branches and twigs, and sometimes on fruits of vaccinium (Watson 2018); males on the upper	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Chrysomphalus ansei</i> (Green)	4	Seychelles in Africa	No record found (García Morales et al. 2019)	surfaces of leaves near the primary veins (Miller & Davidson 2005); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Oligophagous, on two genera in two families of host plants, including brown beech (<i>Litsea glutinosa</i>) and coconut (García Morales et al. 2019)	—	Yes
<i>Chrysomphalus aonidum</i> (Linnaeus)	1, 4, 5	85 countries worldwide	Yes, Qld, NT, NSW, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Chrysomphalus bifasciculatus</i> Ferris	1, 3, 4, 5	12 countries in North America and East Asia	No record found (García Morales et al. 2019)	Polyphagous, on 41 genera in 28 families of host plants, including <i>Araliya</i> , bay laurel, boston ivy, <i>Camellia</i> , camphor, cherry laurel, <i>Citrus</i> , coconut, cycads, <i>Dracaena</i> , <i>Euonymus</i> , <i>Ficus</i> , Ivy, <i>Rhus</i> (sumac) and pandan (García Morales et al. 2019) On leaves during the vegetative, flowering and fruiting stages of the plant (Watson 2018)	Intercepted in South Korea on cocos from Bangladesh and Vietnam, and on <i>Dracaena</i> , <i>Euonymus</i> and <i>Rhapis</i> from Costa Rica, Japan and China (Suh 2016a)	Yes
<i>Chrysomphalus dictyospermi</i> (Morgan)	1, 4, 5, 6	100 countries worldwide	Yes, Qld, NSW, NT, SA (ABRS 2018; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 186 genera in 79 families of host plants, including <i>Ambarella</i> , <i>Annona</i> , avocado, banana, <i>Citrus</i> , cycads, <i>Ficus</i> , grapevine, jackfruit, mango, olive, orchids, sweet bay, papaw, passionfruit, <i>Plumeria</i> , and <i>Zingiber</i> (García Morales et al. 2019) Mostly on leaves, sometimes on fruit and occasionally on branches (Watson 2018); mostly on the upper surfaces of leaves (Miller & Davidson 2005); affecting host plants during the vegetative, flowering, fruiting and post harvest stages (Watson 2018)	Live adults and nymphs intercepted in Australia on fresh fruit (<i>Mangifera</i>), fresh foliage and nursery stock (Orchidaceae) Adult females intercepted in Taiwan on <i>Garcinia mangostana</i> from Indonesia and Thailand (Chen, Wong & Wu 2014)	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
				Assessed as on pathway for papaya from Fiji (Biosecurity Australia 2002b) and for sweet oranges from Italy (Biosecurity Australia 2005b)	Intercepted in South Korea on <i>Cymbidium</i> and <i>Dracaena</i> from Taiwan and Costa Rica, and on Cocos from Vietnam (Suh 2016a)	
<i>Chrysomphalus fodiens</i> (Maskell)	4	Australia	Yes, NT, Vic, WA (ABRS 2018; García Morales et al. 2019){ICDb 2019 #???	Further assessment is not required		No
<i>Chrysomphalus pinnulifer</i> (Maskell)	1, 4, 5	24 countries in Africa, South America, Asia and Europe	Yes, Qld, NSW, WA (Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Chrysomphalus propsimus</i> Banks	1	Six countries in, Asia and Oceania	No record found (García Morales et al. 2019)	Oligophagous, on five genera in two families of host plants, including cabbage palm, coconut and pandan (García Morales et al. 2019) On leaves (McKenzie 1939)	Intercepted in South Korea on <i>Annona</i> , <i>Cocos</i> and <i>Garcinia</i> from the Philippines and Vietnam (Suh 2016a)	Yes
<i>Circulaspis canaliculata</i> (Green)	4,	India, Sri Lanka and mainland China	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Clavaspis covilleae</i> (Ferris)	4	Mexico, the USA	No record found (García Morales et al. 2019)	Oligophagous, on 10 genera in nine families of host plants, including almond, <i>Euonymus</i> , <i>Forchhammeria</i> , <i>Larrea tridentate</i> , <i>Lycium fremontii</i> , olive and pear (García Morales et al. 2019) On twigs, crowns and exposed roots, especially those found under loose bark (Gill 1997b)	—	Yes
<i>Clavaspis disclusa</i> Ferris	4, 5	The USA	No record found (García Morales et al. 2019)	Oligophagous, on six genera in five families of host plants, including ash, dogwood, hickory, oak, peach, and walnuts (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Clavaspis herculeana</i> (Cockerell & Hadden)	4	31 countries in Africa, the Americas, Asia and Europe	Yes, Qld, NSW (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018)	On twigs and branches (Gill 1997b) Further assessment is not required		No
<i>Clavaspis perseae</i> (Davidson)	1, 4	Mexico and the USA	No record found (García Morales et al. 2019)	Monophagous, on avocado (<i>Persea americana</i>) of family Lauraceae (García Morales et al. 2019)	—	Yes
<i>Clavaspis ulmi</i> (Johnson)	4	Canada, the USA and Japan	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in 10 families of host plants, including dogwood, catalpas, elm, <i>Euonymus</i> , hackberries, maple, sago palm and walnuts (García Morales et al. 2019) On trunk and branches, usually under loose outer bark, or deep within the cracks on trunks (Gill 1997b; Miller & Davidson 2005)	—	Yes
<i>Comstockaspis perniciosus</i> (Comstock) [syn: <i>Diaspidiotus perniciosus</i> (Comstock) and <i>Quadraspidiotus perniciosus</i> (Comstock)]	1, 3, 4, 5	66 countries in Africa, the Americas, Australasia, Asia and Europe	Yes, NSW, Vic, Qld, WA, SA, TAS (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018) Declared and not notifiable pest in NT (DPIR 2018)	Polyphagous, on 70 genera in 41 families of host plants, including <i>Acacia</i> , apple, avocado, <i>Acer</i> , <i>Aesculus</i> , <i>Albizia</i> , <i>Aleurites</i> , <i>Alnus</i> , <i>Aloe</i> , <i>Aralia</i> , <i>Asparagus officinalis</i> , <i>Aster</i> , <i>Bambusa</i> , <i>Betula</i> , <i>Bignonia</i> , <i>Buxus</i> , <i>Callistemon</i> , <i>Camellia</i> , <i>Canna</i> , <i>Carya</i> , <i>Castanea</i> , <i>Catalpa</i> , <i>Cedrus</i> , <i>Celtis</i> , cherry, chinese plum, <i>Citrus</i> , <i>Chrysanthemum</i> , <i>Cinnamomum</i> , <i>Cotoneaster</i> , <i>Crataegus</i> , <i>Cupressus</i> , <i>Cydonia</i> , <i>Cytisus</i> , <i>Dahlia</i> , <i>Diospyros</i> , <i>Elaeagnus</i> , <i>Eriobotrya</i> , <i>Eucalyptus</i> , <i>Euonymus</i> , <i>Euphorbia</i> , <i>Fagus</i> , <i>Ficus</i> , grapevine, <i>Ginkgo</i> , <i>Hibiscus</i> , <i>Hydrangea</i> , <i>Ilex</i> , <i>Inula</i> , <i>Jasminum</i> , <i>Juglans regia</i> , <i>Juniperus</i> , kiwi, <i>Laurus</i> , <i>Ligustrum</i> , <i>Lindera</i> , <i>Liquidambar</i> , <i>Magnolia</i> , <i>Mesembryanthemum</i> , <i>Mespilus</i> , <i>Morus</i> , <i>Myrica</i> , <i>Myrtus</i> , <i>Nerium</i> , <i>Olea</i> , <i>papaya</i> , <i>Panicum</i> , peach, pear, <i>Picea</i> , <i>Pinus</i> , <i>Piper</i> , <i>Pittosporum</i> , <i>Platanus</i> , <i>pomegranate</i> , <i>Poncirus</i> , <i>Populus</i> , <i>Pyracantha</i> , <i>Quercus</i> , <i>Rhamnus</i> ,	Adults and immature stages intercepted in Australia on fresh fruits of <i>Malus pumila</i> , <i>Prunus cerasus</i> <i>Actinidia</i> , <i>Citrus reticulata</i> and on <i>Prunus</i> nursery stock Intercepted in Taiwan on products of <i>Actinidia arguta</i> , <i>Actinidia chinensis</i> , <i>Areca cathechu</i> , <i>Diospyros kaki</i> , <i>Garcinia mangostana</i> , <i>Mangifera indica</i> , <i>Nephelium lappaceum</i> , <i>Persea americana</i> , <i>Prunus domestica</i> and on <i>Prunus persica</i> plants from Chile, Japan, New Zealand, the	Yes (NT)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Comstockiella sabalis</i> (Comstock)	4	Eight countries in North America, the Caribbean Islands and France	No record found (García Morales et al. 2019)	<i>Rhododendron, Rhus, Ribes, Ricinus, Robinia, Rubus, Ruscus, Salix, Sambucus, Smilax, Solanum, Sorbus, Spiraea, Tamarix, Taxodium, Taxus, Tecoma, Thuja, Tilia, Tsuga, Ulmus, Vaccinium, Viburnum, Wisteria and Yucca</i> (García Morales et al. 2019; Watson 2018) Oligophagous, on five genera of family Arecaceae, including coconut, palmettos and mexican fan palm (García Morales et al. 2019) Usually infesting the leaves, petioles and occasionally on bark and fruit (Gill 1997b; Miller & Davidson 2005)	USA and Vietnam (Chen, Wong & Wu 2014) Intercepted in Korea on <i>Actinidia</i> from the USA, <i>Juglans</i> from China and on <i>Prunus</i> from Japan (Suh 2016a) Intercepted in New Zealand on fresh produce and less frequently on cut flowers and foliage (Berry 2014)	Yes
<i>Contigaspis farsetiae</i> (Hall)	4	Eight countries in Northern Africa, Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous on 14 genera in 10 families of host plants, including <i>Artemisia, Farsetia, Frankenia</i> (sea heath), <i>Haloxylon</i> , and <i>Zygophyllum</i> (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Cupidaspis cupressi</i> (Coleman)	4	The USA	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Cupressaceae, including cypress, juniper, and <i>Libocedrus</i> (García Morales et al. 2019) On needles (Gill 1997b)	—	Yes
<i>Cupressaspis mediterranea</i> (Lindinger)	4	12 countries in Europe and Africa	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in two families of host plants, including <i>Cupressus, Juniperus, Platycladus</i> and <i>Thuja</i> (García Morales et al. 2019) On fruits, needles (leaves) and the bark of twigs and branches (Ulgenturk et al. 2012; Zahradnik 1990a)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Cynodontaspis piceae</i> Takagi	4	Japan and Russia	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Pinaceae, including Korean Spruce (<i>Picea koraiensis</i>), <i>Picea brachytyla</i> , silver fir (<i>Abies alba</i>), and sakhalin fir (<i>Abies sachalinensis</i>) (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Davidsonaspis aguacatae</i> (Evans, Watson & Miller)	1	Mexico	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Persea</i> of family Lauraceae, including avocado (García Morales et al. 2019)	Intercepted in the USA on fresh avocado fruit from Mexico (Evans & Dooley 2013; Morse et al. 2009) (Stocks & Evans 2017) Intercepted in South Korea on <i>Persea</i> from Mexico (Suh 2016a)	Yes
<i>Diaspidiotus aesculi</i> (Johnson)	4	The USA	No record found (García Morales et al. 2019)	Oligophagous, on 12 genera in nine families of host plants, including <i>Adelia</i> , alder (<i>Alnus</i>), boxelder maple, California buckeye (<i>Aesculus californica</i>), elder, oak, poplar and walnut (García Morales et al. 2019) On bark, causing pitting on twigs on some hosts (Gill 1997b)	—	Yes
<i>Diaspidiotus africanus</i> (Marlatt)	4	Madagascar, South Africa and Zimbabwe	No record found (García Morales et al. 2019)	Polyphagous, on 23 genera in 12 families of host plants, including almond, barberry (<i>Berberis</i>), fig, laurels, maple, <i>Nerium orleander</i> , olive, peach, pear and River bushwillow (<i>Combretum erythrophyllum</i>) and Sumac (<i>Rhus</i>) (García Morales et al. 2019)	—	Yes
<i>Diaspidiotus ancyclus</i> (Putnam)	1, 4, 5, 6	11 countries in the Americas, Europe, Australia, New Zealand, Africa and Asia	Yes Qld, NSW (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of	Polyphagous, on 49 genera in 33 families of host plants, including, apple, apricot, almond, beech, birch, catalpa, elm, eastern hemlock, hackberries, hickory, holly, kiwi, maple, <i>Magnolia</i> , oak, peach, poplar, walnut, willow, and <i>Yucca</i> (García Morales et al. 2019) On bark, leaves or fruit (Miller & Davidson 2005)	Intercepted in South Korea on <i>Actinidia</i> from New Zealand, and on <i>Vaccinium</i> from the USA (Suh 2016a)	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
			Western Australia (2018)			
<i>Diaspidiotus armenicus</i> (Borchsenius)	4	Armenia, Iran, Pakistan and Turkey	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Salicaceae, including <i>Populus</i> and <i>Salix</i> (García Morales et al. 2019) On trunk (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus caucasicus</i> (Borchsenius)	4	Five countries in Asia	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Salicaceae, including <i>Populus</i> and <i>Salix</i> (García Morales et al. 2019) On trunk and twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus coniferarum</i> (Cockerel)	4	Mexico and The USA	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in two families of host plants, including cypress, eastern hemlock (<i>Tsuga canadensis</i>), firs, incense cedar (<i>Calocedrus decurrens</i>), juniper and pines (García Morales et al. 2019) Occur on the bark of the smaller branches, and never found on foliage (García Morales et al. 2019)	—	Yes
<i>Diaspidiotus degeneratus</i> (Leonardi)	4	Nine countries in North America, Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in nine families of host plants, including Araliya, blueberry, <i>Citrus</i> , cranberry, camellias (<i>Camellia japonica</i> & <i>Camellia sasanqua</i>), <i>Euonymus</i> , fragrant, holly, olive (<i>Osmanthus fragrans</i>), pandan (<i>Pandanus</i>), and tea (<i>Camellia sinensis</i>) (García Morales et al. 2019) On leaves (Miller & Davidson 2005)	—	Yes
<i>Diaspidiotus distinctus</i> (Leonardi)	4	11 countries in Europe, Africa and Asia	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including chamomiles, hazel and oaks (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus elaeagni</i> (Borchsenius)	4	Nine countries in Asia	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including apricots, almonds, cherries, common sea buckthorn (<i>Hippophae rhamnoides</i>), nectarines, peaches, plums and oaks (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Diaspidiotus forbesi</i> (Johnson)	4, 5	Canada, the USA, Mexico, Puerto Rico & Vieques Island and South Africa	No record found (García Morales et al. 2019)	Polyphagous, on 21 genera in 12 families of host plants, including apple, apricots, almonds, black tupelo, buckthorn, cherries, crabapple, dogwood, hackberries, hawthorn, holly, hickory, maple, nectarines, peaches, plums, quince and river birch, (García Morales et al. 2019) On bark (Miller & Davidson 2005) twigs, branches and fruit (OSU 2018) Assessed as on pathway for stonefruit from the USA (Biosecurity Australia 2010b)	—	Yes
<i>Diaspidiotus fraxini</i> (McKenzie)	4	The USA and Mexico	No record found (García Morales et al. 2019)	Monophagous, on velvet ash (<i>Fraxinus velutina</i>) of family Oleaceae (García Morales et al. 2019) On leaves (Gill 1997b)	—	Yes
<i>Diaspidiotus gigas</i> (Ferris)	4	25 countries in the Americas, Europe and Asia	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including alder, poplar and willow (García Morales et al. 2019) On the smooth bark of trunks and thick branches, rather than on thin twigs, and occasionally on petioles but not on leaves (Miller & Davidson 2005)	—	Yes
<i>Diaspidiotus juglansregiae</i> (Comstock)	1, 4, 5	Canada, Mexico, the USA	No record found (García Morales et al. 2019)	Polyphagous, on 29 genera in 19 families of host plants, including apricot, blackcherry, crabapple, dogwood, elm, grapevine, holly, pine, plums, peaches, plumleaf, <i>Rosa</i> , sweetgum, walnut and willow (García Morales et al. 2019) On the bark, often hidden under bark flakes or under the host's epidermis and on fruit (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for stonefruit from the USA (Biosecurity Australia 2010b)	Adults intercepted in Australia on fresh peach	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Diaspidiotus leguminosum</i> (Archangelskaya)	4	Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Fabaceae, including black locust (<i>Robinia</i>), salt tree (<i>Halimodendron</i>) and Siberian Peashrub (<i>Caragana</i>) (García Morales et al. 2019) On stems and twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus lenticularis</i> (Lindinger)	4, 6	20 countries in Europe, Africa, Asia and Oceania	Yes, SA (García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 14 genera in 11 families of host plants, including apricots, almonds, beech, common ash, downy birch, <i>Ficus</i> , nectarines, olive, oaks, pistachios, plums, peaches, pine, poplar and sweet cherry (García Morales et al. 2019) On the stems and twigs of host plants (Danzig & Pellizzari 1998)	—	Yes (WA)
<i>Diaspidiotus lepineyi</i> (Balachowsky)	4	Morocco and France	No record found (García Morales et al. 2019)	Monophagous, on olive (<i>Olea europaea</i>) of family Oleaceae (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus liquidambaris</i> (Kotinsky)	4	The USA	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including maple and sweetgum (García Morales et al. 2019) On stems and leaves, causing gall-like depressions on underside of the leaves (Miller & Davidson 2005)	—	Yes
<i>Diaspidiotus mairei</i> (Balachowsky)	4	Italy, Morocco and Spain	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in six families of host plants, including brooms and olive (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus maleti</i> (Vayssièrè)	4	Algeria and Morocco	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Argania spinosa</i> and olive (García Morales et al. 2019) On leaves, sometimes on twigs and fruits (Danzig & Pellizzari 1998)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Diaspidiotus marani</i> (Zahradník)	4	Nine countries in Europe	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in three families of host plants, including apples, european ash, european crab apple, hawthorn, olives, old world sycamore, pear and plums (García Morales et al. 2019) On trunk and twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus osborni</i> (Cockerell)	4	Eight countries in North America, Europe and Africa	No record found (García Morales et al. 2019)	Polyphagous, on 20 genera in 14 families of host plants, including apricots, almonds, ash, beech, birch, chestnut, cherry laurel, cherries, dogwood, grapevine, hawthorn, hickory, maple, nectarines, oaks, persimmons, plums, peaches, willow and walnut (García Morales et al. 2019) On the bark of stems and twigs (Danzig & Pellizzari 1998; Miller & Davidson 2005)	—	Yes
<i>Diaspidiotus ostreaeformis</i> (Curtis) [syn: <i>Quadraspidiotus ostreaeformis</i> (Curtis)]	1, 4, 5, 6	49 countries worldwide	Yes, NSW, SA, Tas, Vic (García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 40 genera in 19 families of host plants, including apple, almond, alder, ash, blackthorn (<i>Prunus spinosa</i>), crabapple, fig, fir, maple, oak, olive, pear, plums, redcurrant (<i>Ribes rubrum</i>), sweet cherry (<i>Prunus avium</i>), sour cherry (<i>Prunus cerasus</i>), walnut and willow (García Morales et al. 2019) On the bark of twigs and branches, sometimes on fruits and leaves (Watson 2018); affecting host plants during the vegetative, fruiting or post-harvest stages (Watson 2018) Assessed as on pathway for nectarines from China (DAFF 2016), apples from China (Biosecurity Australia 2010a), stonefruit from the USA (BA 2010), stone fruit from New Zealand into WA (BA, 2006) and apples from New Zealand (Biosecurity Australia 2006a)	Female adults intercepted in Taiwan on <i>Malus pumila</i> and <i>Prunus persica</i> from New Zealand and the USA (Chen, Wong & Wu 2014) Intercepted in New Zealand on nursery stock (MPI 2014)	Yes (WA)
<i>Diaspidiotus prunorum</i> (Laing)	4	Eight countries in Asia	No record found (García Morales et al. 2019)	Oligophagous, on five genera in three families of host plants, including apple, apricot, almond, blackthorn, cherry plum, plum, peach and sweet cherry and tamarisk (García Morales et al. 2019) On stems and twigs (Danzig & Pellizzari 1998)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Diaspidiotus pyri</i> (Lichtenstein)	4, 6	23 countries in Asia, Europe and Africa	Yes, TAS (Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous on 14 genera in eight families of host plants, including apple, ash, birch, carob tree, common fig, hawthorn, plums, olive, oldworld sycamore, pear, sweet cherry, sour cherry and willow (García Morales et al. 2019) On trunks, twigs and fruits during the vegetative, flowering, fruiting and post harvest stages of the host plant (Watson 2018)	—	Yes (WA)
<i>Diaspidiotus shastae</i> (Coleman)	4	USA	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Cupressaceae, including cypress (<i>Cupressus</i>), coastal redwood (<i>Sequoia sempervirens</i>), incense-cedars (<i>Calocedrus</i>), and junipers (<i>Juniperus</i>) (García Morales et al. 2019; McKenzie 1956) On needles and fruit (Zahradnik 1990a)	—	Yes
<i>Diaspidiotus slavonicus</i> (Green)	4	Nine countries in Asia	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including European ash, poplars and willows (García Morales et al. 2019) On trunk and twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus transcaspensis</i> (Marlatt)	4	Six countries in Asia	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in five families of host plants, including apricot, poplar, oak, Russian olive and sea buckthorn (García Morales et al. 2019) On branches (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus turanicus</i> (Borchsenius)	4	Afghanistan, Armenia, China, Iran and Tajikistan	No record found (García Morales et al. 2019)	Oligophagous, on two genera, <i>Populus</i> (poplars) and <i>Salix</i> (willows) of family Salicaceae (García Morales et al. 2019) On branches (Danzig & Pellizzari 1998)	—	Yes
<i>Diaspidiotus uvae</i> (Comstock)	4	10 countries in the Americas and Europe	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in seven families of host plants, including birch, grapevine, laquat (<i>Eriobotrya japonica</i>), hawthorn, hickory, osage orange (<i>Maclura pomifera</i>), pear, sycamore, and <i>Yucca</i> (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Diaspidiotus wuenni</i> (Lindinger)	4	10 countries in Europe and Asia	No record found (García Morales et al. 2019)	On stems and branches, often under the bark (Miller & Davidson 2005) Oligophagous, on three genera in two families of host plants, including alder, oak and sweet chetnut (García Morales et al. 2019)	—	Yes
<i>Diaspidiotus zonatus</i> (Frauenfeld)	4	30 countries in Europe and Asia	No record found (García Morales et al. 2019)	On trunk and twigs (Danzig & Pellizzari 1998) Polyphagous, on 12 genera in 10 families of host plants, including blueberry, birch, beech, common fig, jujube, oak, rowan, sweet chestnut, and walnut (García Morales et al. 2019)	—	Yes
<i>Diaspis boisduvalii</i> Signoret	1, 4, 5, 6	80 countries worldwide	Yes, Tas, Qld, SA, Vic, NSW (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 125 genera in 33 families of host plants, including areca palm, <i>Acacia</i> , <i>Aechmea</i> , <i>Agave</i> , avocado, banana, coconut, mango, mangosteen, orchids, pineapple, <i>Strelitzia</i> , <i>Tillandsia</i> , <i>Trachycarpus</i> , <i>Vanda</i> and <i>Washingtonia</i> (García Morales et al. 2019) On leaves, twigs and pseudobulbs of orchids during the vegetative, flowering and fruiting stages of the host plant (Watson 2018) Assessed as on pathway for mangosteen fruit from Indonesia (DAFF, 2012)	Intercepted in South Korea on <i>Ananas</i> from Sri Lanka, China, Indonesia, Japan, the Philippines, Singapore, Thailand; on <i>Musa</i> from Ecuador, Guatemala and Peru; on <i>Opuntia</i> from Germany; and on <i>Persea</i> from Mexico (Suh 2016a). Intercepted in England and Wales on <i>Tillandsia</i> from Guatemala (Malumphy 2012) Intercepted in New Zealand on fresh produce (MPI 2014)	Yes (WA)
<i>Diaspis bromeliae</i> (Kerner)	1, 4, 5, 6	74 countries worldwide	Yes, NSW, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA	Polyphagous, on 26 genera in 10 families of host plants, including, bromeliads, brassia orchid, <i>Canna</i> , cattleya orchid, <i>Chamaerops</i> , the duck orchid, <i>Hibiscus</i> , ivy, lady palm (<i>Rhapis excelsa</i>), miniature coconut palm (<i>Lytocaryum weddellianum</i>), pineapple and sugarcane (García Morales et al. 2019) On leaves normally under the epidermis, and occasionally on fruit and stems (Miller & Davidson	Live nymphs and adults intercepted in Australia on bromeliad nursery stock Intercepted in South Korea on <i>Ananas</i> from China and Philippines, and on other material from Indonesia (Suh 2016a). Intercepted in Taiwan	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Diaspis echinocacti</i> (Bouché)	1, 4, 5, 6	73 countries worldwide	(Government of Western Australia 2018) Yes, Qld, NSW (ABRS 2018; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	2005; Watson 2018); affecting host plants during the vegetative, flowering, fruiting and post-harvest stages (Miller & Davidson 2005; Watson 2018) Polyphagous, on 48 genera in eight families of host plants, mainly cacti (García Morales et al. 2019), including succulents from the genera <i>Dudleya</i> and <i>Cotyledon</i> , and also on <i>Cassia</i> and <i>Zygophyllum xanthoxylum</i> (García Morales et al. 2019) Affecting all aerial plant parts of cacti, pads, stems and fruits (Watson 2018); occasionally on the subterranean crown and roots (Miller & Davidson 2005); affecting host plants during the vegetative, flowering, fruiting and postharvest stages (Watson 2018)	on <i>Ananas comosus</i> from the Philippines (Chen, Wong & Wu 2014) Adults intercepted in Australia on fresh tamarillo and unnamed plants. Intercepted in Taiwan on <i>Hylocereus</i> from Malaysia and Vietnam (Chen, Wong & Wu 2014). Intercepted in South Korea on <i>Gymnocalycium</i> and an unnamed species of cactus from China (Ji & Suh 2012)	Yes (WA)
<i>Dicirculaspis philippina</i> Ben-Dov	4,	The Philippines	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Bambusa</i> and <i>Schizostachyum</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Duplachionaspis berlesii</i> (Leonardi)	4,	17 countries in Europe, Africa, the Middle East and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in seven families of host plants, including <i>Andropogon</i> , <i>Arundo</i> , <i>Asparagus</i> , <i>Cytisus</i> and <i>Micromeria</i> (García Morales et al. 2019) On thin twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Duplachionaspis divergens</i> (Green)	1, 3, 4	13 countries in Asia, North and South America, Africa and Oceania	Yes, NT (ABRS 2018; García Morales et al. 2019; Green 1916)	Polyphagous on 18 genera of family Poaceae, including <i>Arundo</i> , <i>Bambusa</i> , <i>Imperata</i> , Indian bluegrass (<i>Bothriochloa pertusa</i>), lemongrass (<i>Cymbopogon citratus</i>), <i>Miscanthus</i> , <i>Paspalum</i> , <i>Pennisetum</i> , <i>Saccharum</i> and vetiver (<i>Chrysopogon zizanioides</i>) (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	Intercepted in Taiwan on <i>Cymbopogon citratus</i> from Vietnam (Chen, Wong & Wu 2014) Intercepted in South Korea on <i>Cymbopogon</i> plants from Cambodia, Thailand and Vietnam (Suh 2016a)	No
<i>Duplachionaspis graminis</i> (Green)	4, 5	Sri Lanka, China and Japan	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Poaceae, including <i>Andropogon</i> , manilla grass (<i>Zoysia matrella</i>) and vetiver (<i>Chrysopogon zizanioides</i>) (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Duplachionaspis natalensis</i> (Maskell)	1, 4	17 countries in Asia, Africa, Europe and South America	No record found (García Morales et al. 2019)	Polyphagous, on 30 genera in four families of host plants, including sugarcane, cypress, Mauritanian grass (<i>Ampelodesmos mauritanicus</i>), giant reed (<i>Arundo donax</i>), lemongrass (<i>Cymbopogon citratus</i>), scutch grass (<i>Cynodon dactylon</i>), cogon grass (<i>Imperata cylindrica</i>) and common reed (<i>Phragmites australis</i>) (García Morales et al. 2019)	Intercepted in the USA on <i>Cymbopogon</i> from Peru and the Virgin Islands (Evans & Dooley 2013)	Yes
<i>Duplachionaspis saccharifolii</i> (Zehntner)	4	Indonesia, China and the Philippines	No record found (García Morales, 2019 #33499)	Oligophagous, on two genera of family Poaceae, including sugarcane and common reed (<i>Phragmites australis</i>) (García Morales et al. 2019) On older sugarcane leaves, causing yellowish red spots and may kill younger leaves entirely (Dammerman 1929)	—	Yes
<i>Duplaspidotus claviger</i> (Cockerell)	4, 5, 6	13 countries in North America, Oceania, Asia and Africa	Yes Qld, NSW (ABRS 2018; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 13 genera in 13 families of host plants, including bitter orange, <i>Citrus</i> , clove (<i>Syzygium aromaticum</i>), <i>Gardenia</i> , <i>Ficus</i> , <i>Hibiscus</i> , lemon, <i>Macadamia</i> , tea (<i>Camellia sinensis</i>), pomegranate, and <i>Viburnum</i> (García Morales et al. 2019) On twigs and branches under the epidermis (Watson 2002); affecting the plant during the vegetative, flowering or fruiting stages (Watson 2018)	—	Yes (WA)
<i>Duplaspidotus tesseratus</i> (Grandpré & Charmoy)	1, 4	27 countries in Africa, Asia, the Americas and the Caribbean Islands	No record found (García Morales et al. 2019)	Polyphagous, on 19 genera in 14 families of host plants, including apricots, almonds, <i>Acalypha</i> , <i>Camellia</i> , cherries, Caribbean royal palm (<i>Roystonea oleracea</i>), grapevine, <i>Ficus</i> , <i>Hibiscus</i> , passionfruit, pomegranate, plums, peaches, nectarines, <i>Rosa</i> , tablegrapes and tamarind (<i>Leucaena leucocephala</i>) (García Morales et al. 2019) On bark, usually under the outer epidermal layer (Miller & Davidson 2005)	Adults intercepted in Australia on unnamed live plants	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Dynaspidiotus abietis</i> (Schrank)	4	21 countries in Europe, Africa, Asia and the USA	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in five families of host plants, including apple, deodar cedar (<i>Cedrus deodara</i>), douglas fir (<i>Pseudotsuga menziesii</i>), fir, juniper, maple, oak, pines, and spruce (García Morales et al. 2019) Females and larvae mostly on needles, and rarely on trunks and branches (Zahradnik 1990a)	—	Yes
<i>Dynaspidiotus britannicus</i> (Newstead)	1, 4	28 countries in the Americas, Europe, Africa and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 32 genera in 22 families of host plants, including apricot, almond, barberry, bay laurel, boxwood (<i>Buxus</i>), camphor, carob tree, cedar, cherry laurel, <i>Citrus</i> , cherry, holly, ivy, jasmine, <i>Livistona</i> , myrtle, nectarine, <i>Phoenix</i> , plum, peach, periwinkle, pines and silverberry (<i>Elaeagnus</i> oak) (García Morales et al. 2019) On leaves, twigs and berries (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2002)	Adults and nymphs intercepted in Australia on unidentified live plants	Yes
<i>Dynaspidiotus californicus</i> (Comstock)	4	North America and Caribbean Islands	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Pinaceae, including pines and douglas firs (<i>Pseudotsuga</i>) (García Morales et al. 2019) On needles (Miller & Davidson 2005); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Dynaspidiotus ephedrarum</i> (Lindinger)	4	16 countries in Africa, Europe, Asia	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Asparagus horridus</i> , sea grape (<i>Ephedra distachya</i>), and shrubby horsetail (<i>Ephedra foliata</i>) (García Morales et al. 2019)	—	Yes
<i>Dynaspidiotus ericarum</i> (Goux)	4	France, Iran, Turkey	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including carob tree (<i>Ceratonia siliqua</i>), mastic tree (<i>Pistacia lentiscus</i>), myrtle, and osyris (<i>Osyris alba</i>) olive, and strawberry tree (<i>Arbutus unedo</i>) (García Morales et al. 2019) On leaves and branches (Danzig & Pellizzari 1998)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Dynaspidiotus tsugae</i> (Marlatt)	4	The USA, Japan, Russia and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Pinaceae, including fir (<i>Abies</i>), silver fir, needle fir, spruce (<i>Picea</i>), <i>Picea brachytyla</i> , pine (<i>Pinus</i>), Korean pine, hemlocks (<i>Tsuga</i>), eastern hemlock (<i>Tsuga canadensis</i>), northern Japanese hemlock (<i>Tsuga diversifolia</i>) and southern Japanese hemlock (<i>Tsuga sieboldii</i>) (García Morales et al. 2019) On the underside of needles (Miller & Davidson 2005)	—	Yes
<i>Epidiaspis leperii</i> (Signoret)	4, 5	41 countries in the Americas, Europe, Africa and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 20 genera in 11 families of host plants, including apple, almond, bay, blackthorn (<i>Prunus spinosa</i>), boxelder maple (<i>Acer negundo</i>), common hawthorn, fig, Norway maple (<i>Acer platanoides</i>), olive, pear, sweet cherry (<i>Prunus avium</i>), plum, peach, plum leaf crab apple, sour cherry (<i>Prunus cerasus</i>), walnut and quince (<i>Cydonia oblonga</i>) (García Morales et al. 2019) Affecting twigs, branches and trunk of the plant often sheltered under lichens on the bark (MAFF 1990; Watson 2018); affecting host plants during the vegetative, flowering, and fruiting stages (Watson 2018)	—	Yes
<i>Fiorinia externa</i> Ferris	4	Canada, the USA, the UK, China and Japan	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in three families of host plants, including cedar, douglas fir (<i>Pseudotsuga</i>), fir, hemlock, juniper, spruce, and <i>Taxus</i> (García Morales et al. 2019) On the undersides of leaves/needles (Watson 2018)	—	Yes
<i>Fiorinia fioriniae</i> (Targioni Tozzetti)	1, 4, 5, 6	55 countries worldwide	Yes, NSW, Qld, (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA	Polyphagous, on 92 genera in 47 families of host plants, including avocado, banana, <i>Anthurium</i> , <i>Aralia</i> , <i>Cirus</i> , <i>Capsicum</i> , <i>Camellia</i> , <i>Croton</i> , <i>Cinamomum</i> , coconut, cycads, <i>Caryota urens</i> , <i>Chamaerops</i> , <i>Dictyosperma album</i> , date palm (<i>Phoenix dactylifera</i>), elms, fig, <i>Hedera</i> , <i>Howea</i> , holly, mango, <i>Macadamia</i> , manihot, persimmons, <i>Phoenix canariensis</i> , oak, <i>Rosa</i> , tea plant, and willow (García Morales et al. 2019)	Adults intercepted in Australia on fresh <i>Ruscus</i> cut flowers. Intercepted in South Korea on <i>Eucalyptus</i> from Indonesia (Suh 2016a). Adult females intercepted in Taiwan on <i>Citrus hystrix</i> from	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Fiorinia japonica</i> Kuwana	1, 4,	12 countries in Asia, North and South America, Africa and Oceania	(Government of Western Australia 2018) Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Absent from Western Australia (Government of Western Australia 2018)	On upper and lower leaf surfaces, preferably on the lower surface, often aligned along the veins (Miller & Davidson 2005); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Polyphagous, on 22 genera in 13 families of host plants, including <i>Camellia japonica</i> , <i>Ficus</i> , <i>Juniperus</i> and <i>Pinus</i> (García Morales et al. 2019)	Thailand (Chen, Wong & Wu 2014)	Yes (WA)
<i>Fiorinia phantasma</i> Cockerell & Robinson	1, 4	22 countries in Oceania, Asia and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 44 genera in 24 families of host plants, including <i>Areca</i> palms, <i>Arundinaria</i> and other grasses, breadfruit (<i>Atrocarpus</i>), coconut, cycads, <i>Dendrochilum</i> orchids, jasmine, lychee, mango, neem (<i>Azadirachta indica</i>), weeping fig (<i>Ficus benjamina</i>) and screw pine (<i>Pandanus</i>) (García Morales et al. 2019) Infesting the underside of the leaf, but may spread to the upper leaf surface during heavy infestations (Berthke 2012)	Intercepted in the UK on <i>Arundinaria</i> and <i>Areca</i> from Thailand, and on rattan palm (<i>Calamus</i> sp.) from Singapore (Malumphy 2013) Intercepted in South Korea on <i>Ficus</i> from Thailand (Suh & Hyun 2015)	Yes
<i>Fiorinia pinicola</i> Maskell	4, 5	Seven countries the Americas, Asia and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 16 genera in 15 families of host plants, including cheesewood (<i>Pittosporum</i>), Chinese mulberry (<i>Morella rubra</i>), cypress, fig, Ivy tree (<i>Schefflera heptaphylla</i>), Japanese laurel (<i>Aucuba japonica</i>), Japanese camellia (<i>Camellia japonica</i>), <i>Magnolia</i> , plum yew (<i>Cephalotaxus</i>), pines, and plumpine (<i>Podocarpus</i>) (García Morales et al. 2019) On the underside of leaves (Danzig & Pellizzari 1998)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Fiorinia proboscidea</i> Green	1, 4, 5	14 countries in Asia and Oceania	No record found (García Morales et al. 2019)	Polyphagous, on 11 genera in 11 families of host plants, including arecanut (<i>Areca catechu</i>), carrot, <i>Citrus</i> , <i>Citrus japonica</i> (Kumquat), bitter orange, lemon, mandarin, mango, (<i>Syzygium jambos</i>), pepper, <i>Pomelo</i> , rose apple and <i>Taxus</i> (García Morales et al. 2019) Associated with leaves and young shoots of citrus (MAFF 1990)	Intercepted in the USA on <i>Citrus</i> , <i>Rosa</i> , and palms from China, Hawaii, Indonesia and Vietnam (Evans & Dooley 2013). Intercepted in the UK on; Swingle from Kenya, <i>Citrus hystrix</i> foliage from Indonesia and Thailand, and on unnamed <i>Citrus</i> fruit and <i>Diospyros</i> foliage from Bangladesh (Malumphy 2013)	Yes
<i>Fiorinia randaiae</i> (Takahashi)	4, 5	Taiwan and Japan	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including <i>Aidia canthioides</i> , <i>Benkara sinensis</i> <i>Citrus</i> , and <i>Eugenia</i> (García Morales et al. 2019)	—	Yes
<i>Fiorinia theae</i> Green	4, 5	20 countries in Asia and the Americas	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in 12 families of host plants, including boxwood, <i>Citrus</i> , <i>Camellia</i> , tea (<i>Camellia sinensis</i>), <i>Camellia oleifera</i> , East Asian eurya (<i>Eurya japonica</i>), <i>Gardenia</i> , holly, Japanese camellia (<i>Camellia japonica</i>), olive, spindle tree (<i>Euonymus</i>), mombins (<i>Spondias</i>) and <i>Rhododendron</i> (García Morales et al. 2019) On the undersides of leaves, and occasionally on stems (Watson 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Formosaspis stegana</i> Ferris	4	China	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Poaceae, including <i>Arundinaria</i> and <i>Bambusa</i> (García Morales et al. 2019) On stems (Danzig & Pellizzari 1998)	—	Yes
<i>Formosaspis takahashii</i> (Takahashi)	4	Mainland China and Taiwan	No record found (García Morales et al. 2019)	Oligophagous on three genera of family Poaceae, including <i>Arundinaria</i> , <i>Bambusa</i> and moso bamboo (<i>Phyllostachys edulis</i>) (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Froggattiella inusitata</i> (Green)	4	Sri Lanka, Taiwan and Japan	No record found (García Morales et al. 2019)	On the undersides of leaves (Ferris 1952) Oligophagous, on two genera of family Poaceae, including <i>Arunidinaria</i> and <i>Bambusa</i> (García Morales et al. 2019)	—	Yes
<i>Froggattiella mcclurei</i> Ben-Dov	4	Indonesia, China, Hong Kong and the Philippines	No record found (García Morales et al. 2019)	On stems (Danzig & Pellizzari 1998) Monophagous, on genus <i>Bambusa</i> of family Poaceae, including hedge bamboo (<i>Bambusa multiplex</i>) (García Morales et al. 2019)	—	Yes
<i>Froggattiella penicillata</i> (Green)	1, 4,	20 countries in Africa, Asia, Oceania and North America	Yes Qld, NSW, WA (ABRS 2018; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required	—	No
<i>Furcaspis biformis</i> (Cockerell)	1, 4,	43 countries in Oceania, the Americas, Caribbeans and Asia	Yes Qld, NT (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018)	Further assessment is not required	—	No
<i>Furchadaspis zamiae</i> (Morgan)	4	40 countries worldwide	No record found (ABRS 2018; García Morales et al. 2019)	Polyphagous, on 17 genera in 10 families of host plants, including banana, bird of paradise (<i>Strelitzia</i>), cycads, Metroxylon palms and sumac (<i>Rhus</i>) (García Morales et al. 2019) Amongst hairs located on the ventral surface of leaves, and occasionally on stems (Gill 1997b; Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Furchaspis oceanica</i> Lindinger	4	Six countries in Oceania and Asia	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in three families of host plants, including banana, coconut, kotop (<i>Clinostigma ponapense</i>), nipa palm (<i>Nypa fruticans</i>) and screwpine (<i>Pandanus</i>) (García Morales et al. 2019)	—	Yes
<i>Genaparlatoria pseudaspidiotus</i> (Lindinger)	1, 4, 5	37 countries worldwide	Yes, Qld (ABRS 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Getulaspis bupleuri</i> (Marchal)	4	Seven countries in Africa, Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 16 genera in 15 families of host plants, including Argan (<i>Argania spinosa</i>), boxwood (<i>Buxus balearica</i>), date palm, juniper, olive, and toothbrush tree (<i>Salvadora persica</i>) (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Gomezmenoraspis pinicola</i> (Leonardi)	4	Cyprus, Portugal and Spain	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae, including allepo pine (<i>Pinus halepensis</i>) and scots pine (<i>Pinus sylvestris</i>) (García Morales et al. 2019) On thin branches (Danzig & Pellizzari 1998)	—	Yes
<i>Gonaspidiotus minimus</i> (Leonardi)	4	14 countries in Europe, Asia and Africa	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including European fan palm (<i>Chamaerops humilis</i>) and oaks (<i>Quercus</i>) (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Greenaspis arundinariae</i> (Green)	4	Sri Lanka	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Arundinaria</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Greenaspis bambusifoliae</i> (Takahashi)	4	Mainland China and Taiwan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019; Wang, Varma & Xu 1998)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Greenaspis decurvata</i> (Green)	4	India and Pakistan	No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including bamboo, date palm (<i>Phoenix dactylifera</i>), lemon grass (<i>Cymbopogon citratus</i>) and rice (García Morales et al. 2019)	—	Yes
<i>Greenaspis elongata</i> (Green)	4	10 countries in South East Asia and Africa	No record found (García Morales et al. 2019)	Polyphagous, on host plants of 11 genera in three families of host plants, including eucalyptus, kooroo-berry (<i>Mystroxydon aethiopicum</i>), and various bamboos such as broad leaf bamboo, <i>Sasa</i> (García Morales et al. 2019) On the undersides of leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Gymnaspis aechmeae</i> Newstead	4	24 countries in the Americas, Europe and Asia	Yes, Qld, NSW, NT (Plant Health Australia 2018)	Further assessment is not required	—	No
<i>Hemiberlesia cupressi</i> (Cockerell)	4	Guatemala and Mexico	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Cupressus</i> (cypress) of family Cupressaceae (García Morales et al. 2019) On bark and cones (Zahradnik 1990a)	—	Yes
<i>Hemiberlesia cyanophylli</i> (Signoret)	1, 4, 5, 6	In 69 countries worldwide	Yes, NT (García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 137 genera in 72 families of host plants including, avocado, banana, breadfruit, bay laurel, cacti, cycads, <i>Citrus</i> , chili peppers (<i>Capsicum</i>), coconut, coffee, chinese celtis, cinnamon, dogwood, date palm, fig, guava, jasmine, kapok tree (<i>Ceiba pentandra</i>), manihot, macadamia nut, <i>Magnolia</i> , olive, orchids, oak, rose apple (<i>Syzygium jambos</i>), rubber (<i>Hevea brasiliensis</i>), <i>Rosa</i> , <i>Solanum</i> , and tea (García Morales et al. 2019) On the ventral surface of leaves, fruits and stems (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for hard green banana from Philippines (Biosecurity Australia 2008b), mango from India (Biosecurity Australia 2008a), mango from Indonesia, Thailand and Vietnam (Department of	Adults and immature stages Intercepted in Australia on dried Indian Bay leaves (<i>Cinnamomum</i> sp.), live cactus nursery stock and on raw betle nut (<i>Areca catechu</i>). Intercepted in Taiwan on <i>Garcinia mangostana</i> from Thailand (Chen, Wong & Wu 2014). Intercepted in New Zealand on fresh produce (Berry 2014). Intercepted in South Korea on <i>Carissa</i> , <i>Crassula</i> , <i>Dracaena</i> , <i>Echeveria</i> , <i>Haworthia</i> , <i>Opuntia</i> and <i>Persea</i> from China, the USA, Costa Rica, Australia, Spain, New Zealand and Thailand (Suh	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Hemiberlesia diffinis</i> (Newstead)	1, 4	16 countries in Central and South America	No record found (García Morales et al. 2019)	Agriculture and Water Resources 2015) and mango from Taiwan (Biosecurity Australia 2006c) Polyphagous, on 35 genera in host plants in 27 families, including <i>Cocos</i> , <i>Dracaena</i> , <i>Hevea</i> , <i>Manihot</i> , <i>Oncidium</i> , <i>Prunus</i> , <i>Punica</i> (pomegranates), <i>Psidium</i> (guava), <i>Plumeria</i> , <i>Theobroma</i> and <i>Ulmus</i> (elm) (García Morales et al. 2019) On the bark of twigs and branches (Hernández-Rivero et al. 2013)	2016a). Intercepted in Japan on Banana (Sugimoto 1994) Intercepted in South Korea on <i>Persea</i> from Mexico (Suh 2016a)	Yes
<i>Hemiberlesia ithacae</i> (Ferris)	4	The USA	No record found (García Morales et al. 2019)	Oligophagous, on four genera in the Pinaceae family, including Douglas fir (<i>Pseudotsuga menziesii</i>), fir (<i>Abies</i>), spruce (<i>Picea</i>), and hemlocks (<i>Tsuga</i>) (García Morales et al. 2019) On the underside of needles and occasionally petioles, usually under the epidermis (Miller & Davidson 2005)	—	Yes
<i>Hemiberlesia lataniae</i> (Signoret)	1, 4, 5	In 105 countries worldwide	Yes Qld, NSW, WA, NT, Vic (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Hemiberlesia mendax</i> McKenzie	1, 4	Guatemala	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Orchidaceae, including <i>Orchis</i> (García Morales et al. 2019) On leaves (McKenzie 1943)	Intercepted in the USA on orchids from Guatemala and Mexico (Evans & Dooley 2013)	Yes
<i>Hemiberlesia musae</i> Takagi & Yamamoto	4	Brazil, Ecuador, Puerto Rico, Vieques Island	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including avocado and banana (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Hemiberlesia ocellata</i> Takagi & Yamamoto	4	Ecuador, Honduras and Japan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Musa</i> of family Musaceae (García Morales et al. 2019)	—	Yes
<i>Hemiberlesia palmae</i> (Cockerell)	1, 4, 5, 6	In 66 countries worldwide	Yes, Qld, NSW (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 92 genera in 53 families of host plants, including apple, african oil palm (<i>Elaeis guineensis</i>), avocado, breadfruit, Citrus, camphor (<i>Cinnamomum camphora</i>), coconut, cycads, date palm, coffee (<i>Theobroma cacao</i>), golden cane palm (<i>Dypsis lutescens</i>), guava, , kapok (<i>Ceiba pentandra</i>), lemon, lychees, mango, manihot, pepper, passion fruit, rubber (<i>Heavea brasiliensis</i>), sweetsop, soursop, tea (<i>Camellia sinensis</i>), turmeric, and <i>Vanilla</i> (García Morales et al. 2019) On leaves and, to a lesser extent, on fruits (Watson 2002); affecting host plants during the vegetative, flowering fruiting and post-harvest stages (Watson 2018) Assessed as on pathway for hard green banana from Philippines (Biosecurity Australia 2008b)	All stages intercepted in Australia, mostly on nursery stocks of <i>Aechmea</i> , bromeliads, and <i>Tillandsia</i> from the USA, and also on the fresh foliage of palms and banana from Papua New Guinea and Thailand. Intercepted in South Korea on <i>Chrysalidocarpus</i> from Indonesia, <i>Cordyline</i> , <i>Chrysalidocarpus</i> and <i>Ficus</i> from Malaysia and <i>Musa</i> from the Philippines (Suh 2016a). Intercepted in Japan on banana (Sugimoto 1994)	Yes (WA)
<i>Hemiberlesia pictor</i> (Williams)	4	United Kingdom	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Cymbidium</i> of family Orchidaceae, including the four season orchid (<i>Cymbidium ensifolium</i>) (García Morales et al. 2019)	—	Yes
<i>Hemiberlesia pitysophila</i> Takagi	3, 4	China, Hong Kong, Japan, South Korea and Taiwan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae, including Chinese red pine (<i>Pinus massoniana</i>) (García Morales et al. 2019) On needles during the vegetative, flowering and fruiting stages (Watson 2018)	Intercepted China from Japan or Taiwan, and has become a pest of <i>Pinus massoniana</i> in mainland China (CABI 2018b)	Yes
<i>Hemiberlesia rapax</i> (Comstock)	1, 4, 5	in 66 countries worldwide	Yes NSW, TAS, Qld, WA, Vic, SA (ABRS 2018; García Morales et al. 2019; Government of	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
			Western Australia 2018; Plant Health Australia 2018)			
<i>Himalaspis caroli</i> (Green)	4	India	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Camellia</i> and eastern arborvitae (<i>Thuja occidentalis</i>) (García Morales et al. 2019)	—	Yes
<i>Howardia biclavis</i> (Comstock)	1, 4, 5, 6	72 countries worldwide	Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 196 genera in 69 families of host plants, including avocados, apricots, almonds, apples, <i>Camellia</i> , <i>Citrus</i> , cherries, <i>Coffea</i> , Ceylon ebony (<i>Diospyros ebenum</i>), <i>Gardenia</i> , garden croton (<i>Codiaeum variegatum</i>), lychees, mango, macadamia, nectarines, peaches, plums, papaw, pigeon pea (<i>Cajanus cajan</i>), sweetsop, soursop, sapodilla (<i>Manilkara sapota</i>), <i>Solanum</i> , tamarind (<i>Leucaena leucocephala</i>) and walnut (García Morales et al. 2019) On the bark of trunks and branches, often under the epidermis (Watson 2002) and rarely on leaves and fruit (Miller & Davidson 2005); affecting all parts of citrus plants including roots (MAFF 1990); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for Unshu mandarin from Japan (Biosecurity Australia 2009)	Intercepted in South Korea on <i>Ficus</i> , <i>Jatropha</i> , <i>Plumeria</i> and other unnamed plants from Indonesia and Malaysia (Suh 2016a)	Yes (WA)
<i>Ischnafiorinia bambusae</i> (Maskell)	4	Mainland China, Hong Kong, Malaysia, Taiwan and Thailand	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including blackberry (<i>Rubus vulgaris</i>) and dwarf whitestripe bamboo (<i>Pleioblastus fortunei</i>) (García Morales et al. 2019)	—	Yes
<i>Ischnafiorinia malayana</i> Takahashi	4	Singapore	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae including <i>Bambusa multiplex</i> (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Ischnaspis longirostris</i> (Signoret)	1, 4, 5, 6	In 93 countries worldwide	Yes, NT, SA, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 144 genera in 50 families of host plants, including apricot, areca palm (<i>Dyopsis lutescens</i>), avocado, african oil palm (<i>Elaeis guineensis</i>), banana, <i>Bromelia</i> , coconut, coffee, cycas, <i>Cattleya</i> orchids, date palm (<i>Phoenix dactylifera</i>), eucalyptus, fig, guava, <i>Garcinia</i> , <i>Gossypium</i> , jasmine, jujubi, jasmine, lychees, <i>Magnolia</i> , mango, pepper, persimmons, soursop, rambutan and tea (García Morales et al. 2019) On leaves and occasionally on bark and fruit (Watson 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for lychee fruit from Taiwan and Vietnam (DAFF, 2013) and mangosteen fruit from Indonesia (DAFF 2012b)	Intercepted in South Korea on <i>Hyophorbe</i> from the Philippines (Suh 2016a). Intercepted in Croatia on <i>Phoenix canariensis</i> from Asia in 2015 (Masten Milek, Simala & Pintar 2016)	Yes (WA)
<i>Kuwanaspis annandalei</i> (Green)	4	Mainland China, India and Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on spiny bamboo (<i>Bambusa blumeana</i>) and male bamboo (<i>Dendrocalamus strictus</i>) of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis arundinariae</i> Takahashi	4	Mainland China, Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on <i>Arundinaria</i> and <i>Pleiblastus</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis bambusicola</i> (Cockerell)	4	Eight countries in Asia, Africa, South America and Europe	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Poaceae, including clumping bamboos (<i>Bambusa</i>), giant clumping bamboos (<i>Dendrocalamus</i>), golden bamboo (<i>Phyllostachys aurea</i>) and himalayan weeping bamboo (<i>Drepanostachyum falcatum</i>) (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis bambusifoliae</i> (Takahashi)	4	Mainland China and Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Poacea, including clumping bamboo (<i>Bambusa</i>) and east asian bamboo (<i>Pseudosasa hindsii</i>) (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Kuwanaspis elongata</i> (Takahashi)	4	Hong Kong, Mainland China and Taiwan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis hikosani</i> (Kuwana)	4	Six countries in Asia and North America	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Poaceae, including broad leaf bamboo (<i>Sasa</i>), clumping bamboo (<i>Bambusa</i>) and timber bamboo (<i>Phyllostachys</i>) (García Morales et al. 2019) On the underside of leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Kuwanaspis howardi</i> (Cooley)	1, 4	Eight countries in Asia, the Americas and Europe	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Poaceae, including common reed (<i>Phragmites</i>), canes (<i>Arundinaria</i>), clumping Bamboos (<i>Bambusa</i>) and timber bamboo (<i>Phyllostachys</i>) (García Morales et al. 2019) Occurring at the nodes of stem, at the bases of leaves (Watson 2002); affecting host plants during the vegetative, flowering or fruiting stages (Watson 2018)	Intercepted in South Korea on <i>Phyllostachys</i> from Japan (Suh 2016a)	Yes
<i>Kuwanaspis linearis</i> (Green)	4	Seven countries in Asia, South America and The Caribbean islands	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae, including <i>Bambusa vulgaris</i> (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis neolinearis</i> (Takahashi)	4	Mainland China, Malaysia, Nepal, Singapore and Taiwan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis pseudoleucaspis</i> (Lindinger)	1, 4	22 countries in North America, Europe, Oceania, Asia and Africa	No record found (García Morales et al. 2019)	Polyphagous, on 13 genera of family Poaceae, including <i>Arundinaria</i> , <i>Bambusa</i> , <i>Cynodon</i> , <i>Fargesia</i> , <i>Paspalum</i> , <i>Phyllostachys</i> , <i>Sasa</i> , <i>Semiarundinaria</i> and <i>Sinobambusa</i> (García Morales et al. 2019) Mainly on stems, especially under the leaf sheaths and bud scales at nodes (Watson 2002); affecting host plants during the vegetative, flowering and fruiting	Intercepted in Croatia on bambuseae from Asia (Masten Milek, Simala & Pintar 2016)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Kuwanaspis suishana</i> (Takahashi)	4	Mainland China, Japan, Nepal, Taiwan and Thailand	No record found (García Morales et al. 2019)	stages (Watson 2002); sometimes spreading away from nodes if canes are located in a well-sheltered position (Henderson 2011) Oligophagous, on <i>Bambusa</i> and <i>Phyllostachys edulis</i> (maso bamboo) of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis takahashii</i> Takagi	4	Japan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis tanzawensis</i> Takagi & Kawai	4	Japan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Sasa</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Kuwanaspis vermiformis</i> (Takahashi)	4	Seven countries in Africa, the Americas and Asia	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Poaceae, including <i>Bambusa multiplex</i> , oldhams bamboo (<i>Bambusa oldhamii</i>), sweet bamboo (<i>Dendrocalamus latiflorus</i>), spiny bamboo (<i>Bambusa blumeana</i>), and <i>Streptogyna crinita</i> (García Morales et al. 2019)	—	Yes
<i>Leonardianna pimentae</i> (Newstead)	4	Jamaica	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pimenta</i> of family Myrtaceae, including myrtle pepper (<i>Pimenta dioica</i>) (García Morales et al. 2019)	—	Yes
<i>Lepidosaphes beckii</i> (Newman)	1, 3, 4, 5, 6	120 countries worldwide	Yes, NSW, Qld, SA, WA, NT (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018) Declared pest in NT (DPIR 2018)	Polyphagous, on 56 genera in 40 families of host plants including <i>Agave sisalana</i> , <i>Banksia</i> , <i>Cercidiphyllum</i> , <i>Citrus</i> spp., <i>Croton</i> , <i>Cupressus</i> , <i>Elaeagnus</i> , <i>Ficus</i> , <i>Hibiscus</i> , <i>Ilex</i> , <i>Mangifera indica</i> , <i>Murraya exotica</i> , <i>Musa</i> , <i>Myrtus</i> , <i>Orchids</i> , <i>Persea</i> , <i>Pinus</i> , <i>Piper</i> , <i>Pomaderris</i> , <i>Poncirus</i> , <i>Prunus</i> , <i>Pyrus</i> , <i>Quercus</i> , <i>Raphia</i> , <i>Rosa</i> , <i>Taxus</i> , <i>Theobroma</i> , <i>Vitis</i> and <i>Wigandia</i> (Watson 2018) On bark of twigs and branches, leaves and fruit (Miller & Davidson 2005); affecting vegetative, flowering, fruiting and post harvest stages of the plant (Watson 2018)	All life stages intercepted in Australia on fresh fruits of <i>Citrus</i> and durian. Live adults also intercepted in Australia on dried <i>Citrus</i> fruit, foliage of <i>Citrus</i> and on vegetable pathway on fresh <i>Citrus</i> leaves and peel as pomander, and on tea with <i>Citrus</i> . Female adults intercepted in Taiwan on <i>Citrus</i> and <i>Piper betle</i> from China, Myanmar,	Yes (NT)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
			There is a record of this species in Victoria (García Morales et al. 2019) based on Maskell (1895) which has not been verified. No records of this species in the VAIC from Victoria (only from Qld) but one record in Agricultural Scientific Collections Unit (ASCU) at NSW Department of Primary Industries with no date of collection and no exact location from Victoria	Assessed as on pathway for mango from India (Biosecurity Australia 2008a)	South Africa and USA (Chen, Wong & Wu 2014). Intercepted in Korea on <i>Citrus</i> plant products, <i>Dracaena</i> , <i>Rohdea</i> , <i>Schefflera</i> and other plants from Chile, Israel, New Zealand, South Africa, USA, mainland China, Indonesia and Philippines (Suh 2016a)	
<i>Lepidosaphes camelliae</i> Hoke	1, 4, 5	Six countries in North America, the Caribbean Islands and Asia	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in seven families of host plants, including common camellia (<i>Camellia japonica</i>), croton (garden croton), cypress (<i>Cupressus</i>), Chinese holly (<i>Ilex cornuta</i>), <i>Ligustrum</i> , <i>Magnolia</i> and <i>Parthenocissus</i> (García Morales et al. 2019) On leaves (Miller & Davidson 2005)	Intercepted in South Korea on <i>Camellia</i> and <i>Parthenocissus</i> from Japan, and <i>Codiaeum</i> from Sri Lanka (Suh 2016a)	Yes
<i>Lepidosaphes chinensis</i> Chamberlin	1, 4	Seven countries in North America, Europe and Asia	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in seven families of host plants, including common camellia (<i>Camellia japonica</i>), croton (garden croton), cypress (<i>Cupressus</i>), Chinese holly (<i>Ilex cornuta</i>), <i>Ligustrum</i> , <i>Magnolia</i> , and <i>Parthenocissus</i> (García Morales et al. 2019)	Live adults and other life stages intercepted in Australia on <i>Dracaena</i> nursery stock Intercepted in South Korea on <i>Camellia</i> and <i>Parthenocissus</i>	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
				On leaves and twigs (Danzig & Pellizzari 1998)	from Japan, on <i>Codiaeum</i> from Sri Lanka (Suh 2016a) and on <i>Rhapis</i> and <i>Cycas</i> from China (Suh, Yu & Hong 2013)	
<i>Lepidosaphes cocculi</i> (Green)	4	Six countries in South-East Asia and Oceania	No record found (García Morales et al. 2019)	Polyphagous, on 10 genera in 10 families of host plants, including cycad queen sago (<i>Cycas circinalis</i>), <i>Dendrobium orchids</i> , <i>Gnetum luofuense</i> , red frangipani (<i>Plumeria rubra</i>) and rubber tree (García Morales et al. 2019) Sucking sap from the branches of rubber trees, causing growth retardation and die back (Chua & Wood 1990)	—	Yes
<i>Lepidosaphes conchiformis</i> (Gmelin)	1, 4, 5	45 countries in the Americas, Caribbean islands, Asia and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 36 genera in 23 families of host plants, including apple, avocado, beech, chinese plum, crab apple, Citron (<i>Citrus medica</i>), castor bean, fig (<i>Ficus carica</i>) key lime (<i>Citrus aurantifolia</i>), plums, pear, pomegranate, <i>Pistacia</i> , and walnut (García Morales et al. 2019) Mainly on leaves and bark (males primarily on leaves), although fruit may also be damaged during heavy infestations (Miller & Davidson 2005) Assessed as on pathway for apple (Fuji) from Japan (AQIS 1998), pear from South Korea (AQIS, 1999) and persimmon from Japan, South Korea and Israel (DAFF, 2004)	Female adults intercepted in Taiwan on <i>Pyrus communis</i> from Japan (Chen, Wong & Wu 2014)	Yes
<i>Lepidosaphes cornuta</i> Ramakrishna Ayyar	1, 4	India	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Piper</i> of family Piperaceae, including <i>Piper betle</i> (García Morales et al. 2019)	Eggs and live adults intercepted in Australia on fresh foliage of <i>Piper betle</i> from India. Intercepted in the USA on <i>Michelia</i> and <i>Piper</i> from Singapore and Thailand (Evans & Dooley 2013)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lepidosaphes euryae</i> (Kuwana)	4	China, Japan and Vietnam	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including <i>Cleyera</i> , <i>Eurya</i> , <i>Euonymus</i> , mango, and tea (<i>Camellia sinensis</i>) (García Morales et al. 2019)	—	Yes
<i>Lepidosaphes flava</i> (Signoret)	4	23 countries in North America, Hawaiian islands, Europe, Asia and Africa	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including black hawthorn (<i>Rhamnus lycioides</i>), carob tree (<i>Ceratonia siliqua</i>), olive (<i>Olea europaea</i>), and privet (<i>Ligustrum</i>) (García Morales et al. 2019) On branches and leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Lepidosaphes gloverii</i> (Packard)	1, 3, 4, 5	82 countries worldwide	Yes NSW, Qld, Vic, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Lepidosaphes granati</i> Koroneos	4	12 countries in Europe, Asia and Africa	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in eight families of host plants, including common fig, hawthorn, hackberry (<i>Celtis australis</i>), oaks, pomegranate and wattle (<i>Acacia cultriformis</i>) (García Morales et al. 2019) On trunk and branches (Danzig & Pellizzari 1998)	—	Yes
<i>Lepidosaphes japonica</i> (Kuwana)	1, 4	Mainland China, Japan, South Korea and Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in three families of host plants, including arbovitae (<i>Thuja</i>), fir, false cypress (<i>Chamaecyparis</i>), hemlocks (<i>Tsuga</i>), spruce (<i>Picea</i>), and <i>Taxus</i> (García Morales et al. 2019) On needles (Danzig & Pellizzari 1998)	Adult females intercepted in Taiwan on <i>Malus pumila</i> (Chen, Wong & Wu 2014)	Yes
<i>Lepidosaphes juniperi</i> Lindinger	4	20 countries in Europe and Asia	No record found (García Morales et al. 2019)	Oligophagous, on eight genera in two families of host plants, including arbovitae (<i>Thuja</i>), cedar, fir, juniper, Mediterranean cypress (<i>Cupressus sempervirens</i>), oriental arbovitae (<i>Platycladus orientalis</i>) and pines (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lepidosaphes karkarica</i> Williams & Watson	1, 4	Papua New Guinea and Vietnam	No record found (García Morales et al. 2019)	On needles and sometimes on cones (Danzig & Pellizzari 1998) Oligophagous, on two genera in two families of host plants, including <i>Citrus</i> and coconut (García Morales et al. 2019)	Eggs and live adults intercepted in Australia on fresh betel fruit	Yes
<i>Lepidosaphes kuwacola</i> Kuwana	4	China, and Japan	No record found (García Morales et al. 2019)	Polyphagous, on 19 genera in 14 families of host plants, including asian pear (<i>Pyrus pyrifolia</i>), ash (<i>Fraxinus</i>), chinese mulberry (<i>Morus australis</i>), elm, Japanese hazel (<i>Corylus sieboldiana</i>), Japanese yew (<i>Taxus cuspidata</i>), maidenhair tree (<i>Ginkgo biloba</i>), mulberry (<i>Morus</i>), plum blossom (<i>Prunus mume</i>), spindle (<i>Euonymus</i>), and willow (<i>Salix</i>) (García Morales et al. 2019)	—	Yes
<i>Lepidosaphes laterochitinsa</i> Green	1, 4, 5	17 countries in Oceania, Asia and the UK	No record found (García Morales et al. 2019)	Polyphagous, on 38 genera in 28 families of host plants, including breadfruit (<i>Artocarpus altilis</i>), areca palm (<i>Areca catechu</i>), Australian umbrella tree (<i>Schefflera actinophylla</i>), coconut, <i>Citrus</i> , <i>Cycas</i> , <i>Dracaena</i> , guava, grapevines, manihot, mango, <i>Sansevieria</i> and tea (García Morales et al. 2019) Associated with fruit (Biosecurity Australia 2006c) Assessed as on pathway for mango from Taiwan (Biosecurity Australia 2006c)	Intercepted in the USA on <i>Citrus</i> , <i>Mangifera</i> and unnamed ornamentals from Asia, Australia and Costa Rica (Evans & Dooley 2013). Intercepted in South Korea on <i>Cocos</i> from Vietnam and the Philippines, on <i>Dracaena</i> from Indonesia, Malaysia, the Philippines, Taiwan and Vietnam, and on <i>Rohdea</i> and <i>Sansevieria</i> from mainland China, Indonesia and Thailand (Suh, Yu & Hong 2013; Suh 2016a)	Yes
<i>Lepidosaphes leei</i> Takagi	1, 4	Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including <i>Cocos</i> , <i>Ilex formosana</i> , linden arrowwood (<i>Viburnum dilatatum</i>) and <i>Symplocos</i> (García Morales et al. 2019)	Adult females intercepted in Taiwan on <i>Podocarpus macrophyllus</i> from Japan Chen et al. 2014)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lepidosaphes malicola</i> Borchsenius	1, 4, 5	India	No record found (García Morales et al. 2019)	Polyphagous, on 36 genera in 24 families of host plants, including apple, apricot, <i>Cotoneaster</i> , cottonwood (<i>Populus</i>), elm (<i>Ulmus</i>), English walnut (<i>Juglans regia</i>), grapevine, oak, pear, pomegranate, red current (<i>Ribes rubrum</i>), <i>Rosa</i> and willow (García Morales et al. 2019) On trunk and branches and also on leaves and fruits in summer (Danzig & Pellizzari 1998)	Intercepted in the USA on <i>Malus</i> , <i>Prunus</i> and <i>Pyrus</i> from the Dominican Republic and Italy (Evans & Dooley 2013)	Yes
<i>Lepidosaphes mcgregori</i> Banks	4, 5	Guam, India, the Philippines	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including coconut and mangoes (García Morales et al. 2019)	—	Yes
<i>Lepidosaphes newsteadi</i> (Sulc)	4	23 countries in Europe, Asia and North America	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in five families of host plants, including Bermuda cedar (<i>Juniperus bermudiana</i>), cedar, <i>Camellia</i> , fir, Japanese cedar (<i>Cryptomeria japonica</i>), pine and spruce (García Morales et al. 2019) On needles (Danzig & Pellizzari 1998)	—	Yes
<i>Lepidosaphes noxia</i> McKenzie	4	The USA, Hawaiian islands and the Philippines	No record found (García Morales et al. 2019)	Oligophagous, on <i>Dendrobium dearei</i> and <i>Vanda</i> of family Orchidaceae (García Morales et al. 2019)	—	Yes
<i>Lepidosaphes pallida</i> (Maskell)	4	15 countries in Oceania, Asia, Europe and North America	No record found (García Morales et al. 2019; Plant Health Australia 2018)	Polyphagous, on 20 genera in 15 families of host plants, including juniper, Japanese cedar (<i>Cryptomeria japonica</i>), grey mangrove (<i>Avicennia marina</i>) lime (<i>Citrus aurantifolia</i>), medlar (<i>Mespilus germanica</i>), plum pine (<i>Podocarpus</i>), pines (<i>Pinus</i>), spruce and ring-cupped oak (<i>Quercus glauca</i>) (García Morales et al. 2019) On leaves (Miller & Davidson 2005) or the base of leaves of coniferous hosts (Henderson 2011)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lepidosaphes pallidula</i> Fernald	4, 5, 6	Seven countries in Asia, Oceania and Africa	Yes Qld (García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 10 genera in nine families of host plants, including <i>Citrus</i> , croton (<i>Codiaeum</i>), eggplant (<i>Solanum melongena</i>), guava, <i>Hibiscus</i> , mango, <i>Murraya</i> , and passionfruit (<i>Passiflora</i>)(García et al. 2018) On leaves and fruits rarely on twigs (Danzig & Pellizzari 1998) Assessed as on pathway for mangoes from Pakistan (Biosecurity Australia 2011b)	—	Yes (WA)
<i>Lepidosaphes pini</i> (Maskell)	1, 4	Seven countries in Asia, Oceania, and North America	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in five families of host plants, including chinese fir (<i>Cunninghamia lanceolata</i>), cycads, fir (<i>Abies</i>), plum pine (<i>Podocarpus</i>), pines (<i>Pinus</i>), Sago palm (<i>Cycas revoluta</i>) and <i>Taxus</i> (García Morales et al. 2019) On needles often near the base of the sheath (Miller & Davidson 2005)	Adult females intercepted in Australia on <i>Pinus thunbergii</i> (Chen, Wong & Wu 2014)	Yes
<i>Lepidosaphes pinnaeformis</i> (Bouché)	1, 4, 5	33 countries in Africa, Oceania, the Americas, Asia and Europe	Yes, NSW, Vic, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Absent from Western Australia (Government of Western Australia 2018)	Polyphagous, on 34 genera in 21 families of host plants, including <i>Camellia</i> , <i>Cinnamomum</i> , <i>Citrus</i> , <i>Cymbidium</i> , <i>Magnolia</i> , <i>Pearsea</i> and <i>Prunus</i> (García Morales et al. 2019)		Yes (WA)
<i>Lepidosaphes pistaciae</i> Archangelskaya	1, 4	15 countries in Asia, Central Asia, Europe and the Middle East	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in nine families of host plants, including apple, apricot, pear, pistachios (<i>Pistacia</i>), <i>Rhododendron</i> , <i>Rosa</i> , and <i>Sorbus</i> (mountain ash) (García Morales et al. 2019) On trunks and branches throughout the year, spreading to the undersides of leaves and fruits during	Intercepted in the USA on pistachios, <i>Malus</i> , <i>Prunus</i> , <i>Pyrus</i> and other plant hosts from India, Egypt, Iran, Jordan, Syria, Tunisia, and Turkey (Evans & Dooley 2013)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lepidosaphes punicae</i> Laing	1	Oceania, Asia, USA, Central and South America and Africa	No record found (García Morales et al. 2019)	summer (Watson 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Polyphagous, on 13 genera in 10 families of host plants, including breadfruit (<i>Artocarpus</i>), lychee, pomegranate, rambutan (<i>Nephelium</i>), <i>Plumeria</i> , <i>Rosa</i> , <i>Solanum</i> , <i>Vanilla</i> and <i>Yucca</i> (García Morales et al. 2019) On stems and branches (Miller & Davidson 2005)	Intercepted in South Korea on imported <i>Plumeria</i> from Indonesia (Suh 2016b) Intercepted in the USA on <i>Litchi</i> either from Africa or Asia (Miller & Davidson 2005)	Yes
<i>Lepidosaphes rubrovittata</i> Cockerell	1, 4	15 countries in Asia, Oceania and the Caribbean Islands	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in 10 families of host plants, including cycads, croton, fig, guava, rubber tree (<i>Hevea brasiliensis</i>), <i>Rosa</i> and watery rose apple (<i>Syzygium aqueum</i>) (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	Intercepted in Australia on fresh Guava. Intercepted in the USA on Cycads, <i>Psidium</i> , <i>Murraya</i> , <i>Nepenthes</i> and other unidentified hosts from Asia, Jamaica, Puerto Rico and South Africa (Evans & Dooley 2013) Intercepted in South Korea on <i>Codiaeum</i> and <i>Eucomnia</i> from Costa Rica and China (Suh 2016a)	Yes
<i>Lepidosaphes serrulata</i> (Ganguli)	4	India and Sri Lanka	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Camellia</i> of family Theaceae, including the tea plant (<i>Camellia sinensis</i>) (García Morales et al. 2019)	—	Yes
<i>Lepidosaphes shikohabadensis</i> Dutta	4, 5	India	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Mangifera</i> of family Anacardiaceae, including mango (Dutta 1990)	—	Yes
<i>Lepidosaphes similis</i> Beardsley	1, 4	Federated States of Micronesia, Northern Mariana Islands,	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Ravenala</i> of family Strelitziaceae, including Traveller's tree (<i>Ravenala madagascariensis</i>) (Beardsley 1975; (García Morales et al. 2019)	Intercepted in the USA on <i>Areca</i> , <i>Cocos</i> , <i>Dracaena</i> , <i>Musa</i> and palms from Asia, the Pacific Islands and Brazil (Evans & Dooley 2013)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lepidosaphes tapleyi</i> Williams	1, 4, 5	Palau and Wake Island 17 countries in Africa, Asia, and Oceania	No record found (García Morales et al. 2019)	Polyphagous, on 26 genera in 19 families of host plants, including bay laurel (<i>Laurus nobilis</i>), <i>Citrus</i> , coconut, <i>Eucalyptus</i> , fig, guava, <i>Hibiscus</i> , jasmine, mango, olive, passionfruit, <i>Rosa</i> , sweet potato (García Morales et al. 2019) Mainly on leaves, spreading to fruits and branches during heavy infestations (Watson 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for mangoes from Pakistan (Biosecurity Australia 2011b)	Intercepted in South Korea on <i>Cocos</i> and other unidentified hosts from Malaysia and China (Suh 2016a) Intercepted in England and Wales on fresh mango from Gambia, Pakistan and Venezuela (Malumphy 1996)	Yes
<i>Lepidosaphes tokionis</i> (Kuwana)	1, 4, 5	28 countries in Africa, Oceania, North America, Caribbean Islands and South East Asia	Yes, Qld, SA (ABRS 2018; García Morales et al. 2019)	Further assessment is not required	—	No
<i>Lepidosaphes tubulorum</i> Ferris	1, 4, 5	Six countries in Asia and Oceania	No record found (García Morales et al. 2019)	Polyphagous, on 34 genera in 24 families of host plants, including apple, birch (<i>Betula</i>), <i>Camellia</i> , <i>Hydrangea</i> , Japanese holly (<i>Ilex crenata</i>), mulberry (<i>Morus</i>), <i>Magnolia</i> , oak (<i>Quercus</i>), peach, plum blossom (<i>Prunus mume</i>), tea and willow (<i>Salix</i>) (García Morales et al. 2019) Assessed as on pathway for pear from South Korea (AQIS 1999)	Intercepted in the USA on unnamed ornamentals from Asia and Guam (Evans & Dooley 2013)	Yes
<i>Lepidosaphes ulmi</i> (Linnaeus)	1, 4, 5	62 countries worldwide	Yes, NSW, SA, Qld, TAS, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia)	Further assessment is not required	—	No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lepidosaphes ussuriensis</i> (Borchsenius)	3, 4	Six countries in Asia including Russia	2018; Plant Health Australia 2018) No record found (García Morales et al. 2019)	Polyphagous, on 17 genera in 11 families of host plants, including apple, alder, Asian pear (<i>Pyrus pyrifolia</i>), birch, chestnut (<i>Castanea</i>), fig, grapevine, Japanese persimmon (<i>Diospyros kaki</i>), plums and plum blossom (<i>Prunus mume</i>) (García Morales et al. 2019) On branches and leaves (EPPO 2013)	—	Yes
<i>Lepidosaphes yanagicola</i> Kuwana	4	Six countries in North America, Asia and Russia	No record found (García Morales et al. 2019)	Polyphagous, on 20 genera in 13 families of host plants, including <i>Albizia</i> , <i>Camellia</i> , dogwood (<i>Cornus</i>), mulberry, persimmons, willow and walnut (García Morales et al. 2019) On stems and bark, and may also be found near leaf midveins during heavy infestations (Miller & Davidson 2005)	—	Yes
<i>Leucaspis gigas</i> (Maskell)	4	New Zealand	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in 11 families of host plants, including <i>Griselinia</i> , <i>Hedycarya arborea</i> , <i>Leptecophylla juniperina</i> and <i>Pittosporum eugenioides</i> and (García Morales et al. 2019)	—	Yes
<i>Leucaspis lowi</i> Colvée	4	30 countries in Europe, Asia, Africa	No record found (García Morales et al. 2019)	Oligophagous, on five genera in two families of host plants, including aleppo pine (<i>Pinus halepensis</i>), black pine (<i>Pinus nigra</i>), Greek fir (<i>Abies cephalonica</i>), maritime pine (<i>Pinus pinaster</i>), mauritania grass (<i>Ampelodesmos mauritanicus</i>), <i>Saccharum spontaneum</i> and St. Augustine grass (<i>Stenotaphrum secundatum</i>) (García Morales et al. 2019) On needles during the vegetative flowering and fruiting stages (Watson 2018)	—	Yes
<i>Leucaspis pini</i> (Hartig)	1, 4	27 countries in Europe, Africa and Middle Eastern Asia	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae, including aleppo pine (<i>Pinus halepensis</i>), pine (<i>Pinus sylvestris</i>) and scots mountain pine (<i>Pinus mugo</i>) (García Morales et al. 2019)	Adults intercepted in Australia on apricot from New Zealand	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Leucaspis pusilla</i> Löw	4	35 Countries in Europe, Africa, South America and Asia	No record found (García Morales et al. 2019)	On needles (Zahradnik 1990a) Oligophagous, on three genera of family Pinaceae, including aleppo pine (<i>Pinus halepensis</i>), atlas cedar (<i>Cedrus atlantica</i>), mountain pine (<i>Pinus mugo</i>), scots pine (<i>Pinus sylvestris</i>), and Siberian fir (<i>Abies sibirica</i>) (García Morales et al. 2019) Infesting host plants at the base of needles (Zahradnik 1990a)	—	Yes
<i>Leucaspis riccae</i> Targioni Tozzetti	1, 4	20 countries in Europe, Africa, Asia and South America	No record found (García Morales et al. 2019)	Oligophagous, on six genera in six families of host plants, including <i>Euphorbia</i> , fig, olive and <i>Nerium oleander</i> (García Morales et al. 2019) On leaves and branches (Danzig & Pellizzari 1998)	Intercepted in the USA on <i>Olea</i> from Europe (Evans & Dooley 2013)	Yes
<i>Leucaspis signoreti</i> Signoret	4	11 countries in Europe, Africa and Oceania	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Pinus</i> of family Pinaceae, including maritime pine (<i>Pinus pinaster</i>) and scots pine (<i>Pinus sylvestris</i>) (García Morales et al. 2019) On needles (Zahradnik 1990a)	—	Yes
<i>Lindingaspis ferrisi</i> McKenzie	4, 5	Mainland China, India, Pakistan and Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including Alexandrian laurel balltree (<i>Calophyllum inophyllum</i>) and <i>Citrus</i> (García Morales et al. 2019) On foliage and not known to be associated with fruit (Pena 1993)	—	Yes
<i>Lindingaspis floridana</i> Ferris	4, 5	Eight countries in North America, Caribbeans, the Middle East and Asia	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including fig, mango and olive (García Morales et al. 2019) On leaves (García Morales et al. 2019)	—	Yes
<i>Lindingaspis greeni</i> (Brain & Kelly)	4, 5	South Africa, Uganda and Sri Lanka	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including pomegranate (Balikai, Kotikal & Prasanna 2009) african fig tree (<i>Ficus cyathistipula</i>) and <i>Capparis moonii</i> (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lindingaspis misrae</i> (Laing)	1, 4,	India and Sri Lanka	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Capparis moonii</i> , tamarind (<i>Tamarindus indica</i>) and queen sago (<i>Cycas circinalis</i>) (García Morales et al. 2019) On the leaves of sago palm (McKenzie 1943)	Adults intercepted in Australia on mango Intercepted in the USA on <i>Cycas</i> , <i>Murraya</i> , <i>Tamarindus</i> and <i>Mangifera</i> from India (Evans & Dooley 2013)	Yes
<i>Lindingaspis musae</i> (Laing)	4	Cameroon, Guinea, Sierra Leone, Tanzania and Zaire	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including african oil palm (<i>Elaeis guineensis</i>), <i>Gardenia</i> and <i>Musa</i> (Chua & Wood 1990; García Morales et al. 2019)	—	Yes
<i>Lindingaspis picea</i> (Malenotti)	4	Cameroon, Kenya, Somalia, Uganda and the USA	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including bitter orange (<i>Citrus aurantium</i>), <i>Elaeodendron schweinfurthianum</i> , <i>Hydnocarpus</i> and tulip tree (<i>Liriodendron tulipifera</i>) (García Morales et al. 2019) On leaves (McKenzie 1943)	—	Yes
<i>Lindingaspis rossi</i> (Maskell)	1, 4, 5	36 countries in Africa, Oceania, the Americas, Europe and Asia	Yes, NSW, Vic, WA, Qld, SA, NT, TAS (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Lindingaspis tingi</i> McKenzie	1, 4	The Philippines, Guam and Christmas Island	No record found for mainland Australia (García Morales et al. 2019)	Monophagous, on genus <i>Phalaenopsis</i> of family Orchidaceae, including <i>Phalaenopsis schilleriana</i> (García Morales et al. 2019)	Adults intercepted in Australia on <i>Mangifera</i>	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Lineaspis striata</i> (Newstead)	4	17 countries in Europe, Africa, the Middle East and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 10 genera in five families of host plants, including arbovitae (<i>Thuja</i>), Cypress, English yew (<i>Taxus baccata</i>), juniper, and roast-beef plant (<i>Iris foetidissima</i>) (García Morales et al. 2019) On needles (Danzig & Pellizzari 1998)	—	Yes
<i>Lopholeucaspis cockerelli</i> (Grandpré & Charmoy)	4, 5	54 countries worldwide	Unreliable Record The Australian record of this species in ScaleNet (García Morales et al. 2019) is considered as unreliable because the reference (Woodruff et al. 1998) cited does not provide any evidence to support this record.	Polyphagous, on 62 genera in 33 families of host plants, including avocado, bitter orange (<i>Citrus aurantium</i>), <i>Citrus</i> , citron (<i>Citrus medica</i>), coconut, coffee, <i>Dracaena</i> , key lime (<i>Citrus aurantifolia</i>), lemon, lychee, many orchid genera, pomelo, pepper, passionfruit, <i>Rosa</i> and rubber tree (García Morales et al. 2019) On leaf ridges (Varshney 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for Tahitian lime from New Caledonia (Biosecurity Australia 2006b)	—	Yes
<i>Lopholeucaspis japonica</i> (Cockerell)	1, 3, 4, 5, 6	20 countries in Asia, Europe, Africa and the Americas	Yes, NT (ABRS 2018; García Morales et al. 2019) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 58 genera in 36 families of host plants, including apple, alder, Asian pear (<i>Pyrus pyrifolia</i>), bay laurel (<i>Laurus nobilis</i>), boxwood, beech, camphor, chestnut, <i>Citrus</i> , cherry plum (<i>Prunus cerasifera</i>), <i>Camellia</i> , cottonwood, dogwood, elm, European pear, (<i>Pyrus communis</i>), fig, grapevine, holly, <i>Hydrangea</i> , jujube, <i>Magnolia</i> , maple, medlar (<i>Mespilus germanica</i>), oak, persimmon, plum (<i>Prunus domestica</i>), plum blossom (<i>Prunus mume</i>), pomegranate, poplar, <i>Rosa</i> , spindle, tea plant	Intercepted in South Korea on <i>Acer</i> from Japan (Suh 2016a). Intercepted in Croatia on unnamed plants from Asia (Masten Milek, Simala & Pintar 2016)	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Mangaspis bangalorensis</i> Takagi & Kondo	5	India	No record found (García Morales et al. 2019)	<p>(<i>Camellia sinensis</i>), white mulberry (<i>Morus alba</i>) and willow (García Morales et al. 2019)</p> <p>Mainly on the bark of trunks and branches, and rarely on leaves and fruits (Watson 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)</p> <p>Assessed as on pathway for apples from China (Biosecurity Australia, 2010), pears from China (AQIS 1998b; Biosecurity Australia 2005a) and Fuji apples from Japan (AQIS 1998a)</p> <p>Monophagous, on genus <i>Mangifera</i> of family Anacardiaceae, including mango (García Morales et al. 2019; Takagi & Kondo 1997)</p> <p>On twigs, usually beneath leaf buds however adult females also occurring under the epidermis of the twigs (Takagi & Kondo 1997)</p>	—	Yes
<i>Melanaspis bromiliae</i> (Leonardi)	1, 4, 5	37 countries in Africa, Oceania, the Americas, the Caribbean islands, Europe and Asia	No record found (García Morales et al. 2019)	<p>Oligophagous, on five genera in three families of host plants, including bromeliads, coconut, pineapple, red pineapple (<i>Ananas bracteatus</i>), and Pandan (<i>Pandanus</i>) (Deitz & Davidson 1986a; García Morales et al. 2019)</p> <p>On leaves and fruits (Danzig & Pellizzari 1998)</p> <p>Assessed as on pathway for Pineapple from Malaysia (DAFF 2012a) and for Pineapple (AFFA 2002)</p>	<p>Nymphs and adults intercepted in Australia on pineapple.</p> <p>Intercepted in South Korea on <i>Ananas</i> from the Philippines and Thailand (Suh 2016a)</p>	Yes
<i>Melanaspis calura</i> (Cockerell)	1, 4	Eight countries in Central and South America and Asia	No record found (García Morales et al. 2019)	<p>Oligophagous, on five genera in five families of host plants, including hawthorn, mamee (<i>Mammea americana</i>), mombin (<i>Spondias</i>) and 'true mangroves' (<i>Rhizophora</i>) (Deitz & Davidson 1986; García Morales et al. 2019)</p> <p>Under bark and concealed within cracks (Ferris 1941)</p>	Intercepted in the USA on <i>Spondias</i> , <i>Crataegus</i> and <i>Mammea</i> from Costa Rica, Ecuador, Guatemala, Honduras and Mexico (Evans & Dooley 2013)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Melanaspis glomerata</i> (Green)	4	India and Pakistan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Saccharum</i> of family Poaceae, including sugarcane (Williams & Greathead 1990) On moderately hard internodes of stems and midribs of leaves (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Melanaspis inopinata</i> (Leonardi)	1, 4	13 countries in Asia and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 23 genera in 13 families of host plants, including apricot, almonds, castor bean (<i>Ricinus communis</i>), maple, oak, pear, pistacios, sweet cherry (<i>Prunus avium</i>) and walnut (García Morales et al. 2019) On trunk, branches, leafstalks and rarely on fruits (Danzig & Pellizzari 1998)	Intercepted in the USA on pistacios, <i>Dioscorea</i> , <i>Malus</i> and <i>Prunus</i> from the Middle East (Evans & Dooley 2013)	Yes
<i>Melanaspis obscura</i> (Comstock)	1, 4, 5	Brazil, Canada, the USA and Japan	No record found (García Morales et al. 2019)	Polyphagous, on 18 genera in 12 families of host plants, including apricots, almonds, beech, chestnut cherries, elm, grapevine, hickory (<i>Carya</i>), maple, nectarines, olive, oak, plums, peaches (García Morales et al. 2019) On the bark, often under loose outer bark flakes (Watson 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	Intercepted in South Africa on Pecan nut nursery stock from the USA (Saccaggi & Pieterse 2013)	Yes
<i>Melanaspis smilacis</i> (Comstock)	1, 4	21 countries in Africa, the Americas, Asia and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 18 genera in 11 families of host plants, including <i>Andropogon</i> , canes (<i>Arundinaria</i>), <i>Bambusa</i> (clumping bamboos), greenbriers (<i>Smilax</i>), mamee (<i>Mammea americana</i>), pineapple, Switchgrass (<i>Panicum virgatum</i>), southern wax myrtle (<i>Morella cerifera</i>) and <i>Yucca</i> (García Morales et al. 2019) On the stems (Ferris 1941)	Intercepted in Taiwan on <i>Ananas comosus</i> from the Philippines (Chen, Wong & Wu 2014)	Yes
<i>Melanaspis sulcata</i> Ferris	4, 5	Seven countries in the central Americas, the Caribbean	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in 10 families of host plants, including <i>Citrus</i> , cherimoya (<i>Annona cherimola</i>), mombins (<i>Spondias</i>), Japanese persimmon (<i>Diospyros kaki</i>), <i>Plumeria</i> , manihot (<i>Manihot</i>	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
		Islands, Asia and Germany		<i>esculenta</i>) and willow (Deitz & Davidson 1986b; García Morales et al. 2019) On the trunks, branches, stems and leaves (Deitz & Davidson 1986b)		
<i>Melanaspis tenebricosa</i> (Comstock)	4, 5	Mexico, the USA and the Galapagos Islands	No record found (García Morales et al. 2019)	Polyphagous, on 28 genera in 19 families of host plants, including apple, grapevine, elm, English walnut (<i>Juglans regia</i>), maple (<i>Acer</i>), mulberry (<i>Morus</i>), oak, peach and willow (Deitz & Davidson 1986b) (García Morales et al. 2019) On the bark (Miller & Davidson 2005)	—	Yes
<i>Mercetaspis baluchistanensis</i> (Rao)	4	Pakistan	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including almonds (<i>Prunus dulcis</i>) and <i>Polyalthia amygdalina</i> (García Morales et al. 2019)	—	Yes
<i>Mercetaspis halli</i> (Green)	4, 5	20 countries in Asia, the Middle East Asia, Europe and North America	No record found (García Morales et al. 2019)	Polyphagous, on 12 genera in five families of host plants, including apple, apricot, almond, blackberries (<i>Rubus</i>), crabapple, cherry plum (<i>Prunus cerasifera</i>), nectarines, peach, plums, pear, pomegranate, sweet cherry and sour cherry (<i>Prunus cerasus</i>)(García Morales et al. 2019; Miller & Davidson 2005) On trunks and branches, particularly in bark crevices, and on fruit during heavy infestations; affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018); infesting nectarines and peach developing red spots under the scales (Watson 2018)	—	Yes
<i>Microparlatoria fici</i> (Takahashi)	1, 4,	Indonesia, Taiwan and Thailand	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Ficus</i> of family Moraceae, including <i>Ficus retusa</i> (García Morales et al. 2019)	Intercepted in South Korea on <i>Ficus</i> plants from Taiwan and Indonesia (Suh & Hyun 2015; (Suh 2016a)	Yes
<i>Mixaspis bambusicola</i> (Takahashi)	4,	Mainland China and Taiwan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Morganella longispina</i> (Morgan)	1, 4, 5, 6	42 countries worldwide	Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 34 genera in 22 families of host plants, including breadfruit, <i>Camellia</i> , <i>Citrus</i> , common fig (<i>Ficus carica</i>), guava, <i>Hibiscus rosa-sinensis</i> , jasmine, mango, <i>Magnolia</i> , macadamia, olive, papaw (<i>Carica papaya</i>) and true cinnamon (<i>Cinnamomum verum</i>) (García Morales et al. 2019) On the bark of branches and on fruit (Watson 2018); rarely found on leaves and roots (Miller & Davidson 2005); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for Tahitian lime from New Caledonia (BA, 2006) and Unshu mandarins from Japan (Biosecurity Australia 2009)	Intercepted in South Korea on <i>Citrus</i> from the USA and on <i>Lagerstroemia</i> from China (Suh 2016a)	Yes (WA)
<i>Mycetaspis apicata</i> (Newstead)	4	Six countries in the Americas and the Caribbean Islands	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in six families of host plants, including <i>Albizia</i> , black mangrove (<i>Avicennia germinans</i>), <i>Croton</i> , wattles (<i>Acacia</i>) and <i>Magnolia</i> (Ferris 1941; García Morales et al. 2019) On the bark of limbs and trunks, with scales concealing themselves beneath bark flakes, in cracks or under the epidermis of the bark (Ferris 1941)	—	Yes
<i>Mycetaspis personata</i> (Comstock)	4, 5	41 countries worldwide	No record found (ABRS 2018; García Morales et al. 2019)	Polyphagous, on 28 genera in 19 families of host plants, including avocado, <i>Areca</i> , banana, <i>Camellia</i> , cashew (<i>Anacardium</i>), <i>Citrus</i> , coconut, fig, jasmine, mango, sapodilla (<i>Manilkara zapota</i>) and mammee (<i>Mammea americana</i>) (García Morales et al. 2019) On leaves (Ferris 1941); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Neoleucaspis parallela</i> Green	4	India	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> (clumping bamboo) of family Poaceae (Green 1926; (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Neopinnaspis harperi</i> McKenzie	4, 5	The USA, Hawaiian Islands, Japan and Taiwan	No record found (García Morales et al. 2019)	Polyphagous, on 58 genera in 33 families of host plants, including avocado, common fig, hawthorn, holly, <i>Hibiscus</i> , hickory, macadamia, Japanese magnolia, olive, oak, persimmon (<i>Diospyros kaki</i>), pomegranate, peach, pear, Portuguese laurel (<i>Prunus lusitanica</i>), <i>Rosa</i> and walnut (García Morales et al. 2019) On the bark of twigs and branches, especially in cracks (Miller & Davidson 2005; Watson 2002); affecting host plants during the vegetative, growing, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Neoselenaspis silvaticus</i> (Lindinger)	4	12 countries in Africa	No record found (García Morales et al. 2019)	Polyphagous, on 27 genera of 21 plant families, including bitter orange, barberry (<i>Berberis</i>), camphor, cacao (<i>Theobroma cacao</i>), cabbage palm (<i>Agave sisalana</i>), Canary Island date palm (<i>Phoenix canariensis</i>), grapevine, <i>Gardenia</i> , loquat (<i>Eriobotrya japonica</i>), mango, olive and Sisal plant (<i>Agave sisalana</i>) (García et al. 2018)	—	Yes
<i>Nikkoaspis formosana</i> (Takahashi)	4	Mainland China and Taiwan	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Nikkoaspis hichiseisana</i> (Takahashi)	4	Mainland China and Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on three genera in two families of host plants, including <i>Bambusa</i> , <i>Phragmites</i> (common reed) and <i>Polypodiodes</i> (Tao 1978; (García Morales et al. 2019)	—	Yes
<i>Nikkoaspis sasae</i> (Takahashi)	4	China	No record found (García Morales et al. 2019)	Oligophagous, on two genera, <i>Bambusa</i> and <i>Sasa</i> in family Poaceae (García Morales et al. 2019)	—	Yes
<i>Nikkoaspis shiranensis</i> Kuwana	4	Japan and Russia	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Laisa</i> and <i>Sasa</i> (<i>Sasa veitchii</i>) in two families of host plants (García Morales et al. 2019) On the upper surfaces of leaves (Danzig & Pellizzari 1998)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Oceanaspidiotus spinosus</i> (Comstock)	1, 4, 5	46 countries worldwide	No record found (García Morales et al. 2019)	Polyphagous, on 49 genera in 38 families of host plants, including <i>Actinidia chinensis</i> , avocado, bromeliads, black sugar palm (<i>Arenga pinnata</i>), <i>Camellia</i> , <i>Citrus</i> , common fig, egg plant, <i>Encephalartos</i> , grapevine, <i>Hydrangea</i> , Japanese persimmon (<i>Diospyros kaki</i>), lychees, lady palm (<i>Rhapis excelsa</i>), mango, <i>Magnolia</i> , cinnamon, ponytail palm (<i>Beaucarnea recurvata</i>), prickly pear cactus (<i>Opuntia</i>), <i>Rubus</i> and <i>Rosa</i> (García Morales et al. 2019) On leaves, twigs and bark (Miller & Davidson 2005)	Intercepted in Taiwan on <i>Zingiber mioga</i> from Thailand (Chen, Wong & Wu 2014)	Yes
<i>Octaspidiotus stauntoniae</i> (Takahashi)	1, 4, 5	Nine countries in Oceania and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 22 genera in 18 families of host plants including bamboo orchid (<i>Arundina graminifolia</i>), fig, guava, grapevine, <i>Jasminum</i> , mango and mandarin (<i>Citrus reticulata</i>) (García Morales et al. 2019) On the leaves of the host plants, and associated with leaves and young shoots of citrus (MAFF 1990; (García Morales et al. 2019)	intercepted in South Korea on <i>Jasminum</i> from Vietnam (Suh 2016a)	Yes
<i>Octaspidiotus tamarindi</i> (Green)	4	India	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Tamarindus</i> of family Fabaceae including tamarind (<i>Tamarindus indica</i>) (Takagi 1984; (García Morales et al. 2019) On leaves (Takagi 1984)	—	Yes
<i>Odonaspis arcusnotata</i> Ben-Dov	4	Malaysia, Taiwan, mainland China and Japan	No record found (García Morales et al. 2019)	Oligophagous, on five genera of family Poaceae, including <i>Bambusa</i> , <i>Pseudosasa</i> , <i>Pleioblastus</i> , <i>Sasa</i> , and <i>Schizostachyum</i> (Bendov 1988b; Aono 2009; (García Morales et al. 2019)	—	Yes
<i>Odonaspis bambusarum</i> (Cockerell)	4	Japan	No record found (García Morales et al. 2019)	Oligophagous, on five genera of family Poaceae including <i>Bambusa Pleioblastus</i> , simons bamboo (<i>Arundinaria simonii</i>), <i>Semiarundinaria</i> and <i>Sasa</i> (Aono 2009; García Morales et al. 2019)	—	Yes
<i>Odonaspis benardi</i> Balachowsky	4	Eight countries in North and	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants including beard grass (<i>Andropogon</i>), bahia grass	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
		Central Americas		(<i>Paspalum</i>), <i>Echeveria</i> and <i>Maranta</i> (García Morales et al. 2019)		
<i>Odonaspis crenulatus</i> (Ben-Dov)	4	India and the Philippines	No record found (García Morales et al. 2019)	Oligophagous on three genera in family Poaceae including <i>Arundinaria</i> , <i>Bambusa</i> and <i>Schizostachyum lumampao</i> (Ben Dov 1988b; (García Morales et al. 2019)	—	Yes
<i>Odonaspis greenii</i> Cockerell	4	23 countries in Oceania, Asia, Europe, Africa, North and South Americas and Caribbean Islands	No record found (García Morales et al. 2019)	Oligophagous, on six genera of family Poaceae including <i>Arundinaria</i> , <i>Bambusa</i> , <i>Dinochloa scandens</i> , giant clumping bamboo (<i>Gigantochloa</i>), silvergrass (<i>Miscanthus</i>) and <i>Schizostachyum diffusum</i> (Aono 2009; García Morales et al. 2019) Young insects on the stem under the leaf sheath, adult females gradually moving in between the layers of the leaf sheath, excavating a cell for itself (Green 1896e); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Odonaspis lingnani</i> Ferris	4	China, Indonesia and Malaysia	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae, including <i>Bambusa multiplex</i> and <i>Bambusa vulgaris</i> (Ben Dov 1988b; (Aono 2009; García Morales et al. 2019) Found as tight masses of insects near the axils of the branches (Ferris 1955)	—	Yes
<i>Odonaspis pacifica</i> Ben-Dov	4	Guam (Oceania) and the Philippines	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Bambusa</i> and <i>Dinochloa</i> (<i>Dinochloa scandens</i>) of family Poaceae (Ben-Dov 1988; (Aono 2009; García Morales et al. 2019)	—	Yes
<i>Odonaspis paucipora</i> Ben-Dov	4	Guyana and India	No record found (García Morales et al. 2019)	Monophagous, on <i>Bambusa tulda</i> of family Poaceae (García Morales et al. 2019)	—	Yes
<i>Odonaspis ruthae</i> Kotinsky	4	43 countries worldwide	Yes, NSW, Qld, SA, WA (García Morales et al. 2019; Government of	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Odonaspis saccharicaulis</i> (Zehntner)	1, 4	36 countries in Africa, Oceania, the Americas, Caribbean Islands and Asia	Western Australia 2018; Plant Health Australia 2018) Yes, NT (García Morales et al. 2019; Plant Health Australia 2018)	Further assessment is not required		No
<i>Odonaspis secreta</i> (Cockerell)	1, 4	26 countries in Oceania, the Americas, Africa, Asia and Europe	Yes (García Morales et al. 2019)	Further assessment is not required		No
<i>Odonaspis serrata</i> Ben-Dov	1, 4	Sri Lanka and Vietnam	No record found (García Morales et al. 2019)	Oligophagous, on two genera, <i>Arundinaria</i> and <i>Bambusa</i> of family Poaceae (Ben-Dov 1988b; (García Morales et al. 2019)	Intercepted in South Korea on <i>Bambusa</i> from Sri Lanka (Suh 2016a)	Yes
<i>Odonaspis siamensis</i> (Takahashi)	4	China, Hong Kong, the Philippines and Thailand	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Bambusa</i> and <i>Dendrocalamus</i> of family Poaceae, including <i>Bambusa multiplex</i> and sweet bamboo (<i>Dendrocalamus latiflorus</i>) (García Morales et al. 2019)	—	Yes
<i>Odonaspis tsinjoarivensis</i> Mamet	4	Madagascar	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Bambusa</i> of family Poaceae (Ben Dov 1988b; (García Morales et al. 2019)	—	Yes
<i>Opuntiaspis philococcus</i> (Cockerell)	4	Mexico, France, Germany and Japan	No record found (García Morales et al. 2019)	Polyphagous, on 10 genera in three families of host plants, including <i>Agave</i> , <i>Yucca</i> and <i>Zamia</i> (García et al. 2018); majority of host plants belonging to the Cactaceae family, including <i>Creus</i> , <i>Myrtillocactus</i> , <i>Mammillaria</i> , <i>Pachycereus</i> and <i>Pilosocereus chrysacanthus</i> (García Morales et al. 2019) On leaves or on bark (Danzig & Pellizzari 1998)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Parlatoreopsis chinensis</i> (Marlatt)	1, 4, 5	Eight countries in Asia, the Middle East and North America	No record found (García Morales et al. 2019)	Polyphagous, on 52 genera in 23 families of host plants, including apple, arbovitae (<i>Thuja</i>), birch, currants (<i>Ribes</i>), fig, <i>Hibiscus</i> , hawthorn, hazel, jujube, loquat (<i>Eriobotrya japonica</i>), olive, plum blossom (<i>Prunus mume</i>), pear, pistachios, <i>Rosa</i> , walnut, wattle (<i>Acacia oshanesii</i>) and willow (García Morales et al. 2019) On the bark of twigs and branches (Miller & Davidson 2005).	Intercepted in South Korea on <i>Styphnolobium</i> from China (Suh 2016a)	Yes
<i>Parlatoreopsis longispina</i> (Newstead)	4	Nine countries in Asia and Africa	No record found (García Morales et al. 2019)	Polyphagous, on 27 genera in 18 families of host plants, including black locust (<i>Robinia pseudoacacia</i>), crabapple, century plant (<i>Agave americana</i>), fig, jasmine, olive, plums, pear, pomegranate, <i>Rosa</i> , wattle (<i>Acacia oshanesii</i>), and weeping willow (<i>Salix babylonica</i>) (García Morales et al. 2019)	—	Yes
<i>Parlatoria blanchardi</i> (Targioni Tozzetti)	1, 3, 4, 6	29 countries worldwide	Yes, Qld, NT, NSW (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared and not notifiable pest in NT (DPIR 2018) Declared and not notifiable pest in SA (PIRSA 2017) Absent from Western Australia (Government of Western Australia 2018)	Polyphagous, on 10 genera in four families of host plants, including Canary Island palm (<i>Phoenix canariensis</i>), date palm (<i>Phoenix dactylifera</i>), desert fan palm (<i>Washingtonia filifera</i>), doum palm (<i>Hyphaene thebaica</i>), European fan palm (<i>Chamaerops</i>), Indian jujube (<i>Ziziphus mauritiana</i>), Jasmine, Pritchardia and blue periwinkle (<i>Vinca major</i>) (García Morales et al. 2019) On the entire plant, especially on the underside of leaves near the bases, and on young fruit (Watson 2002). During heavy infestations scales may settle on all parts of the host plant, including fruits (Watson 2002); affecting host plants during the vegetative, flowering, fruiting and post-harvest stages (Watson 2018); scales may infest all parts of date palms, with the heaviest infestations occurring at the base of the leaves and crown; the primary feeding site on the host is the succulent white tissue at the base of the leafstalk (CABI 2018c)	Live adults intercepted in Australia on fresh foliage of palms	Yes (NT, SA, WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Parlatoria camelliae</i> Comstock	4, 5	32 countries worldwide	Yes (Danzig & Pellizzari 1998; García Morales et al. 2019) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 38 genera in 25 families of host plants, including bay laurel (<i>Laurus nobilis</i>), <i>Citrus</i> , cherry laurel (<i>Prunus laurocerasus</i>), <i>Camellia</i> , <i>Cacao</i> , <i>Cinnamomum</i> , fig, grapevine, <i>Gardeniya</i> , <i>Hibiscus</i> , Indian bael (<i>Aegle marmelos</i>), <i>Jasminum</i> , Japanese holly (<i>Ilex crenata</i>), <i>Magnolia</i> , mango, oak, and persimmon (García Morales et al. 2019) On upper and lower leaf surfaces (Miller & Davidson 2005).	—	Yes (WA)
<i>Parlatoria cinerea</i> Hadden in Doane & Hadden	1, 4, 5	46 countries in the Americas, the Caribbean Islands, Asia, Oceania and Africa	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in 12 families of host plants, including apple, bitter orange, <i>Citrus</i> , european crab apple (<i>Malus sylvestris</i>), grapevine, <i>Gardenia</i> , <i>Hibiscus</i> , <i>Jasminum</i> , key lime, lemon, mango, mandarin, Oleander (<i>Nerium indicum</i>), pomelo, phalsa (<i>Grewia asiatica</i>) and soursop (<i>Annona muricata</i>) (García Morales et al. 2019) Mainly on stems and branches, occasionally on leaves and fruit, and rarely on citrus roots (Watson 2018); affecting host plants during the vegetative, flowering, fruiting and post-harvest stages (Watson 2018) Assessed as on pathway for Tahitian lime from New Caledonia (BA, 2006), lychee fruit from Taiwan and Vietnam (DAFF 2013), Unshu mandarin from Japan (Biosecurity Australia 2009) and mangoes from Pakistan (BA 2011)	Intercepted in South Korea on <i>Citrus</i> from Israel and on <i>Hibiscus</i> and <i>Stephanotis</i> from China (Suh 2016a)	Yes
<i>Parlatoria citri</i> McKenzie	1, 4	Cook Islands, India, Indonesia, Nigeria and Thailand	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Citrus</i> of family Rutaceae, including bitter orange (García Morales et al. 2019) On leaves (McKenzie 1945)	Intercepted in the USA on <i>Citrus</i> and <i>Pyrus</i> from Indonesia and Vietnam (Evans & Dooley 2013) Intercepted in South Korea on <i>Citrus</i> from Thailand (Suh 2016a)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Parlatoria crypta</i> McKenzie	1, 4, 5	Eight countries in Africa and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 39 genera in 24 families of host plants, including apple, banana, century plant (<i>Agave americana</i>), fig, <i>Ipomea</i> , <i>Jasminum</i> , mango, <i>Myrtle</i> , olive, persimmons, pear, <i>Rosa</i> , wattle, and yucca (<i>Yucca baccata</i>) (García Morales et al. 2019) On twigs and leaves (Danzig & Pellizzari 1998) Assessed as on pathway for mango from India (BA 2008) and mangoes from Pakistan (Biosecurity Australia 2011b)	Intercepted in England and Wales on fresh mango from Sudan and Pakistan (Malumphy 1996).	Yes
<i>Parlatoria desolator</i> McKenzie	4, 5	Asia	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in five families of host plants, including apple, Asiatic apple (<i>Malus spectabilis</i>), <i>Buxus</i> , Chinese quince (<i>Pseudocydonia sinensis</i>), <i>Hibiscus</i> , Japanese camellia (<i>Camellia japonica</i>), myrtles, peach and pear (García Morales et al. 2019) On stems (McKenzie 1960)	—	Yes
<i>Parlatoria fluggeae</i> Hall	1, 4	Five countries in Africa, Oceania and Asia	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including <i>Aleurites</i> , common fig, <i>Erythrina droogmansiana</i> , <i>Flueggea virosa</i> , <i>Hibiscus</i> and peregrina (<i>Jatropha integerrima</i>) (García Morales et al. 2019) On branches (Danzig & Pellizzari 1998)	Intercepted in the USA on <i>Adenia</i> from Germany and on <i>Ficus</i> and <i>Hibiscus</i> from Hawaii (Evans & Dooley 2013)	Yes
<i>Parlatoria fulleri</i> (MacGillivray)	4	Australia, New Zealand and France	Yes, NSW, Qld, SA, Vic, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Parlatoria leucaspis</i> (Lindinger)	4	Japan and South Korea	No record found (García Morales et al. 2019)	Oligophagous, on six genera in two families of host plants, including cypress, Japanese cedar, juniper, <i>Thujaopsis</i> and <i>Quercus</i> (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Parlatoria multipora</i> McKenzie	1, 4	China	No record found (García Morales et al. 2019)	Likely oligophagous, originally described from specimens on unidentified plant cuttings (García Morales et al. 2019; McKenzie 1945); host plants may include dogwood (<i>Cornus</i>) (Evans & Dooley 2013) On stems (McKenzie 1945)	Intercepted in the USA on <i>Cornus</i> from South Korea (Evans & Dooley 2013)	Yes
<i>Parlatoria mytilaspiformis</i> Green	4	Hawaiian Islands, India, the Philippines, Sri Lanka and Taiwan	No record found (García et al. 2018)	Polyphagous, on 12 genera in 10 families of host plants, including <i>Citrus</i> , <i>Camellia</i> , croton (<i>Codiaeum</i>), <i>Dracaena</i> , <i>Hibiscus</i> , kokum (<i>Garcinia indica</i>), sago palm (<i>Cycas revoluta</i>), and <i>Vanda</i> orchids (García Morales et al. 2019)	—	Yes
<i>Parlatoria oleae</i> (Colvée)	1, 4, 5	57 countries worldwide	Yes, Qld, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Parlatoria parlatoriae</i> (Šulc)	4	16 countries in Europe	No record found (García Morales et al. 2019)	Oligophagous, on five genera of family Pinaceae, including cedar (<i>Cedrus</i>), fir (<i>Abies</i>), hemlocks (<i>Tsuga</i>), pines (<i>Pinus</i>) and spruce (<i>Picea</i>) (García Morales et al. 2019) On needles (Danzig & Pellizzari 1998)	—	Yes
<i>Parlatoria pergandii</i> Comstock	1, 4, 5, 6	85 countries worldwide	Yes, Qld (ABRS 2018; García Morales et al. 2019; Plant	Polyphagous, on 54 genera in 35 families of host plants, including apple, <i>Agave</i> , avocado, <i>Anthurium</i> , bitter orange, cherry laurel, <i>Citrus</i> , <i>Camellia</i> , Cymbidium orchids, croton, cycads, figs, <i>Jasminum</i> , Japanese persimmon (<i>Diospyros kaki</i>), kumquat	All life stages intercepted in Australia, predominantly on fresh and dried <i>Citrus</i>	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
			Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	(<i>Citrus japonica</i>), lemon, mango, mandarin, myrtle, <i>Osmanthus</i> , oak, pomelo, sweet orange, and <i>Yucca</i> (García Morales et al. 2019) Mainly on leaves, but scales are sometimes recorded on bark, twigs and fruit of host plant (Watson 2018); affecting host plants during the flowering, fruiting and post-harvest stages (Watson 2018) Assessed as on pathway for Unshu mandarin from Japan (Biosecurity Australia 2009), mangoes from Pakistan (Biosecurity Australia 2011b), sweet oranges from Italy (Biosecurity Australia 2005b) and persimmon from Japan, South Korea and Israel (DAFF 2004b)	Intercepted in Taiwan on <i>Citrus hystrix</i> , <i>Citrus oparadisi</i> , <i>Citrus sinensis</i> and <i>Citrus</i> spp from Thailand and the USA (Chen, Wong & Wu 2014) Intercepted in South Korea on <i>Citrus</i> and <i>Ilex</i> from the USA, Thailand, mainland China, Mexico, Taiwan, Vietnam and Japan (Suh 2016a) Intercepted in Croatia on <i>Citrus</i> spp from Spain and Brazil (Masten Milek, Simala & Pintar 2016) and on <i>Fortunella</i> sp. from South Africa (Masten Milek, Simala & Koric 2009)	
<i>Parlatoria pittospori</i> Maskell	1, 4, 5	Australia, New Zealand, South Africa, the UK and the USA	Yes, Qld, SA, TAS, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018) There is record of this species in Victoria (García Morales et al. 2019) based on literature of Morrison (1939) and Webster (1968) but this cannot be	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Parlatoria proteus</i> (Curtis)	1, 4, 5	68 countries worldwide	confirmed. No records of this species from Victoria in the VAIC or APPD Yes, Qld, SA, TAS, WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018) There is record of this species in Victoria (García Morales et al. 2019) based on literature of Morrison (1939) and Webster (1968) but this cannot be confirmed. Five specimens in VAIC with identification uncertain “? “	Further assessment is not required		No
<i>Parlatoria theae</i> Cockerell	1, 4, 5	21 countries in Oceania, North America, Asia and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 54 genera in 32 families of host plants, including apple, apricot, Asian bayberry (<i>Nageia nagi</i>), blackcurrant (<i>Ribes nigrum</i>), bay (<i>Persea</i>), bay laurel (<i>Laurus nobilis</i>), citrus, <i>Camellia</i> , <i>Croton</i> , dogwood, <i>Euonymus</i> , grapevine, holly, Japanese pepper (<i>Zanthoxylum piperitum</i>), maple, <i>Magnolia</i> , manchurian pear (<i>Pyrus ussuriensis</i>),	Intercepted South Korea on <i>Cleyera</i> and <i>Ilex</i> plants from Japan (Suh 2016a)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
				persimmons, plums, plum blossom (<i>Prunus mume</i>), peach, pear, sour cherry (<i>Prunus cerasus</i>), <i>Rosa</i> and tea plant (García Morales et al. 2019) On all aerial plant parts, including stems and branches (Miller & Davidson 2005) Assessed as on pathway for Unshu mandarin from Japan (BA, 2009) and pear from South Korea (AQIS 1999)		
<i>Parlatoria yanyuanensis</i> Tang	4, 5	China	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including apple and paper mulberry (<i>Broussonetia papyrifera</i>) (Tang 1984) Assessed as on pathway for apples from China (Biosecurity Australia 2010a)	—	Yes
<i>Parlatoria yunnanensis</i> Ferris	4,	China	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including buckthorn (<i>Rhamnus</i>), Japanese plum (<i>Prunus salicina</i>), peach, and <i>Pistacia chinensis</i> (Ferris 1950) On bark (Danzig & Pellizzari 1998)	—	Yes
<i>Parlatoria ziziphi</i> (Lucas)	1, 3, 4, 5, 6	92 countries worldwide	No longer present (Smith, Bellis & Gillespie 2013)	Polyphagous, on 16 genera in 12 families of host plants, including bitter orange, <i>Citrus</i> , citron (<i>Citrus medica</i>), Cymbidium orchids, croton, coconut, guava, jujube, lime (<i>Citrus aurantiifolia</i>), mandarin (<i>Citrus reticulata</i>), pomelo, rambutan (<i>Nephelium lappaceum</i>), tea plant, and weeping fig (<i>Ficus benjamina</i>) (García Morales et al. 2019) On all aerial parts, including branches, leaves and fruits (Watson 2002); upper surfaces of leaves and fruits being particularly vulnerable to infestation (Watson 2002); affecting host plants during the vegetative, flowering, fruiting and postharvest stages (Watson 2018) Assessed as on pathway for citrus from Egypt (Biosecurity Australia 2002a)	Nymphs and adults intercepted in Australia on <i>Citrus</i> foliage, lime fruit and on Kaffir lime leaves Intercepted in Taiwan on <i>Citrus hystrix</i> from Thailand (Chen, Wong & Wu 2014) Intercepted in South Korea on <i>Citrus</i> from Thailand, Libya and Vietnam, and on unspecified commodities from Australia and Thailand (Suh 2016a) Intercepted in the USA and the Caribbean on <i>Citrus</i> (Evans &	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Pentalaminaspis minuta</i> (Kotinsky)	1, 4,	Singapore	No record found (García Morales et al. 2019)	Oligophagous on four genera of family Loranthaceae, including <i>Dendrophthoe pentandra</i> , <i>Elytranthe</i> , and <i>Lepidaria kingii</i> (Smith-Pardo, Evans & Dooley 2012)	Dooley 2013; Jenkins et al. 2014) Adults intercepted in Australia on manufactured items (steel and various metals)	Yes
<i>Pinnaspis aspidistrae</i> (Signoret)	1, 4, 5, 6	85 countries worldwide	Yes, NSW, Qld, ACT, Tas, SA, NT (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 131 genera in 69 families of host plants, including <i>Agave</i> , cycads, <i>Acacia</i> , <i>Albizia</i> , breadfruit, anthurium, areca palm, <i>Annona</i> , banana, bay, <i>Citrus</i> , cinnamon, cycads, <i>Camellia</i> , <i>Capsicum</i> , croton, cotton, cocout, fig, ferns, holly, jujube, mango, orchids, <i>Prunus</i> , pepper, tomato, tea (García Morales et al. 2019) Mainly on fronds and leaves, and rarely on the branches or fruits of host plants (Henderson 2011; Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for Tahitian lime from New Caledonia (BA, 2006) and mangoes from Indonesia, Thailand and Vietnam (Department of Agriculture and Water Resources 2015)	Intercepted in Australia on fresh orange, nursery stocks of <i>Nepenthus</i> and <i>Sansevieria</i> and raw Areca nut (<i>Areca catechu</i>) Adult females intercepted in Taiwan on <i>Citrus limon</i> , <i>Citrus paradisi</i> , <i>Citrus sinensis</i> and <i>Piper nigrum</i> from Japan, Thailand and the USA (Chen, Wong & Wu 2014) Intercepted in South Korea on <i>Citrus</i> and <i>Musa</i> from the USA, the Philippines and Thailand, and on <i>Cymbidium</i> , <i>Sansevieria</i> and <i>Dracaena</i> plants from Costa Rica, Taiwan, Indonesia and Thailand (Suh 2016a) Intercepted in New Zealand mostly on fresh produce, and also on cut-flowers and foliage, plant material and nursery stock (Berry 2014)	Yes (WA)
<i>Pinnaspis buxi</i> (Bouché)	1, 4, 5	75 countries worldwide	Yes, WA, NT, NSW, Qld (ABRS 2018; García Morales et al. 2019; Government of Western Australia	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Pinnaspis exercitata</i> (Green)	4	China, India, Malaysia, Pakistan and Sri Lanka	2018; Plant Health Australia 2018) No record found (García Morales et al. 2019)	Oligophagous, on seven genera in seven families of host plants, including <i>Camellia</i> , <i>Eurya japonica</i> , tea, <i>Mirabilis</i> , mu oil tree (<i>Vernicia montana</i>), pepper, and Siamese cassia (<i>Senna siamea</i>) (García Morales et al. 2019)	—	Yes
<i>Pinnaspis musae</i> Takagi	1, 4, 5	The Philippines	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Musa</i> of family Musaceae (García Morales et al. 2019) Assessed as on pathway for mature hard green banana from the Philippines (Biosecurity Australia 2008b)	Intercepted in South Korea on <i>Musa</i> from the Philippines (Suh 2016a) Intercepted in Japan on banana from the Philippines (Sugimoto 1994)	Yes
<i>Pinnaspis strachani</i> (Cooley)	1, 3, 4, 5	110 countries worldwide	Yes, SA, Qld, NT, WA (ABRS 2018; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Pinnaspis theae</i> (Maskell)	1, 4	Eight countries in South East Asia, The Caribbean Islands and South America	No record found (García Morales et al. 2019)	Oligophagous, on six genera in six families of host plants, including <i>Camellia</i> , <i>Cordyline</i> , Japanese camellia, pomegranate and tea (García Morales et al. 2019) Male scales arranging themselves in great numbers on host leaves, close together and all pointing in the same direction (Ferris & Rao 1947)	Intercepted in the USA on <i>Thea</i> from Brazil, Colombia, Guadeloupe and Martinique (Evans & Dooley 2013)	Yes
<i>Pinnaspis uniloba</i> (Kuwana)	1, 4	Six countries in Oceania and South East Asia	No record found (García Morales et al. 2019)	Oligophagous, on nine genera in seven families of host plants, including East Asian eurya (<i>Eurya japonica</i>), Indian bael (<i>Aegle marmelos</i>), Japanese camellia, <i>Magnolia</i> , and <i>Osmanthus</i> (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	Intercepted in Taiwan on <i>Piper nigrum</i> from Thailand (Chen, Wong & Wu 2014)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Poliaspis media</i> Maskell	4	Six countries in Oceania, Europe and North America	No record found (García Morales et al. 2019)	Polyphagous, on 29 genera in 21 families of host plants, including <i>Astelia fragrans</i> , <i>Coprosma</i> , cycads, manuka plant (<i>Leptospermum scoparium</i>), orchids, pygmy pine (<i>Lepidothamnus laxifolius</i>) and red matipo (<i>Myrsine australis</i>) (García Morales et al. 2019; Henderson 2011) Mainly on the undersides of leaves, and less often on stems (Henderson 2011); inducing various galls on certain infested host plants, such as leaf tip rolls on <i>Myrsine australis</i> and leaf rosette galls on <i>Coprosma</i> spp. (Henderson 2011)	—	Yes
<i>Poliaspoides formosana</i> (Takahashi)	4	Seven countries in Asia and Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Poaceae: <i>Bambusa</i> , <i>Dendrocalamus</i> and <i>Schizostachyum</i> bamboo (García Morales et al. 2019)	—	Yes
<i>Prodiaspis tamaricicola</i> (Malenotti)	4	19 countries in Asia, Europe and Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Tamaricaceae: <i>Myricaria Reaumuria</i> and <i>Tamarix</i> (García Morales et al. 2019)	—	Yes
<i>Pseudaonidia corbetti</i> Hall & Williams	1, 4	Malaysia	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including nutmeg (<i>Myristica fragrans</i>) and watery rose apple (<i>Syzygium aqueum</i>) (García Morales et al. 2019)	Intercepted in the USA on <i>Garcinia</i> and unspecified ornamentals from China (Evans & Dooley 2013)	Yes
<i>Pseudaonidia curculiginis</i> (Green)	1, 4	Eight countries in Oceania and Asia	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including cabbage palm (<i>Corypha utan</i>), <i>Gardenia</i> and palm grass (<i>Molineria capitulata</i>) (García Morales et al. 2019)	Intercepted in the USA on <i>Pholidota</i> from the Philippines, and <i>Gardenia</i> and palms from Malaysia, Thailand and Vietnam (Evans & Dooley 2013)	Yes
<i>Pseudaonidia dryandrae</i> (Fuller)	4	Australia	Yes WA (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018)	Further assessment is not required		No

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Pseudaonidia duplex</i> (Cockerell)	1, 3, 4, 5	13 countries in Oceania, Asia, the Middle East, Hawaiian Islands and North America	No record found (García Morales et al. 2019)	<p>Polyphagous, on 26 genera in 17 families of host plants, including alder, <i>Camellia</i>, <i>Citrus</i>, cinnamon, Chinese bayberry (<i>Morella rubra</i>), fig, holly, Japanese camellia, lychees, mango, olive, oak, <i>Osmanthus</i>, <i>Rosa</i>, <i>Rhododendron arboretum</i> and tea (García Morales et al. 2019)</p> <p>Mainly on the bark of stems and branches, and occasionally on fruits and leaves (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)</p> <p>Assessed as on pathway for apple (Fuji) from Japan (AQIS 1998a), Unshu mandarins from Japan (Biosecurity Australia 2009), nectarines from China (DAFF, 2016), pear from South Korea (AQIS 1999) and persimmon from Japan, South Korea and Israel (DAFF 2004b)</p>	Intercepted in South Korea on <i>Vaccinium</i> from China (Suh 2016a)	Yes
<i>Pseudaonidia paeoniae</i> (Cockerell)	1, 4	Eight countries in North America, Europe and Asia	No record found (García Morales et al. 2019)	<p>Polyphagous, on 15 genera in 14 families of host plants, including <i>Buxus</i>, dogwood, <i>Camellia</i>, Chinese mulberry (<i>Morus australis</i>), fig, holly, mango, <i>Osmanthus</i>, potato, <i>Rhododendron</i> and tea (García Morales et al. 2019)</p> <p>On the bark of stems and branches, often under bark flakes (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)</p>	Intercepted in South Korea on <i>Camellia</i> from Japan, <i>Ficus</i> plants from mainland China and Taiwan, on <i>Mangifera</i> from the Philippines, and on <i>Rhododendron</i> from Japan (Suh, Yu & Hong 2013; Suh 2016a)	Yes
<i>Pseudaonidia trilobitiformis</i> (Green)	1, 4, 5, 6	73 countries in Africa, Oceania, the Americas, the Caribbean Islands and Asia	Yes, Qld, NT (ABRS 2018; García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of	<p>Polyphagous, on 106 genera in 46 families of host plants, including <i>Annona</i>, avocado, bay laurel (<i>Laurus nobilis</i>), breadfruit (<i>Artocarpus altilis</i>), <i>Citrus</i>, capsicum, <i>Camellia</i>, <i>Coffeae</i>, <i>Cacao</i>, cinnamon, coconut, <i>Dracaena</i>, fig, grapevine, guava, Ixora, jujube, <i>Jasminum</i>, lychees, oak, papaya, pomegranate, passionfruit, seagrape (<i>Coccoloba uvifera</i>), sapodilla (<i>Manilkara zapota</i>) and <i>Solanum</i> (García Morales et al. 2019)</p>	<p>Live adults intercepted in Australia on unspecified host plants and manufactured items (metal/steel products) (AIMS)</p> <p>Intercepted in South Korea on <i>Ficus</i> and <i>Rhododendron</i> from mainland China, Taiwan, Thailand and Japan, and on</p>	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
			Western Australia 2018)	On the underside of leaves, bark and fruit (Miller & Davidson 2005); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for Tahitian lime from New Caledonia (Biosecurity Australia 2006b), Unshu mandarins from Japan (Biosecurity Australia 2009), mangoes from Indonesia, Thailand and Vietnam (Department of Agriculture and Water Resources 2015) mangoes from Pakistan (Biosecurity Australia 2011b) and mangosteen fruit from Indonesia (DAFF 2012b)	<i>Mangifera</i> from the Philippines (Suh, Yu & Hong 2013; Suh 2016a)	
<i>Pseudaulacaspis brimblecombei</i> Williams	1, 4, 6	Australia, New Zealand and the UK	Yes, Qld (García Morales et al. 2019; Plant Health Australia 2018)	Further assessment is not required		No
<i>Pseudaulacaspis cockerelli</i> (Cooley)	1, 4, 5, 6	52 countries worldwide	Yes, NT, NSW, Qld, Vic, SA (García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous, on 148 genera in 80 families of host plants, including mango, cucurbits, <i>Annona</i> , avocado, banana, <i>Buxus</i> , bromeliads, <i>Canna</i> , <i>Camellia</i> , cycads, <i>Citrus</i> , chili pepper (<i>Capsicum annum</i>), cashew, <i>Gardenia</i> , <i>Hibiscus</i> , <i>Ixora</i> , <i>Jasminum</i> , java plum, <i>Magnolia</i> , olive, <i>Osmanthus</i> , <i>Plumeria</i> , <i>Papaya</i> , persimmons, and <i>Rhododendron</i> (García Morales et al. 2019) Mainly on leaves along major veins, and occasionally on stems (Miller & Davidson 2005) Assessed as on pathway for hard green banana from the Philippines (Biosecurity Australia 2008b) and mango from India (Biosecurity Australia 2008b)	Live and dead adults and nymphs intercepted in Australia on fresh mango, <i>Phoenix</i> nursery stock and on other commodities (woven baskets) Adult females intercepted in Taiwan on <i>Actinidia chinensis</i> , <i>Areca catechu</i> , <i>Diospyrus kaki</i> , <i>Garcinia mangostana</i> , <i>Mangifera indica</i> , <i>Nephelium lappaceum</i> , <i>Piper nigrum</i> , <i>Piper sarmentosum</i> and on unknown plant products from mainland China, Indonesia, South Korea and Thailand (Chen, Wong & Wu 2014) Intercepted in South Korea many times on <i>Berzelia</i> from	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
					<p>Australia, <i>Camellia</i> from mainland China, <i>Caryota</i> from Malaysia <i>Chrysalidocarpus</i> from Malaysia, <i>Cymbopogon</i> from Thailand, <i>Dracaena</i> from China, <i>Ficus</i> from Indonesia, <i>Jasminum</i> from Vietnam, <i>Leucadendron</i> from South Africa and Australia, <i>Leucospermum</i> from Australia, <i>Palmae</i> from Indonesia, <i>Stephanotis</i> from mainland China, <i>Plumeria</i> from Indonesia, <i>Cocos</i> from Bangladesh, Indonesia and Vietnam, <i>Cucurbita</i> from Tonga, <i>Diospyros</i> from Indonesia, <i>Mangifera</i> from the USA and Philippines, <i>Musa</i> from Vietnam and other commodities from China, Malaysia, Indonesia and Australia (Suh, Yu & Hong 2013; Suh 2016a)</p> <p>Intercepted in Croatia in 2010 from Asia (Masten Milek, Simala & Pintar 2016)</p> <p>Intercepted in Japan on banana from Philippines (Sugimoto 1994)</p>	
<i>Pseudaulacaspis coloisuvae</i> Williams & Watson	1, 4	Fiji and Solomon Islands	No record found (ABRS 2018; García Morales et al. 2019; Government of Western Australia	Oligophagous, on two genera in two families of host plants, including <i>Gardenia</i> and <i>Terminalia</i> and (García Morales et al. 2019; Hodgson & Lagowska 2011; Suh 2016a)	Intercepted in South Korea on <i>Gardenia</i> from Indonesia (Suh 2016a)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Pseudaulacaspis eugeniae</i> (Maskell)	1, 4	11 countries in Oceania, Africa and South East Asia	2018; Plant Health Australia 2018) Yes, WA, NSW, TAS, Vic (García Morales et al. 2019; Government of Western Australia 2018; Plant Health Australia 2018)	Further assessment is not required		No
<i>Pseudaulacaspis manni</i> (Green in Green & Mann)	4	China, India, Malaysia and India	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including <i>Camellia</i> , <i>Citrus</i> , <i>Diospyros</i> , eggplant and fig (García Morales et al. 2019)	—	Yes
<i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti)	1, 3, 4, 5, 6	110 countries worldwide	Yes, NSW, Qld (García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Highly polyphagous with a host range of 221 genera in 85 families of host plants, including apple, almonds, <i>Actinidia</i> , <i>Aralia</i> , <i>Camellia</i> , <i>Capsicum</i> , <i>Citrus</i> , <i>Cinnamon</i> , cucurbits, coconut, chestnut, cycads, croton, currsweet cherry, crab apple, elm, egg plant, grapevine, <i>Ginkgo</i> , mango, maple, mombins (<i>Spondias</i>), <i>Magnolia</i> , <i>Nerium</i> , oak, papaya, <i>Prunus</i> , plum, peach, plum blossom (<i>Prunus mume</i>), poplar, <i>Plumeria</i> , sour cherry, tea, tobacco, tomato, walnut and willow (García Morales et al. 2019) Mainly on stems and fruits, and occasionally on leaves and roots (Watson 2018); affecting host plants during the seedling, vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for island cabbage from the Cook Islands, Fiji, Samoa, Tonga, Vanuatu (DAFF 2013b), table grapes from Japan (Department of Agriculture 2014), nectarines from China (Department of Agriculture and Water Resources 2016), papaya	Eggs, nymphs and adults intercepted in Australia on kiwi, fresh cuttings and <i>Cytisus</i> seeds for sowing. Intercepted in Taiwan on <i>Actinidia chinensis</i> , <i>Olumeria</i> spp, <i>Prunus persica</i> and <i>Prunus communis</i> from mainland China, France, Indonesia, Italy, Japan and the USA (Chen, Wong & Wu 2014) Intercepted in South Korea on <i>Actinidia</i> , <i>Carica</i> , <i>Chimonanthus Codiaeum</i> , <i>Diospyros</i> , <i>Dracaena</i> , <i>Fraxinus</i> , <i>Juglans</i> , <i>Lantana</i> , <i>Morus</i> , <i>Olea</i> , <i>Parthenocissus</i> , <i>Plumeria</i> , <i>Polyscias</i> , <i>Prunus</i> and <i>Schefflera</i> from Japan, France, Italy, New	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Pseudaulacaspis prunicola</i> (Maskell)	1, 4, 5	Eight countries in South East Asia, Europe and North America	No record found (García Morales et al. 2019)	<p>from Fiji (Biosecurity Australia 2002b) and persimmon from Japan, South Korea and Israel (DAFF 2004b)</p> <p>Polyphagous, on 24 genera in 16 families of host plants, including apple, alder, boxwood, croton, cucurbits, <i>Camellia</i>, <i>Eugenia</i>, holly, <i>Jasminum</i>, <i>Magnolia</i>, <i>Nerium</i>, <i>Osmanthus</i>, <i>Prunus</i>, plums, peach, sweet cherry, and sour cherry (García Morales et al. 2019)</p> <p>On bark and fruit, and occasionally on leaves (Miller & Davidson 2005)</p> <p>Assessed as on pathway for nectarines from China (Department of Agriculture and Water Resources 2016) and stonefruit from the USA (Biosecurity Australia 2010b)</p>	Zealand, the USA, mainland China, Indonesia, Sri Lanka, Thailand, Tonga and Taiwan, and on unspecified commodities from Indonesia, Japan and Malaysia (Suh, Yu & Hong 2013)	Yes
<i>Pseudaulacaspis rubra</i> (Green)	4, 5	India and Sri Lanka	No record found (García Morales et al. 2019)	Oligophagous, on four genera in three families of host plants, including <i>Helixanthera intermedia</i> , <i>Loranthus</i> , mango, nutmeg (<i>Myristica fragrans</i>), and the showy mistletoes (García Morales et al. 2019)	—	Yes
<i>Pseudischnaspis bowreyi</i> (Cokerell)	4	25 countries in the Americas	No record found (García Morales et al. 2019)	<p>Polyphagous, on 39 genera in 27 families of host plants, including avocado, <i>Annona</i>, <i>Agave</i>, <i>Aloe</i>, banana, <i>Camellia</i>, <i>Citrus</i>, <i>Coffea</i>, <i>Citrus</i>, <i>Dracaena</i>, <i>Eucalyptus</i>, guava, <i>Jasminum</i>, <i>Hibiscus</i>, hickory, mango, orchids, <i>Passiflora</i>, <i>Prunus</i>, pear, <i>Rosa</i>, <i>Vitis</i> and <i>Yucca</i> (García Morales et al. 2019)</p> <p>On bark and leaves during the vegetative, flowering and fruiting stages of the host plant (Watson 2018)</p>	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Pseudoparlatoria mammata</i> (Ferris)	1, 4	Brazil and Panama	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Brosimum utile</i> and <i>Cardoon</i> (artichoke thistle) (García Morales et al. 2019)	Intercepted in the USA on <i>Chamaedorea</i> palms from Mexico and Panama (Evans & Dooley 2013)	Yes
<i>Pseudoparlatoria ostreata</i> Cockerell	4	23 countries in Africa and the Americas	No record found (ABRS 2018; Plant Health Australia 2018)	Polyphagous, on 53 genera in 34 families of host plants, including avocado, <i>Acalypha</i> , <i>Agave</i> , cashew, coconut, grapevine, geraniums, orchids, pepper, papaw and spindle tree (<i>Euonymus</i>) (García Morales et al. 2019) On bark and leaves (Miller & Davidson 2005)	—	Yes
<i>Pseudoparlatoria parlatoroides</i> (Comstock)	4	30 countries in Africa, Oceania, the Americas, Asia and Europe	No record found (ABRS 2018; García Morales et al. 2019)	Highly polyphagous, on 142 genera in 54 families of host plants including <i>Annona</i> , <i>Anthurium</i> , avocado, banana, breadfruit, <i>Camellia</i> , <i>Citrus</i> , coconut, coffee, guava, <i>Hibiscus</i> , <i>Jasminum</i> , mango, <i>Magnolia</i> , olive, orchids, peach, <i>Rosa</i> , pines, sabal palm, and <i>Vanilla</i> (García Morales et al. 2019) On leaves, stem/barks and pseudobulbs; affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	—	Yes
<i>Quernaspis lepinyei</i> (Balachowsky)	4	15 countries in Europe and Africa	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Fagaceae, including oaks and sweet chestnut (García Morales et al. 2019) On twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Quernaspis quercus</i> (Comstock)	4	Mexico and the USA	No record found (García Morales et al. 2019)	Oligophagous, on four genera in two families of host plants, including <i>Hibiscus</i> and oak (García Morales et al. 2019) On leaves and bark, with males on leaves but females on bark concealed beneath loose epidermal layers (Miller & Davidson 2005)	—	Yes
<i>Radionaspis indica</i> (Marlatt)	1, 4, 5	14 countries in Africa, Oceania, The Caribbeans,	No records found (García et al. 2018)	Monophagous, on genus <i>Mangifera</i> of family Anacardiaceae (García Morales et al. 2019)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
		Central America, Hawaiian Islands and South Asia		On bark during the vegetative, flowering and fruiting stages of the host plant, attacking fruit buds, branches and the trunk (Peña 1994)		
<i>Rhizaspidiotus canariensis</i> (Lindinger)	4	19 countries in Africa, the Middle East, Europe and Asia	No record found (García Morales et al. 2019)	Polyphagous, on 17 genera in seven families of host plants, including <i>Aster</i> , euphorbias, germanders (<i>Teucrium</i>), marguerite daisy (<i>Argyranthemum frutescens</i>), mugworts (<i>Artemisia</i>), stonecrop (<i>Sedum</i>), thymes (<i>Thymus</i>) and yarrows (<i>Achillea</i>) (García Morales et al. 2019) On stems (Danzig & Pellizzari 1998)	—	Yes
<i>Rhizaspidiotus dearnessi</i> (Cockerell)	4	Canada, Cuba, Mexico and the USA	No record found (García Morales et al. 2019)	Polyphagous, on 24 genera in nine families of host plants, including <i>Aster</i> , California buckwheat (<i>Eriogonum fasciculatum</i>), goldenrod (<i>Solidago</i>), mugworts (<i>Artemisia</i>), sunflower and <i>Salicornia</i> (García Morales et al. 2019) On bark, the subterranean crown and primary root system of composite hosts, and on the trunk and branches of ericaceous hosts (Miller & Davidson 2005)	—	Yes
<i>Rolaspis leucadendri</i> (Brain)	1, 4	South Africa	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Leucadendron</i> of family Protaceae, including Silver tree (<i>Leucadendron argenteum</i>) (García Morales et al. 2019)	Intercepted in the USA from South Africa on <i>Leucadendron</i> (Evans & Dooley 2013)	Yes
<i>Rolaspis lounsburyi</i> (Cooley)	1	Mauritania, Mozambique, Namibia, South Africa and Zimbabwe	No record found (García Morales et al. 2019)	Polyphagous, on 14 genera in 11 families of host plants, including <i>Carissa</i> , conebrushes (<i>Leucadendron</i>), desert date (<i>Balanites aegyptiaca</i>), <i>Mimusops caffra</i> , olive, shepherd tree (<i>Boscia albitrunca</i>), and <i>Salvadora persica</i> (García Morales et al. 2019)	Intercepted in South Korea on <i>Phyllica</i> from South Africa (Suh 2016a) Intercepted in Japan on cutflowers and on <i>Paranomus</i> , <i>Serruria</i> and <i>Berzelia</i> from South Africa (Takagi 2016)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Rutherfordia major</i> (Cockerell)	4, 5	25 countries in Africa, Oceania, the Caribbean Islands, Asia and North and South America	No record found (García Morales et al. 2019)	Polyphagous, on 27 genera in 15 families of host plants, including <i>Croton</i> , <i>Euphorbia</i> , fig, longan, lychees, malay apple (<i>Syzygium malaccense</i>), rambutan (<i>Nephelium</i>), soursop (<i>Annona muricata</i>), wild-lime (<i>Zanthoxylum fagara</i>) and willow (García Morales et al. 2019) On bark (Dekle 1976)	—	Yes
<i>Sahasapis ceardi</i> (Balachowsky)	4,	Algeria, Morocco, Sardinia and Sicily	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including carob tree (<i>Ceratonia siliqua</i>), fig, grapevine, jujube, olive, (<i>Ziziphus lotus</i>), pistachio and white mulberry (<i>Morus alba</i>) (García Morales et al. 2019) On leaves twigs and branches (Danzig & Pellizzari 1998)	—	Yes
<i>Salicicola kermanensis</i> (Lindinger)	4,	19 countries in Asia, Europe and Africa	No record found (García Morales et al. 2019)	Oligophagous, on seven genera in six families of host plants, including apple, cottonwood, <i>Ephedra</i> , olive, poplar and <i>Quercus</i> (García Morales et al. 2019) On trunk and twigs (Danzig & Pellizzari 1998)	—	Yes
<i>Selenaspidopsis browni</i> Nakahara	1	Mexico	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Chamaedorea</i> of family Arecaceae (García Morales et al. 2019)	Intercepted in the USA on <i>Chamaedorea</i> palms from Mexico (Evans & Dooley 2013)	Yes
<i>Selenaspidus albus</i> McKenzie	1, 4	Eritrea, Namibia, South Africa and the USA	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Euphorbia</i> of family Euphorbiaceae, including <i>Euphorbia abyssinica</i> , <i>Euphorbia caput-medusae</i> , <i>Euphorbia clavarioides</i> and <i>Euphorbia ferox</i> (García Morales et al. 2019) On green areas of the host plant, including stems and leaves (Miller & Davidson 2005)	Intercepted in the UK on <i>Euphorbia caput-medusae</i> from South Africa (Malumphy & Halstead 2010)	Yes
<i>Selenaspidus articulatus</i> (Morgan)	1, 3, 4, 5	58 countries in Africa, Oceania, the Americas and Asia	Yes (García Morales et al. 2019; Mamet 1958)	Highly polyphagous, on 91 genera in 50 families of host plants, including avocado, <i>Annona</i> , ambarella (<i>Spondias dulcis</i>), breadfruit, bitter orange, coconut, croton coffee, fig, guava, grapevine, <i>Gardenia</i> , <i>Hibiscus</i> , Indian jujube (<i>Ziziphus mauritiana</i>), lychee,	Adults Intercepted in Australia on fresh foliage (khat leaves) from Ethiopia and on unknown live plants and <i>Chamaeropsis</i>	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
			Declared pest, prohibited by WA (Government of Western Australia 2018)	papaw, key lime, rambutan (<i>Nephelium</i>), lemon, mandarin, mango, olive, pomelo, passion fruit, <i>Rosa</i> , rose apple (<i>Syzygium jambos</i>), sugarcane and tea (<i>Camellia sinensis</i>) (García Morales et al. 2019) On both sides of leaves, with a preference for upper leaf surfaces (Watson 2018); occasionally on fruits/pods, growing points and stems, but very rarely on bark (Watson 2018) Assessed as on pathway for hard green banana from the Phillipines (Biosecurity Australia 2008b) and lychees from Taiwan and Vietnam (DAFF 2013c)	seeds intended for sowing from Fiji Intercepted in South Korea on <i>Coffea</i> plants from Vietnam and on <i>Ficus</i> plants from China (Suh 2016a)	
<i>Selenaspis rubidus</i> McKenzie	1, 4	China, Germany, Singapore, South Africa and the USA	No record found (García Morales et al. 2019)	Oligophagous, on four genera in four families of host plants, including <i>Cacti</i> , chameleon plant (<i>Houttuynia</i>), <i>Euphorbia</i> and sugarbush (<i>Protea repens</i>) (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	Intercepted in South Korea on <i>Houttuynia</i> from South Africa (Suh 2016a)	Yes
<i>Selenaspis spinosus</i> Laing	4,	Africa	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including banana, <i>Suregada procera</i> and <i>Synsepalum brevipes</i> (García Morales et al. 2019)	—	Yes
<i>Semelaspidus mangiferae</i> Takahashi	4, 5	The Phillipines and Taiwan	No record found (García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Mango</i> and fig (García Morales et al. 2019) On upper surfaces of leaves, along the midrib (Takahasi 1939)	—	Yes
<i>Silvestraspis uberifera</i> (Lindinger)	1, 4,	Six countries in South East Asia	No record found (García Morales et al. 2019)	Oligophagous, on five genera in four families of host plants, including breadfruit, <i>Cinnamon</i> , rose apple (<i>Syzygium jambos</i>), <i>Machilus</i> and <i>Malloutus</i> (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	Intercepted in the USA on <i>Cinnamomum</i> , <i>Machilus</i> and <i>Pimenta</i> from Vietnam (Evans & Dooley 2013)	Yes
<i>Situlaspis yuccae</i> (Cockerell)	4,	Mexico and the USA	No record found (García Morales et al. 2019)	Polyphagous, on 29 genera in 14 families of host plants, including <i>Agave</i> , currant, <i>Cassia</i> , <i>Cereus</i> ,	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
				grapevine, ivy (<i>Hedera</i>), olive, palo verde (<i>Cercidium</i>), <i>Rosa</i> and <i>Yucca</i> (García Morales et al. 2019) On stems and leaves (Miller & Davidson 2005)		
<i>Stramenaspis kelloggi</i> (Coleman)	4,	Mexico and the USA	No record found (García Morales et al. 2019)	Oligophagous, on five genera in two families of host plants, including fir, hemlocks (<i>Tsuga</i>), <i>Libocedrus</i> , and pine (García Morales et al. 2019)	—	Yes
<i>Suturaspis archangelskyae</i> (Lindinger)	1, 4,	11 countries in Asia, Europe and Africa	No record found (García Morales et al. 2019)	Polyphagous, on 16 genera in nine families of host plants, including apple, apricot, crabapple, common medlar (<i>Mespilus germanica</i>), European ash (<i>Fraxinus excelsior</i>), myrtle, olive, plums, peach, pear, <i>Populus</i> , quince, <i>Rubus</i> , sweet cherry, and walnut (García Morales et al. 2019) On the bark of trunks and branches, and occasionally on fruits of pear (Watson 2018); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018)	Intercepted in the USA on an unnamed plant from the Netherlands (Evans & Dooley 2013)	Yes
<i>Targionia arthrophyti</i> (Archangelskaya)	4,	Georgia, Iran, Tajukistan, Turkmenistan and Uzbekistan	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Haloxylon</i> and <i>Salsola</i> of family Amaranthaceae (García Morales et al. 2019) On stems and branches (Danzig & Pellizzari 1998)	—	Yes
<i>Targionia vitis</i> (Signoret)	4, 5	27 countries in Africa, Asia and Europe	No record found (ABRS 2018; García Morales et al. 2019)	Oligophagous, on eight genera in five families of host plants, including beech, chestnut, grapevine, oak, sycamore (<i>Platanus orientalis</i>), strawberry tree (<i>Arbutus unedo</i>) and willow (García Morales et al. 2019) On the bark of host plants (Ferris 1943)	—	Yes
<i>Thysanofiorinia leei</i> Williams	1, 4, 5	Hawaiian Islands, Hong Kong, Taiwan and India	No record found (García Morales et al. 2019)	Oligophagous, on two genera of family Sapindaceae, including lychee (<i>Litchi chinensis</i>) and rambutan (<i>Nephelium</i>) (García Morales et al. 2019)	Intercepted in the USA on <i>Dimocarpus</i> , <i>Nephelium</i> and <i>Litchi</i> from Hawaii, South Korea, India and Taiwan (Evans & Dooley 2013)	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Thysanofiorinia nephelii</i> (Maskell)	1, 4, 5	15 countries in Oceania, the Americas, Asia and Africa	Yes, NSW, Qld (ABRS 2018; García Morales et al. 2019; Government of Western Australia 2018)	Further assessment is not required		No
<i>Unachionaspis bambusae</i> (Cockerell)	4	China, Japan, Algeria and Russia	No record found (García Morales et al. 2019)	Oligophagous, on four genera of family Poaceae, including <i>Bambusa</i> , broad leaf bamboo (<i>Sasa</i>), Guadua bamboo (<i>Indocalamus</i>), and moso bamboo (<i>Phyllostachys edulis</i>) (García Morales et al. 2019) On the lower surface of leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Unachionaspis signata</i> (Maskell)	4	Japan	No record found (García Morales et al. 2019)	Oligophagous, on three genera of family Poaceae, including <i>Bambusa</i> , broad leaf bamboo (<i>Sasa</i>) and large-leaved bamboo (<i>Indocalamus tessellatus</i>) (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Unachionaspis tenuis</i> (Maskell)	1, 4	China, Japan and Russia	No record found (García Morales et al. 2019)	Oligophagous, on six genera of family Poaceae, including <i>Bambusa</i> , broad leaf bamboo (<i>Sasa</i>), Japanese timber bamboo (<i>Phyllostachys bambusoides</i>) and ruscus bamboo (<i>Shibataea kumasasa</i>) (García Morales et al. 2019) On the lower surface of leaves (Danzig & Pellizzari 1998)	Intercepted in South Korea on <i>Phyllostachys</i> from Japan (Suh 2016a)	Yes
<i>Unaspis acuminata</i> (Green)	4, 5	Mainland China, India, Sri Lanka, Taiwan and Thailand	No record found (García Morales et al. 2019)	Polyphagous, on 13 genera in 11 families of host plants, including <i>Citrus</i> , <i>Dipterocarpus</i> , fig, <i>Leea</i> , mango, mahua (<i>Madhuca longifolia</i>) and sago palm (<i>Cycas revoluta</i>) (García Morales et al. 2019) Assessed as on pathway for mangoes from Indonesia, Thailand and Vietnam (Department of Agriculture and Water Resources 2015) and mango from Taiwan (Biosecurity Australia 2006c)	—	Yes

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
<i>Unaspis citri</i> (Comstock)	1, 3, 4, 5, 6	96 countries in Asia, the Americas, Africa and Oceania	Yes NSW, Qld, NT (García Morales et al. 2019; Plant Health Australia 2018) Declared pest, prohibited by WA (Government of Western Australia 2018)	Polyphagous, on 18 genera in 14 families of host plants, including avocado, banana, <i>Citrus</i> , <i>Cocos</i> , guava, jackfruit (<i>Artocarpus heterophyllus</i>), mango, pineapple, peppers (<i>Capsicum</i>), rambutan (<i>Nephelium lappaceum</i>), and soursop (<i>Annona muricata</i>)(CABI EPPO 2011) (García Morales et al. 2019) Mainly on the trunk and main branches of host plants, but occasionally found on leaves and fruits (Watson 2002); affecting host plants during the vegetative, flowering and fruiting stages (Watson 2018) Assessed as on pathway for island cabbage from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu (DAFF 2013b), Tahitian lime from New Caledonia (Biosecurity Australia 2006b) and pineapple from Malaysia (DAFF 2012a)	Adults intercepted in Australia on <i>Citrus sinensis</i> Intercepted in South Korea on <i>Citrus</i> from China, France, Mexico and the USA (Suh 2016a)	Yes (WA)
<i>Unaspis euonymi</i> (Comstock)	1, 4, 5, 6	40 countries in the Americas, Aisa, Africa and Europe	No record found (García Morales et al. 2019)	Polyphagous, on 29 genera in 21 families of host plants, including boxwood, <i>Citrus</i> , <i>Camellia</i> , European ash (<i>Fraxinus excelsior</i>), fig, holly, <i>Hedera</i> , <i>Hibiscus</i> , <i>Magnolia</i> , <i>Prunus</i> , and spindle trees (<i>Euonymus</i>) (García Morales et al. 2019) Scales occur on all above ground parts of the host; scales occurring predominantly on leaves, whereas females preferring stems and branches (Miller & Davidson 2005) Assessed as on pathway for Unshu mandarins from Japan (Biosecurity Australia 2009)	Intercepted in South Korea on <i>Euonymus</i> from Japan (Suh 2016a). Intercepted in Croatia from Asia in 1945 (Masten Milek, Simala & Pintar 2016)	Yes
<i>Unaspis mabilis</i> Lit & Barbecho	4	The Philippines	No record found (García Morales et al. 2019)	Monophagous, on genus <i>Lansium</i> of family Meliaceae, including lanzones (<i>Lansium domesticum</i>) (García Morales et al. 2019)	—	Yes
<i>Unaspis yanonensis</i> (Kuwana)	1, 3, 4, 5, 6	20 countries in Oceania, Asia and Europe	Yes (Blackburn & Miller 1984; García Morales et al. 2019)	Oligophagous, on two genera in two families of host plants, including <i>Citrus</i> , <i>Damnacanthus</i> , kumquat (<i>Citrus japonica</i>), mandarin, pumelo, and trifoliolate orange (<i>Citrus trifoliata</i>) (García Morales et al. 2019)	Adults and nymphs intercepted in Australia on fresh <i>Citrus</i> (mandarin and orange) fruit	Yes (WA)

Species	Criteria for inclusion (Table 2.1)	Global distribution (García Morales et al. 2019)	Present within Australia	Host plants, plants parts affected and/or previous pathway assessment	Interception events for Australia and other countries	Quarantine pest
			Declared pest, prohibited by WA (Government of Western Australia 2018)	On leaves and small branches, and on fruits during periods of heavy infestations (Watson 2018); affecting host plants during the vegetative, flowering, fruiting and post harvest stages (Watson 2018) Assessed as on pathway for unshu mandarins from Japan (Biosecurity Australia 2009) and for sweet oranges from Italy (Biosecurity Australia 2005b)	Intercepted in Taiwan on <i>Citrus</i> from Japan (Chen, Wong & Wu 2014) Intercepted in the USA on <i>Citrus</i> , <i>Alyxis</i> , <i>Citrullus</i> , <i>Fortunella</i> and <i>Araceae</i> from Asia, Australia, China, Greece, Hawaii and Japan (Evans & Dooley 2013). Intercepted in South Korea on <i>Citrus</i> from China, Japan and Vietnam (Suh 2016a)	
<i>Varicaspis fiorineides</i> (Newstead)	4	Angola and Kenya	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including <i>Coffea canephora</i> , <i>Jasminum</i> and <i>Syzygium guineense</i> (García Morales et al. 2019)	—	Yes
<i>Voraspsis ceratoniae</i> (Marchal)	4	Algeria, Morocco and Tunisia	No record found (García Morales et al. 2019)	Oligophagous, on three genera in three families of host plants, including argan (<i>Argania spinosa</i>), carob tree (<i>Ceratonia siliqua</i>), and olive (García Morales et al. 2019) On leaves (Danzig & Pellizzari 1998)	—	Yes
<i>Xiphuraspsis spiculata</i> (Green)	4	India and China	No record found (García Morales et al. 2019)	Oligophagous, on two genera <i>Bambusa</i> and <i>Phyllostachys</i> of family Poaceae (García Morales et al. 2019; Wang, Varma & Xu 1998)	—	Yes

10 Appendix D: Summary of previous pest risk assessments for soft and hard scales

Table 10.1 Summary of previous pest risk assessments of soft scales

Species	Policy (commodity and origin)	Likelihood of						Consequences	URE
		Importation	Distribution	Entry	Establishment	Spread	EES		
<i>Coccus capparidis</i>	Cabbage (Pacific) 2013	H	M	M	H	H	M	L	L
<i>Coccus viridis</i> (WA)	Longan and lychees (China/Thailand) 2004	H	M	M	H	H	M	L	L
<i>Drepanococcus chiton</i>	Longan and lychees (China/Thailand) 2004	H	M	M	H	H	M	L	L
	Mangosteen (Indonesia) 2012	H	L	L	H	H	L	L	VL
	Longans (Vietnam) 2019	H	L	L	H	H	L	L	VL
<i>Milviscutulus mangiferae</i>	Mango (Taiwan) 2006	H	M	M	H	M	L	L	VL
<i>Parthenolecanium corni</i> (WA)	Table grape (Chile) 2005	H	L	L	H	M	L	L	VL
	Table grape (Korea) 2011	H	L	L	H	M	L	L	VL
	Table grape (China) 2011	H	L	L	H	M	L	L	VL
	Table grape (California) to WA 2013	M	L	L	H	M	L	L	VL
	Table grape (Japan) 2014	M	L	L	H	M	L	L	VL
	Table grapes (India) 2016	—	—	—	—	—	—	—	VL (a)
	Table grapes (Mexico) 2016	—	—	—	—	—	—	—	VL (a)
<i>Parthenolecanium orientalis</i>	Table grape (China) 2011	H	L	L	H	M	L	L	VL
<i>Protospulvinaria pyriformis</i>	Mango (Taiwan) 2006	H	M	M	H	M	L	L	VL
<i>Pulvinaria psidii</i>	Longan and lychees (China/Thailand) 2004	H	M	M	H	H	M	L	L
<i>Pulvinaria vitis</i>	Table grape (China) 2011	H	L	L	H	M	L	L	VL
<i>Saissetia neglecta</i> (WA)	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	H	L	L	H	M	L	L	VL

a: No likelihoods nor consequences were specified for *P. corni* in the PRAs for table grapes from India and Mexico, which stated that the URE of *P. corni* in these PRA was adopted from previous pest risk assessments for soft scales and achieved the ALOP for Australia.

Table 10.2 Summary of previous pest risk assessments of hard scales

Species	Policy (commodity and origin)	Likelihood of						Consequences	URE
		Importation	Distribution	Entry	Establishment	Spread	EES		
<i>Aonidomytilus albus</i>	Mango (Taiwan) 2006	H	M	M				L	VL
<i>Aspidiella hartii</i>	Ginger (Fiji) 2013	H	H	H	H	H	H	L	
<i>Aspidiotus coryphae</i>	Banana (Philippines) 2008	H	H	H	M	H	M	L	L
<i>Aspidiotus excisus</i>	Banana (Philippines) 2008	H	H	H	M	H	M	L	L
<i>Chrysomphalus dictyospermi</i> (WA)	Sweet orange (Italy) 2005	H	L	L	H	M	L	L	VL
	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	—	—	—	—	—	—	—	VL (a)
	Breadfruit (Pacific) 2019	H	L	L	H	M	L	L	VL
	Avocado (Chile) 2019	H	L	L	H	M	L	L	VL
<i>Diaspidiotus forbesi</i>	Stonefruit (USA) 2010	L	L	VL	H	M	VL	L	N
<i>Diaspidiotus juglansregiae</i>	Stonefruit (USA) 2010	L	L	VL	H	M	VL	L	N
<i>Diaspidiotus ostreaeformis</i> (WA)	Apple (China) 2010	M	L	L	H	M	L	L	VL
	Apple (New Zealand) 2006	L	L	VL	H	M	VL	L	N
	Apple (China) 2010	M	L	L	H	M	L	L	VL
	Apple (New Zealand) 2006	L	L	VL	H	M	VL	L	N
	Stonefruit (New Zealand) 2006	L	L	VL	H	M	VL	L	N
<i>Diaspis boisduvalii</i> (WA)	Mangosteen (Indonesia) 2012	H	L	L	H	M	L	L	VL
<i>Diaspis bromeliae</i> (WA)	Pineapple (Taiwan) 2019	H	L	L	H	M	L	L	VL

Species	Policy (commodity and origin)	Likelihood of						Consequences	URE
		Importation	Distribution	Entry	Establishment	Spread	EES		
<i>Fiorinia fioriniae</i> (WA)	Avocado (Chile) 2019	H	L	L	H	M	L	L	VL
<i>Fiorinia phoenicis</i> (WA)	Fresh dates (Middle East and North Africa) 2019	H	L	L	H	M	L	L	VL
	Mango (Taiwan) 2006	H	M	M	H	M	L	L	VL
	Banana (Philippines) 2008	H	H	H	M	H	M	L	L
	Mango (India) 2008	H	L	L	H	M	L	L	VL
<i>Hemiberlesia cyanophylli</i> (WA)	Mango (Indonesia/Thailand/Vietnam) 2015	H	M	M	H	M	L	L	VL
	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	—	—	—	—	—	—	—	VL (a)
	Breadfruit (Pacific) 2019	H	L	L	H	M	L	L	VL
	Avocado (Chile) 2019	H	L	L	H	M	L	L	VL
<i>Hemiberlesia latastei</i>	Avocado (Chile) 2019	H	L	L	H	M	L	L	VL
	Banana (Philippines) 2008	H	H	H	M	H	M	L	L
<i>Hemiberlesia palmae</i> (WA)	Breadfruit (Pacific) 2019	H	L	L	H	M	L	L	VL
<i>Howardia biclavis</i> (SA, WA)	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
<i>Ischnaspis longirostri</i> (WA)	Lychee (Taiwan and Vietnam) 2013	VL	L	VL	H	M	VL	L	N
	Mangosteen (Indonesia) 2012	H	L	L	H	M	L	L	VL
	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
<i>Lepidosaphes gloverii</i> (SA, WA)	Tahitian lime (New Caledonia) 2006	H	L	L	H	M	L	L	VL
	Sweet orange (Italy) 2005	H	L	L	H	M	L	L	VL

Species	Policy (commodity and origin)	Likelihood of						Consequences	URE
		Importation	Distribution	Entry	Establishment	Spread	EES		
<i>Lepidosaphes laterochitinos</i>	Mango (Taiwan) 2006	H	M	M	H	M	L	L	VL
<i>Lepidosaphes pinnaeformis</i> (WA)	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
<i>Lopholeucaspis cockerelli</i>	Tahitian lime (New Caledonia) 2006	H	L	L	H	M	L	L	VL
<i>Lopholeucaspis japonica</i>	Apple (China) 2010	H	L	L	H	M	L	L	VL
	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
	Apple (China) 2010	H	L	L	H	M	L	L	VL
<i>Melanaspis bromiliae</i>	Pineapple (global) 2002	M	M	L	L	M	VL	N	N
	Pineapple (Malaysia) 2012	H	L	L	H	M	L	L	VL
<i>Morganella longispina</i> (SA, WA)	Tahitian lime (New Caledonia) 2006	H	L	L	H	M	L	L	VL
	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	—	—	—	—	—	—	—	VL
<i>Parlatoria cinerea</i>	Tahitian lime (New Caledonia) 2006	H	L	L	H	M	L	L	VL
	Lychee (Taiwan and Vietnam) 2013	VL	L	VL	H	M	VL	L	N
	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	—	—	—	—	—	—	—	VL (a)
<i>Parlatoria crypta</i>	Mango (India) 2008	H	L	L	H	M	L	L	VL
	Mango (Pakistan) 2011	H	L	L	H	M	L	L	VL
<i>Parlatoria oleae</i>	Stonefruit (USA) 2010	L	L	VL	H	M	VL	L	N
<i>Parlatoria pergandii</i> (SA, WA)	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	—	—	—	—	—	—	—	VL (a)

Species	Policy (commodity and origin)	Likelihood of						Consequences	URE
		Importation	Distribution	Entry	Establishment	Spread	EES		
<i>Parlatoria pseudaspidotus</i> (WA)	Mango (Taiwan) 2006	H	M	M	H	M	L	L	VL
	Mango (Pakistan) 2011	H	M	M	H	M	L	L	VL
<i>Parlatoria theae</i>	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
<i>Parlatoria yanyuanensis</i>	Apple (China) 2010	L	L	VL	H	M	VL	L	N
	Apple (China) 2010	L	L	VL	H	M	VL	L	N
<i>Parlatoria ziziphi</i>	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
	Sweet orange (Italy) 2005	H	L	L	H	M	L	L	VL
<i>Parlatoria cinerea</i>	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
<i>Parlatoria oleae</i> (WA)	Apple (China) 2010	H	L	L	H	M	L	L	VL
	Apple (China) 2010	H	L	L	H	M	L	L	VL
<i>Parlatoria pergandii</i> (WA)	Sweet orange (Italy) 2005	H	L	L	H	M	L	L	VL
<i>Pinnaspis aspidistrae</i> (WA)	Tahitian lime (New Caledonia) 2006	H	L	L	H	M	L	L	VL
	Mango (Indonesia/Thailand/Vietnam) 2015	H	M	M	H	M	L	L	VL
	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	—	—	—	—	—	—	—	VL (a)
	Avocado (Chile) 2019	H	L	L	H	M	L	L	VL
<i>Pinnaspis musae</i>	Banana (Philippines) 2008	H	H	H	M	H	M	L	L
<i>Pseudaonidia duplex</i>	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
	Nectarines (China) 2016	L	L	VL	H	M	VL	L	N
<i>Pseudaonidia trilobitiformis</i> (SA, WA)	Mangosteen (Indonesia) 2012	H	L	L	H	M	L	L	VL
	Tahitian lime (New Caledonia) 2006	H	L	L	H	M	L	L	VL

Species	Policy (commodity and origin)	Likelihood of						Consequences	URE
		Importation	Distribution	Entry	Establishment	Spread	EES		
	Mango (Indonesia/Thailand/Vietnam) 2015	H	M	M	H	M	L	L	VL
	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
<i>Pseudaulacaspis cockerelli</i> (WA)	Banana (Philippines) 2008	H	H	H	M	H	M	L	L
	Cabbage (Pacific) 2013	M	L	L	M	H	L	L	VL
<i>Pseudaulacaspis pentagona</i> (WA)	Capsicum (South Korea) 2009	M	L	L	H	M	L	L	VL
	Stonefruit (USA) 2010	L	L	VL	H	M	VL	L	N
	Breadfruit (Pacific) 2019	H	L	L	H	M	L	L	VL
<i>Pseudaulacaspis prunicola</i> (WA)	Stonefruit (USA) 2010	L	L	VL	H	M	VL	L	N
	Nectarines (China) 2016	L	L	VL	H	M	VL	L	N
<i>Radionaspis indica</i>	Mango (Indonesia/Thailand/Vietnam) 2015	H	M	M	H	M	L	L	VL
<i>Selenaspis articulatus</i> (WA)	Banana (Philippines) 2008	H	H	H	M	H	M	L	L
	Lychee (Taiwan and Vietnam) 2013	VL	L	VL	H	M	VL	L	N
<i>Unaspis acuminata</i>	Mango (Indonesia/Thailand/Vietnam) 2015	H	M	M	H	M	L	L	VL
	Mango (Taiwan) 2006	H	M	M	H	M	L	L	VL
	Tahitian lime (New Caledonia) 2006	H	L	L	H	M	L	L	VL
	Pineapple (Malaysia) 2012	H	L	L	H	M	L	L	VL
<i>Unaspis citri</i> (SA, WA)	Cabbage (Pacific) 2013	M	L	L	M	H	L	L	VL
	Tahitian limes (Cook Islands, Niue, Samoa, Tonga and Vanuatu) 2018	—	—	—	—	—	—	—	VL (a)
	Avocado (Chile) 2019	H	L	L	H	M	L	L	VL
<i>Unaspis euonymi</i>	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL

Species	Policy (commodity and origin)	Likelihood of						Consequences	URE
		Importation	Distribution	Entry	Establishment	Spread	EES		
<i>Unaspis yanonensis</i>	Unshu mandarin (Japan) 2009	H	L	L	H	M	L	L	VL
	Sweet orange (Italy) 2005	H	L	L	H	M	L	L	VL

a: No likelihoods nor consequences were specified for the six hard scale species in the PRA for Tahitian limes from Cook Islands, Niue, Samoa, Tonga and Vanuatu, which stated that the URE of these species in the PRA was adopted from previous pest risk assessments for hard scales and achieved the ALOP for Australia.

11 Appendix E: Interceptions of soft and hard scales by Australia (2000–2018)

Australian interceptions of Coccidae (soft scales)

There have been 496 coccid interception events recorded on the plant import pathway by Australia in the last 18 years (2000–2018) (Table 11.1).

Almost three-quarters (74.9%) of intercepted soft scales were identified only to family level of Coccidae. Only 9.7% were identified to generic level and 15.4% to species level.

A total of 10 genera of intercepted soft scales were identified. The most frequently intercepted genera, in descending order, were *Coccus*, *Saissetia*, *Pulvinaria* and *Ceroplastes*. A total of 15 species were identified, the most frequently intercepted, in descending order, were *Coccus hesperidum*, *Coccus viridis*, *Pulvinaria psidii* and *Saissetia coffeae*.

Table 11.1 Interceptions of soft scales (Coccidae) by Australia (2000–2018)

Family	Genus	Species	Interception events (a)
Coccidae	<i>Ceroplastes</i>	<i>ceriferus</i>	2
Coccidae	<i>Ceroplastes</i>	<i>rubens</i>	2
Coccidae	<i>Ceroplastes</i>	<i>rusci</i>	2
Coccidae	<i>Ceroplastes</i>	spp.	6
Coccidae	<i>Coccus</i>	<i>hesperidum</i>	32
Coccidae	<i>Coccus</i>	<i>longulus</i>	3
Coccidae	<i>Coccus</i>	<i>viridis</i>	8
Coccidae	<i>Coccus</i>	spp.	24
Coccidae	<i>Drepanococcus</i>	spp.	2
Coccidae	<i>Heliococcus</i>	sp.	1
Coccidae	<i>Milviscutulus</i>	<i>mangiferae</i>	1
Coccidae	<i>Neosaissetia</i>	sp.	1
Coccidae	<i>Parasaissetia</i>	<i>nigra</i>	2
Coccidae	<i>Parasaissetia</i>	sp.	1
Coccidae	<i>Parthenolecanium</i>	<i>corni</i>	1
Coccidae	<i>Parthenolecanium</i>	sp.	1
Coccidae	<i>Pulvinaria</i>	<i>polygonata</i>	2
Coccidae	<i>Pulvinaria</i>	<i>psidii</i>	6
Coccidae	<i>Pulvinaria</i>	spp.	6
Coccidae	<i>Saissetia</i>	<i>coffeae</i>	5
Coccidae	<i>Saissetia</i>	<i>miranda</i>	3
Coccidae	<i>Saissetia</i>	<i>oleae</i>	5
Coccidae	<i>Saissetia</i>	<i>vivipara</i>	1

Coccidae	<i>Saissetia</i>	spp.	5
Coccidae			364
Total	10 identified genera	15 identified species	486

a: Each interception is based on presence of at least a single individual insect on a consignment. The number of individuals present per event is not generally recorded, and multiple insects can contaminate the same or different commodities in the same consignment.

Australian interceptions of Diaspididae (hard scales)

There have been 2,691 diaspidid interception events recorded on the plant import pathway by Australia in the last 18 years (2000–2018).

Less than half (44.9%) of intercepted hard scales were identified only to family level of Diaspididae (Table 4.1). Only 7.1% were identified to generic level and 48% to species level. It is noted that the percentage of identified species of intercepted Diaspididae (48%) is much higher than that of Pseudococcidae and Rhizoecidae together (10%) and Coccidae (15.4%). This is mainly due to the three most frequently intercepted species: *Aonidiella aurantii*, *Hemiberlesia lataniae* and *Pseudaulacaspis pentagona*, together making up 35.4% of the total interceptions.

A total of 30 genera of intercepted hard scales were identified. The most frequently intercepted genera, in descending order, were *Aonidiella*, *Hemiberlesia*, *Pseudaulacaspis* and *Lepidosaphes*. A total of 55 species were identified (Table 11.2), the most frequently intercepted, in descending order, were *Aonidiella aurantii*, *Hemiberlesia lataniae* and *Pseudaulacaspis pentagona*.

Table 11.2 Interceptions of hard scales (Diaspididae) by Australia (2000–2018)

Family	Genus	Species	Interception events (a)
Diaspididae	<i>Abgrallaspis</i>	<i>cyanophylli</i>	3
Diaspididae	<i>Abgrallaspis</i>	sp.	1
Diaspididae	<i>Andaspis</i>	spp.	2
Diaspididae	<i>Aonidiella</i>	<i>aurantii</i>	485
Diaspididae	<i>Aonidiella</i>	<i>aurantii</i> C.F.	37
Diaspididae	<i>Aonidiella</i>	<i>citrina</i>	49
Diaspididae	<i>Aonidiella</i>	<i>inornata</i>	4
Diaspididae	<i>Aonidiella</i>	<i>orientalis</i>	6
Diaspididae	<i>Aonidiella</i>	spp.	74
Diaspididae	<i>Aspidiella</i>	<i>hartii</i>	4
Diaspididae	<i>Aspidiotus</i>	<i>destructor</i>	3
Diaspididae	<i>Aspidiotus</i>	<i>nerii</i>	6
Diaspididae	<i>Aspidiotus</i>	spp.	11
Diaspididae	<i>Aulacaspis</i>	<i>madiunensis</i>	1
Diaspididae	<i>Aulacaspis</i>	spp.	3
Diaspididae	<i>Aulacaspis</i>	<i>tubercularis</i>	13
Diaspididae	<i>Carulaspis</i>	<i>minima</i>	1
Diaspididae	<i>Chrysomphalus</i>	<i>aonidum</i>	5

Diaspididae	<i>Chrysomphalus</i>	<i>dictyospermi</i>	4
Diaspididae	<i>Chrysomphalus</i>	<i>pinnulifer</i>	1
Diaspididae	<i>Chrysomphalus</i>	spp.	5
Diaspididae	<i>Diaspidiotus</i>	<i>juglansregiae</i>	3
Diaspididae	<i>Diaspidiotus</i>	<i>perniciosus</i>	11
Diaspididae	<i>Diaspis</i>	<i>bromeliae</i>	1
Diaspididae	<i>Diaspis</i>	<i>echinocacti</i>	4
Diaspididae	<i>Diclavaspis</i>	sp.	1
Diaspididae	<i>Duplachionaspis</i>	<i>divergens</i>	3
Diaspididae	<i>Duplaspidotus</i>	sp.	1
Diaspididae	<i>Duplaspidotus</i>	<i>tessaratus</i>	2
Diaspididae	<i>Dynaspidotus</i>	<i>britannicus</i>	1
Diaspididae	<i>Fiorinia</i>	<i>fioriniae</i>	1
Diaspididae	<i>Hemiberlesia</i>	<i>lataniae</i>	248
Diaspididae	<i>Hemiberlesia</i>	<i>lataniae C.F.</i>	1
Diaspididae	<i>Hemiberlesia</i>	<i>palmae</i>	5
Diaspididae	<i>Hemiberlesia</i>	<i>rapax</i>	30
Diaspididae	<i>Hemiberlesia</i>	sp.	31
Diaspididae	<i>Lepidosaphes</i>	<i>beckii</i>	48
Diaspididae	<i>Lepidosaphes</i>	<i>chinensis</i>	6
Diaspididae	<i>Lepidosaphes</i>	<i>cornuta</i>	4
Diaspididae	<i>Lepidosaphes</i>	<i>gloverii</i>	1
Diaspididae	<i>Lepidosaphes</i>	<i>karkarica</i>	1
Diaspididae	<i>Lepidosaphes</i>	<i>pinnaeformis</i>	1
Diaspididae	<i>Lepidosaphes</i>	<i>rubravittata</i>	1
Diaspididae	<i>Lepidosaphes</i>	spp.	41
Diaspididae	<i>Lepidosaphes</i>	<i>tokionis</i>	1
Diaspididae	<i>Lepidosaphes</i>	<i>ulmi</i>	2
Diaspididae	<i>Lindingaspis</i>	<i>misrae</i>	1
Diaspididae	<i>Lindingaspis</i>	<i>rossi</i>	1
Diaspididae	<i>Melanaspis</i>	<i>bromiliae</i>	1
Diaspididae	<i>Melanaspis</i>	sp.	1
Diaspididae	<i>Mycetaspis</i>	sp.	1
Diaspididae	<i>Oceanaspidotus</i>	spp.	2
Diaspididae	<i>Odonaspis</i>	<i>ruthae</i>	1
Diaspididae	<i>Odonaspis</i>	sp.	1
Diaspididae	<i>Parlatoria</i>	<i>blanchardi</i>	1
Diaspididae	<i>Parlatoria</i>	<i>pergandii</i>	15
Diaspididae	<i>Parlatoria</i>	<i>proteus</i>	2
Diaspididae	<i>Parlatoria</i>	spp.	4
Diaspididae	<i>Parlatoria</i>	<i>ziziphi</i>	9

Diaspididae	<i>Pentalaminaspis</i>	<i>minuta</i>	1
Diaspididae	<i>Pinnaspis</i>	<i>aspidistrae</i>	4
Diaspididae	<i>Pinnaspis</i>	<i>buxi</i>	4
Diaspididae	<i>Pinnaspis</i>	spp.	2
Diaspididae	<i>Pinnaspis</i>	<i>strachani</i>	17
Diaspididae	<i>Pseudaonidia</i>	<i>duplex</i>	1
Diaspididae	<i>Pseudaonidia</i>	<i>trilobitiformis</i>	4
Diaspididae	<i>Pseudaulacaspis</i>	<i>cockerelli</i>	4
Diaspididae	<i>Pseudaulacaspis</i>	<i>pentagona</i>	219
Diaspididae	<i>Pseudaulacaspis</i>	spp.	9
Diaspididae	<i>Selenaspis</i>	<i>articulatus</i>	4
Diaspididae	<i>Selenaspis</i>	sp.	1
Diaspididae	<i>Unaspis</i>	<i>citri</i>	2
Diaspididae	<i>Unaspis</i>	sp.	1
Diaspididae	<i>Unaspis</i>	<i>yanonensis</i>	4
Diaspididae			1207
Total	30 identified genera	55 identified species	2691

a: Each interception is based on presence of at least a single individual insect on a consignment. The number of individuals present per event is not generally recorded, and multiple insects can contaminate the same or different commodities in the same consignment.

Glossary

Term or abbreviation	Definition
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995). The <i>Biosecurity Act 2015</i> defines the ALOP for Australia as a high level of sanitary and phytosanitary protection aimed at reducing biosecurity risks to very low, but not to zero.
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2019b).
Arthropod	The largest phylum of animals, including the insects, arachnids and crustaceans.
Australian territory	Australian territory as referenced in the <i>Biosecurity Act 2015</i> refers to Australia, Christmas Island and Cocos (Keeling) Islands.
Biosecurity	The prevention of the entry, establishment or spread of unwanted pests and infectious disease agents to protect human, animal or plant health or life, and the environment.
Biosecurity risk	The <i>Biosecurity Act 2015</i> refers to biosecurity risk as the likelihood of a disease or pest entering, establishing or spreading in Australian territory, and the potential for the disease or pest causing harm to human, animal or plant health, the environment, economic or community activities.
Biosecurity import risk analysis (BIRA)	The <i>Biosecurity Act 2015</i> defines a BIRA as an evaluation of the level of biosecurity risk associated with particular goods, or a particular class of goods, that may be imported, or proposed to be imported, into Australian territory, including, if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or the class of goods, to a level that achieves the ALOP for Australia. The risk analysis process is regulated under legislation.
Commodity	A type of plant, plant product, or other article being moved for trade or other purpose (FAO 2019b).
Embryogenesis	The formation and development of an embryo.
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2019b).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2019b).
Goods	The <i>Biosecurity Act 2015</i> defines goods as an animal, a plant (whether moveable or not), a sample or specimen of a disease agent, a pest, mail or any other article, substance or thing (including, but not limited to, any kind of moveable property).
Haplodiploidy	A sex-determination system in which males develop from unfertilized eggs and are haploid, and females develop from fertilized eggs and are diploid.
Import risk analysis	An administrative process through which quarantine policy is developed or reviewed, incorporating risk assessment, risk management and risk communication.
Infection	The internal 'endophytic' colonisation of a plant, or plant organ, and is generally associated with the development of disease symptoms as the integrity of cells and/or biological processes are disrupted.
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2019b).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (FAO 2019b).
Instar	An instar is a developmental stage of arthropods, such as insects, between each moult (ecdysis), until sexual maturity is reached. Arthropods must shed the exoskeleton in order to grow or assume a new form.

Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced or used (FAO 2019b).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2019b).
International Plant Protection Convention (IPPC)	The IPPC is an international plant health agreement, established in 1952, that aims to protect cultivated and wild plants by preventing the introduction and spread of pests. The IPPC provides an international framework for plant protection that includes developing International Standards for Phytosanitary Measures (ISPMs) for safeguarding plant resources.
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on Phytosanitary Measures or the Commission on Phytosanitary Measures, established under the IPPC (FAO 2019b).
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO 2019b).
Non-regulated risk analysis	Refers to the process for conducting a risk analysis that is not regulated under legislation (Biosecurity import risk analysis guidelines 2016).
Nymph	The immature form of some insect species that undergoes incomplete metamorphosis. It is not to be confused with larva, as its overall form is already that of the adult.
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2019b).
Open reading frames	In molecular genetics, an open reading frame (ORF) is the part of a reading frame that has the potential to be translated. An ORF is a continuous stretch of codons that do not contain a stop codon (usually UAA, UAG or UGA).
Pathogen	A biological agent that can cause disease to its host.
Pathway	Any means that allows the entry or spread of a pest (FAO 2019b).
Parthenogenesis	Reproduction from an ovum without fertilization, especially as a normal process in some invertebrates and lower plants.
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2019b).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2019b).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2019b).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the magnitude of the associated potential economic consequences (FAO 2019b).
Pest risk assessment (for regulated non-quarantine pests)	Evaluation of the probability that a pest in plants for planting affects the intended use of those plants with an economically unacceptable impact (FAO 2019b).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2019b).
Pest risk management (for regulated non-quarantine pests)	Evaluation and selection of options to reduce the risk that a pest in plants for planting causes an economically unacceptable impact on the intended use of those plants (FAO 2019b).
Pest status (in an area)	Presence or absence, at the present time, of a pest in an area, including where appropriate its distribution, as officially determined using expert judgement on the basis of current and historical pest records and other information (FAO 2019b).
Phoresy	A biologic association between two organisms in which one travels on the body of another, without being a parasite.

Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2019b).
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2019b).
Pupa	An inactive life stage that only occurs in insects that undergo complete metamorphosis, for example butterflies and moths (Lepidoptera), beetles (Coleoptera) and bees, wasps and ants (Hymenoptera).
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing or treatment (FAO 2019b).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2019b).
Regulated pest	A quarantine pest or a regulated non-quarantine pest (FAO 2019b).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Risk analysis	Refers to the technical or scientific process for assessing the level of biosecurity risk associated with the goods, or the class of goods, and if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or class of goods to a level that achieves the ALOP for Australia.
Risk management measure	Conditions that must be met to manage the level of biosecurity risk associated with the goods or the class of goods, to a level that achieves the ALOP for Australia. In this risk analysis, the term 'risk management measure' and 'phytosanitary measure' may be used interchangeably.
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO 2019b).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures.
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Surveillance	An official process which collects and records data on pest occurrence or absence by surveying, monitoring or other procedures (FAO 2019b).
The department	The Department of Agriculture.
Thelytokous	A type of parthenogenesis in which females are produced from unfertilized eggs.
Treatment	Official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalisation (FAO 2019b).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk mitigation measures.
Vector	An organism that does not cause disease itself, but which causes infection by conveying pathogens from one host to another.
Viruliferous	An organism that contains, produces, or conveys an agent of infection, principally a virus.
Viviparity	Retention and growth of the fertilized egg within the maternal body until the young animal, as a larva or newborn, is capable of independent existence
Zoogeographical region	Zoogeographical region, also called faunal region, is defined on the basis of distinctive animal life on the earth into six regions: Afrotropical (AFR) region, including Trans-Saharan Africa and Arabia; Australian (AUS) region, including Australia, New Guinea, New Caledonia, New Zealand, Melanesia, Micronesia, and Polynesia; Nearctic (NEA) region, including most of North America; Neotropical (NEO) region, including South America, Central America, and the Caribbean; Oriental (ORI) region, including the Indian subcontinent, Southeast Asia, and southern China; and Palearctic (PAL) region, including the bulk of Eurasia and North Africa.

Zygote	The cell formed by the union of the nuclei of two reproductive cells (gametes), especially a fertilized egg cell.
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