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Catalogue of the exotic armoured scale insects (Hemiptera: Coccoidea: Diaspididae) in New Zealand

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Abstract An up-to-date catalogue of New Zealand's exotic Diaspididae has been developed from studies of curated specimens and the literature. Twenty-eight species are recorded as established by July 2002. *Lepidosaphes pallida* is recorded in New Zealand for the first time. Five new synonymies are proposed (with the senior synonym in parentheses): *Chionaspis candida* (= *Chionaspis angusta*; *Mytilaspis eucalypti*; *Lepidosaphes ulmi* var. *novozealandica* (= *Lepidosaphes multipora*); *Fiorinia grossulariae* 1884 (= *Lepidosaphes ulmi*); and *Chionaspis xerotidis* (= *Pseudaulacaspis eugeniae*). For the first time, literature records are shown to be erroneous for a further eight species, which are therefore considered to be not present in New Zealand. They are: *Aspidiotus destructor*, *Ischnaspis longirostris*, *Lepidosaphes flava*, *Parlatoria pergandii*, *Parlatoria ziziphi*, *Pinnaspis strachani*, *Pseudaulacaspis pentagona*, and *Unaspis citri*. An annotated list of all 36 species provides for each species a selective synonymy and a summary of some basic biological details, host plant range, geographical distribution, and environmental impact.

Keywords synonymies; records; geographical distribution; biology; quarantine; pest control

INTRODUCTION

The dispersal between countries of exotic pests of plants is an inevitable consequence of international travel, tourism, and trade. New insect pests of export crops may lead to restrictions in trade and may threaten native flora and fauna. Many governments are responding to these threats by signing international protocols to limit the deliberate or accidental importation of pests. For example, Article 8h of the Convention on Biological Diversity (to which New Zealand is signatory) *inter alia* requires parties to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species." New Zealand has provided additional protection by enacting domestic legislation, such as the Biosecurity Act 1993 and the Hazardous Substances and New Organisms (HSNO) Act 1996. In the end, the continuation of international trade and travel relies heavily on the development of rational, scientifically justified phytosanitary protocols, which, in turn, rely on national catalogues of pest species.

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The accurate documentation of exotic pest species is also required for domestic pest control and environmental research programmes. In New Zealand, provisions of the HSNO legislation makes it increasingly difficult to import biological control agents of plant pests or of weeds. These natural enemies are usually also exotic insects from the same region of origin as the pest. They may provide the most sustainable long-term option for controlling many of the exotic pests that are already established, or that continue to establish despite the best endeavours of border security services. However, they are now assumed to be a threat to native flora and fauna, and approval for importation and release will not be given unless it can be scientifically demonstrated that their potential economic benefits outweigh their potential threat to the environment. One of the first steps in the science programme must be to identify existing target and non-target species and their interactions with existing natural enemies, so that the new "threats" can be compared with or to those already present. Only then can a cost-benefit analysis of introducing more natural enemies be made.

Just over half of the horticultural insect pests in New Zealand are in the superfamily Coccoidea (Hemiptera) (Charles 1998). One of the families in the Coccoidea, the Diaspididae or armoured scale insects, contains about 2000 species worldwide and some of the most damaging insect pests of perennial plants. The many cosmopolitan pest species testify to the ease with which they have been transported around the world, predominantly as unseen or ignored passengers on nursery plants. Diaspididae are extremely specialised insects. Adult females are legless and wingless, with mouthparts highly adapted for piercing and sucking. Their "armour" (a hard wax secretion incorporating the nymphal exuviae), immobility, and often cryptic nature provide excellent protection. They are notoriously difficult to kill using manufactured remedies, but are known to be attacked by a large number of natural enemies—both predators and parasitoids.

Exotic species of Diaspididae probably established in New Zealand with the arrival of the earliest European colonists. William Maskell recorded the first species and their pest status at the end of the 19th century (e.g., Maskell 1887), and other taxonomists and ecologists throughout the 20th century have added to this work. Most recently, Wise (1977) recorded 70 species of Diaspididae, of which 39 were native and restricted to native host plants and 31 were exotic. Nevertheless, Wise (1977) included erroneous records, arising mainly from the world catalogues of Fernald (1903) and Borchsenius (1966). New records and taxonomic revisions since Wise's (1977) checklist (e.g., Henderson 2000) give added impetus to the need to update the previous checklists and catalogues.

This paper provides an annotated catalogue of the exotic species of Diaspididae recorded in New Zealand by July 2002. The work is not a taxonomic revision, but does attempt to clarify the historical records through a selective synonymic listing of citations in the New Zealand literature. An important aim is to formally expunge erroneous records published by Fernald (1903), MacGillivray (1921), Borchsenius (1966), Wise (1977), and Nakahara (1982) that may otherwise continue to be uncritically perpetuated in print. Similarly, it is not a biological treatise but does collate and summarise known details of basic biology, host plant range, geographical distribution, and environmental impact of these species in New Zealand.

New Zealand's endemic species of Diaspididae will be treated elsewhere.

METHODS

The catalogue was developed from studies of curated specimens and literature.

The key collection for specimens was the New Zealand Arthropod Collection (NZAC) curated by Landcare Research at Mt Albert, Auckland. Additional collections examined included those at the National Plant Pest Reference Laboratory (NPPRL) at Lynfield and

Lincoln (NZMAF); at Forest Research (FRNZ), Rotorua; and at the Museum of Natural History, London (BMNH). None of the insect collections held at Auckland Museum, Museum of New Zealand Te Papa Tongarewa (Wellington), Canterbury Museum, or the Otago Museum contains any Diaspididae. Wherever possible, curated specimens were matched with literature records.

Literature records were collected from the New Zealand and international literature, and from unpublished New Zealand records held, for example, in the Plant Pest Information Network (PPIN) of the New Zealand Ministry of Agriculture and Forestry (NZMAF). The records of Maskell cited in various publications from 1879 to 1898 were checked for validity and subsequent synonymy. The taxonomy of many of New Zealand's exotic Diaspididae has been repeatedly revised over the past century. Apart from the contributions by Maskell, most revisions have been published in non-New Zealand journals, some of which were (and are) not easily accessible. Thus, while the names in the New Zealand literature reflected the taxonomic position of the species as understood by the authors at the time, they were not always correct. As a result it has become difficult to keep track of the different names for the same insect. To clarify the association between the New Zealand literature and international taxonomic revisions over time, selective but relevant synonymic lists were developed for each species.

Details of the known biology (in New Zealand, or elsewhere if unknown in New Zealand) were extracted from the literature and from personal observations or correspondence, as were the probable geographical origins of the species. The latter data were collected to provide an overview of the global origins of the exotic Diaspididae and are not definitive. Common names are those in use in New Zealand (Scott & Emberson 1999), Australia (Naumann 1993), and California (Gill 1997), in that order of priority.

RESULTS AND DISCUSSION

The exotic species of Diaspididae in New Zealand

Twenty-eight species of exotic Diaspididae have established in New Zealand (Table 1). *Lepidosaphes pallida* is recorded in New Zealand for the first time. The recent "rediscovery" of two species (*Parlatoria fulleri* and *Trullifiorinia acaciae*) after 80 and 45 years, respectively, without records illustrates the ability of small populations of Diaspididae to persist unobtrusively over time. Thus, *Leucaspis cordylinidis*, *Pinnaspis aspidistrae*, and *Pseudoparlatoria parlatoriodes*, which have not been recorded for 81, 25, or 40 years, respectively, may or may not remain established in New Zealand.

It has been suggested that the Diaspididae originated in Gondwanaland and then radiated across the world (Kozar 1990). Seven of the 28 species are known only from Australia and New Zealand and thus share a Gondwanan heritage (*Chionaspis angusta*, *Lepidosaphes multipora*, *Leucaspis cordylinidis*, *Parlatoria fulleri*, *Pseudaulacaspis brimblecombei*, *P. eugeniae*, and *Trullifiorinia acaciae*). An additional two cosmopolitan species (*Lindingaspis rossi* and *Parlatoria pittospori*) are considered to have originated in Australia. Seven species probably originated in the Palaearctic (*Aspidiotus nerii*, *Aulacaspis rosae*, *Carulaspis juniperi*, *Diaspidiotus ostreaeformis*, *D. perniciosus*, *Hemiberlesia rapax*, and *Lepidosaphes ulmi*), seven in Asia/the Orient (*Aonidiella aurantii*, *Aulacaspis rosarum*, *Kuwanaspis pseudoleucaspis*, *Lepidosaphes beckii*, *L. pallida*, *Parlatoria desolator*, and *Pinnaspis aspidistrae*), and only three from the Nearctic or Neotropical regions of the New World (*Diaspis boisduvalii*, *Hemiberlesia cyanophylli*, and *Pseudoparlatoria parlatorioides*). Two are so cosmopolitan that their origins have become obscured by time and human trade (*Hemiberlesia lataniae* and *Lepidosaphes pinnaeformis*) (Table 1).

Table 1 Summary data for the 28 exotic species of Diaspididae in New Zealand. P, occurs commonly and may be a pest on economically important hosts; N, occurs on endemic host plants within native forest; 1st R, year of first record in New Zealand; NZAC, dated specimen held at New Zealand Arthropod Collection.

P	N	Species	Hosts	1st R	Origin	Reference
✓		*Aonidiella aurantii* (Maskell, 1879)	Polyphagous, prefers *Citrus* spp.	1878	Asia	Maskell (1879)
✓	✓	*Aspidiotus nerii* Bouché, 1833	Polyphagous	1879	?Europe	Maskell (1879)
✓		*Aulacaspis rosae* (Bouché, 1833)	*Rosa* spp., *Rubus* spp.	1891	?Europe	NZAC
✓		*Aulacaspis rosarum* Borchsenius, 1958	*Rosa* spp. *Rubus* spp.	1877	?Asia (China)	NZAC
		Carulaspis juniperi (Bouché, 1851)	Conifers	1942	?Palaearctic	Deitz (1979)
		Chionaspis angusta Green, 1904	*Leptospermum*, *Callistemon*	1890	Australia	NZAC
✓		*Diaspidiotus ostreaeformis* (Curtis, 1843)	Polyphagous	1939	Palaearctic	NZAC; Richards (1960)
✓		*Diaspidiotus perniciosus* (Comstock, 1881)	Polyphagous	1908	Palaearctic	Kirk & Cockayne (1909)
		Diaspis boisduvalii Signoret, 1869	Polyphagous, prefers orchids	1879	New World	Maskell (1879)
		Hemiberlesia cyanophylli (Signoret, 1869)	Polyphagous	1934	New World	NZAC; Manson (1968)
✓	✓	*Hemiberlesia lataniae* (Signoret, 1869)	Polyphagous	1979	Cosmopolitan	Morales (1988)
✓	✓	*Hemiberlesia rapax* (Comstock, 1881)	Polyphagous	1879	?Europe	Maskell (1879)
		Kuwanaspis pseudoleucaspis (Kuwana, 1902)	Bamboo	1976	Asia	NZAC
✓		*Lepidosaphes beckii* (Newman, 1869)	Citrus (most)	1895	?Asia	Maskell (1895)
✓		*Lepidosaphes multipora* (Leonardi, 1904)	Polyphagous	1904	Australia	Leonardi (1904)
		Lepidosaphes pallida (Maskell, 1895)	*Cryptomeria japonica*	2001	Asia	cited herein
		Lepidosaphes pinnaeformis (Bouché, 1851)	Orchids	1952	Cosmopolitan	NZAC; Ward (1968)
✓		*Lepidosaphes ulmi* (Linnaeus, 1758)	Polyphagous	1879	Palaearctic	Maskell (1879)
		Leucaspis cordylinidis Maskell, 1893	"Palm tree"	1921	Australia	Green (1929)
✓	✓	*Lindingaspis rossi* (Maskell, 1891)	Polyphagous	1895	Australia?	Thomson (1922)
		Parlatoria desolator McKenzie, 1960	Apple, pear, plum	1936	Asia	Henderson (2000), NZAC
		Parlatoria fulleri Morrison, 1939	Polyphagous	1956	Australia	Henderson (2000), NZAC
✓		*Parlatoria pittospori* Maskell, 1891	Polyphagous, *Pinus*	1921	Australia	Green (1929)
		Pinnaspis aspidistrae (Signoret, 1869)	Polyphagous, prefers ferns	1935	India/Ceylon	NZAC; Ferris & Rao (1947)
		Pseudaulacaspis brimblecombei Williams, 1973	Waratah	1938	Australia	NZAC
✓		*Pseudaulacaspis eugeniae* (Maskell, 1892)	Polyphagous	1922	Australia	Green (1929)
		Pseudoparlatoria parlatorioides (Comstock, 1883)	Orchids, begonia	1962	?New World	Ward (1968)
		Trullifiorinia acaciae (Maskell, 1892)	Acacias	1922	Australia	NZAC

Table 2 Exotic Diaspididae erroneously recorded by F, Fernald 1903; M, McGillivray 1921; B, Borchsenius 1966; W, Wise 1977; and N, Nakahara 1982, with page numbers, and now recognised as **not** present in New Zealand.

Species	F	M	B	W	N	Primary reference
Aspidiotus destructor (Signoret, 1869)	–	–	270	113	–	Maskell 1892, p. 12; 1897, p. 297
Ischnaspis longirostris (Signoret, 1882)	318	–	78	109	–	Maskell 1894, p. 52
Lepidosaphes flava (Targioni Tozzetti, 1868)	309	–	54	107	–	Maskell 1894, p. 47; 1898, p. 230
Parlatoria pergandii Comstock, 1881	321	–	196	111	–	Henderson 2000, p. 51
Parlatoria ziziphi (Lucas, 1853)	–	–	199	111	–	Henderson 2000, p. 51
Pinnaspis strachani (Cooley, 1899)	–	–	–	–	71	Williams & Watson 1988, p. 212; Ferris & Rao 1947, p. 36
Pseudaulacaspis pentagona (Targioni Tozzetti, 1886)	234	315	176	110	–	Maskell 1887, p. 214; 1894, p. 45, 49
Unaspis citri (Comstock, 1883)	214	359	106	109	–	Maskell 1884, p. 23; 1887, p. 54; 1892, p. 211

Erroneous records from New Zealand

Eight species have been erroneously published as present in New Zealand (Table 2). During the 20 years from 1879, Maskell recorded and described many species of Diaspididae from New Zealand and around the world (Deitz & Tocker 1980), predominantly in the *Transactions and Proceedings of the New Zealand Institute*. Many of the errors stem from this period. When Fernald (1903) wrote her catalogue in the United States she mistakenly assumed from the *Transactions and Proceedings of the New Zealand Institute* journal title, that Maskell's papers always referred to New Zealand records, whereas Maskell often described, or referred to, scale insects sent to him by colleagues in other countries. Borschenius (1966) repeated those citations in his major catalogue of the Diaspididae. In fact, the species in Table 2 were either never recorded from New Zealand, or were recorded as border interceptions that have never established.

The history of Diaspididae establishment in New Zealand

As female Diaspididae are sedentary and flightless, it is reasonable to assume that all of the exotic species arrived in New Zealand on plant nursery stock or fruit, starting with European colonisation. Six species had established by the time Maskell described the first New Zealand scale insects in 1879 and the remaining 22 species appear to have established at more or less regular intervals over the next 120 years, at a rate of about 1 species every 6–7 years (Fig. 1). Species from different geographical regions have arrived equally throughout this period (Table 1). The recent discovery of *Lepidosaphes pallida* in Auckland was the first new species recorded for almost 30 years, although it might have been present for some time.

New Zealand species elsewhere in the world

While 28 species of exotic Diaspididae have become part of the local fauna in the course of modern history, far fewer New Zealand native armoured scale insects have established elsewhere in the world, and none appears to be regarded as a pest. *Leucaspis portaeaureae* Ferris is considered native to New Zealand but has established on *Podocarpus* in California, United States (Gill 1997), while *Eulepidosaphes pyriformis* (Maskell, 1879) and

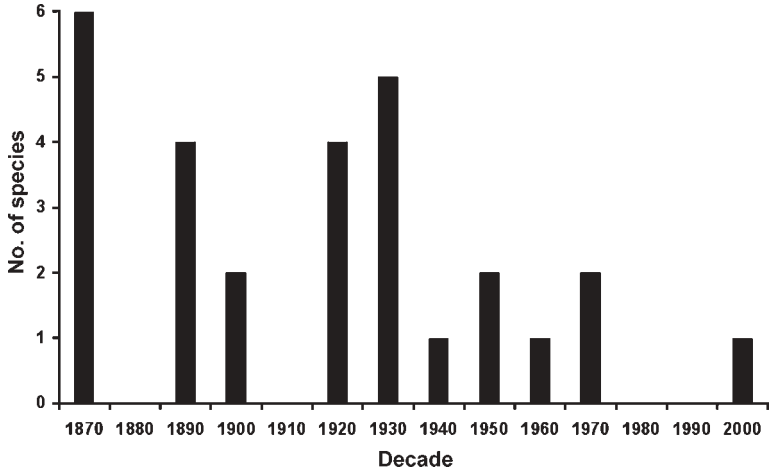

Fig. 1 Recorded arrival in New Zealand of exotic Diaspididae, by decade, 1870–2002.

Leucaspis podocarpi (Green, 1929) are both established in the Scilly Isles, United Kingdom (Williams 1985), and *Labidaspis myersi* (Green, 1929) is recorded from New Caledonia (specimens in BMNH, London). Wise (1977) recorded that *Pseudaulacaspis* (as *Phenacaspis*) *dubia* (Maskell) was present in both New Zealand and Fiji. However, it is now known that while *P. dubia* is native to New Zealand, the Fiji species is not the same as the New Zealand *P. dubia* (Williams & Watson 1988). Further research is needed to determine the identity/origin of the Fijian species.

Quarantine regulations and exotic Diaspididae

Early entomologists such as Maskell frequently observed live scale insects on imported fruit and plants, and The Orchard and Gardens Pest Act 1903 was passed "to prevent the Introduction to New Zealand of Diseases affecting Orchards and Gardens, and to provide for the eradication of such diseases, and to prevent the spread thereof". This Act gave powers to inspectors to "prohibit absolutely the introduction of any plant, fruit, fungus, parasite, insect or any other thing likely to introduce any disease into New Zealand". The term "diseases" included insects, and San José scale (*Diaspidiotus perniciosus*) was prominent in the schedule of pests which were to be kept out by all possible means (Thomson 1922). In principle this Act had much the same intent as today's Biosecurity Act 1996, but it suffered from some of the same problems, such as relying on others for the eradication or management of existing insects. A case in point was the apple mussel scale, *Lepidosaphes ulmi*, which became the responsibility of district authorities. The legislation was consolidated in 1908 (the Orchards and Gardens Diseases Act) such that by 1922 "there is pretty close inspection at all ports of entry of seeds, fruits etc., and few deleterious things pass the inspectors" (Thomson 1922). The Orchards and Gardens Diseases Act was amended several times over the next 50 years, taking into account, *inter alia*, the arrival of aircraft as a means of international transport, before being superseded by the Plants Act 1970 and then the Biosecurity Act 1996. Many scale insects were intercepted at the border during this period, perhaps none of which has been as well documented as *Hemiberlesia lataniae*, which was intercepted more than 100 times between 1951 and 1987 (Morales 1988). Some of these records were from "open" post-entry quarantine facilities and nurseries. It seems likely that establishment of *H. lataniae* in New Zealand resulted from these early populations, but was facilitated by the rapid expansion of commercial, subtropical fruit growing and demand for plants (Morales 1988). No new

exotic pest Diaspididae has established in New Zealand since *H. lataniae*, possibly reflecting improved post-entry plant quarantine measures since then. *L. pallida* is considered a pest elsewhere, but not yet in New Zealand.

During the past 150 years New Zealanders have deliberately or accidentally imported, or allowed to establish, about 25 000 species of exotic plants (Taylor & Smith 1997). Many of these were presumably imported as living plants (rather than as seeds) and hence were potential hosts for Diaspididae. The means and speed of international trade and travel has changed dramatically and increased hugely in volume over the past 100 years. Yet, although nearly 500 of the world's 2000 Diaspididae species may be "pests" (Miller & Davidson 1990), only 28 have established in New Zealand, and only about half of these may be considered "pests" (Table 1). They have established despite legislation, regulations, border inspections, and continuing improvements in quarantine facilities and knowledge of entomology. Nonetheless, it seems reasonable to suggest that New Zealand's small exotic fauna should be regarded as a measure more of the long-term success of official quarantine policy than of its failure.

Diaspididae as economic and environmental pests in New Zealand

Some of the exotic (but not the native) armoured scale insects are important pests in New Zealand, particularly of tree crops and some woody shrubs, while others are rare or rarely seen (Maskell 1887; Charles 1998; Table 1). The pest species have had their greatest economic impact on fruit crops, where damage to trees and vines, or fruit disfiguration, may cause direct economic losses. Most plants tolerate quite high numbers of scale insects on leaves or wood, but increasing populations often eventually cause die-back of individual branches or tree death. Compared with other Coccoidea, the extent of damage caused by Diaspididae infestations often appears out of proportion to the size of the populations. The reasons for such severe fruit and tree symptoms are not understood, but probably result from the unusual feeding and digestion system in these insects. As there is no direct connection between the stomach and hind intestine they do not produce honeydew. Instead, it is presumed that excess food is re-injected into the plant with salivary fluids, possibly with toxic effect. Any fluid that is excreted from the anus appears to interact with the fibres secreted from the pygidial glands to form the armoured scale cover (Banks 1990).

Ecological studies on Diaspididae in New Zealand have been carried out almost exclusively as part of modern pest control programmes, especially against *L. ulmi*, *D. perniciosus*, and *D. ostreaeformis* in temperate pip and stone fruit crops, and *Aspidiotus nerii*, *H. rapax*, and *H. lataniae* in subtropical crops such as kiwifruit and avocado. These are polyphagous species, some of which are now occasionally found on native plants in isolated patches of native bush, raising concerns of the threat that exotic Diaspididae may pose to the environment. In fact, polyphagy (defined as feeding on several plant families) is the most common feeding strategy in the Diaspididae, followed by monophagy (defined as feeding on a single genus of plants) (McClure 1990). Extreme monophagy (restriction to a single host species) is rare, but some species are oligophagous (feeding on only a few genera). The exotic species in New Zealand show almost the full range of host specificity exhibited by the family, and the highly polyphagous species, such as *A. nerii*, *H. rapax*, and *Lindingaspis rossi*, each of which is known to feed on hundreds of plant species from many families, are the ones most likely to invade native habitats and attack native plants. Intriguingly, though, other polyphagous species, such as *D. perniciosus* and *Lepidosaphes ulmi*, remain known only from exotic plants. Other species are as oligophagous as in their country of origin and are restricted to predictable exotic hosts in modified landscapes. Thus, *C. juniperi* is known only from conifers and *K. pseudoleucaspis* only from bamboo.

Many Diaspididae exhibit extreme phenotypic plasticity, which can frustrate both taxonomic and ecological research. Different species have been described for polymorphic individuals of the same species that have developed on different plants, under different temperatures, or even on different parts of the same plant. In addition, a species may have uniparental (parthenogenetic) or biparental (bisexual) populations, or both, either in sympatry or in allopatry. There is no clear understanding of the forces behind these individual or population variables, nor how to interpret the results from a systematic viewpoint (Gerson 1990), but such developmental flexibility might well help a species adapt to new environments and hosts. Most of the exotic species in New Zealand are biparental, but some of the most polyphagous and serious pest species (including *A. nerii*, *D. ostreaeformis*, *L. ulmi*, *H. rapax*, and *H. lataniae*) may be, or are completely, uniparental.

A consequence of these life-history variables is that the different population densities (and presumed reproductive capacities) of species observed on different host plants, or between neighbouring trees of the same species, is often unexplained. Also unexplained are the relative pest status and temporal changes in pest status of some species. For example, why is *L. beckii* such a cosmopolitan pest elsewhere, but not in New Zealand? Why has the pest status of *Lindingaspis rossi* apparently declined in New Zealand over the past 100 years? Why did the pest status of *Lepidosaphes ulmi* and *D. perniciosus* change over time? Why is *D. perniciosus* displaced by *D. ostreaeformis* in southern latitudes? Whether these changes reflect simple interspecific competition, climatic changes, more complex biotic and/or abiotic interactions, or some combination of these, has not been investigated.

While the basic biology of the key pest species in New Zealand is known, there is almost a total lack of data for most of the exotic species, even taking into account what is known from overseas research. While the pest status of economically important hosts is rapidly identified through market forces, integrated studies of the taxonomy and developmental biology of exotic Diaspididae on exotic and native hosts may be required to determine the real threats that they pose to the environment.

Of international concern is that some Diaspididae, monophagous in their country of origin, have become polyphagous when transported to new environments and exposed to new species or assemblages of host plants. None of the exotic species in New Zealand has so far shown this trait, but the possibility underlines why all exotic Diaspididae should be considered potentially serious pests, regardless of their status elsewhere in the world, and why they are likely to remain significant quarantine pests in the future.

Pest control of Diaspididae

Armoured scale insect pests have always been difficult to control, and it is sobering to realise that the pest-control techniques of today remain much the same as 100 years ago. By 1887, various combinations of kerosene, oil, and soap sprays were thought to give the best results (Maskell 1887), while fumigation by hydrogen cyanide gas was becoming more common by 1900 (e.g., Theobald 1899). Today, oil sprays remain a key to successful control of all pest Diaspididae, at least in fruit crops. While the use of synthetic insecticides has decreased to very low levels, there may still be considerable reliance on them to achieve export quality fruit.

The potential for biological control of Diaspididae has been recognised for more than 100 years (Maskell 1887). Some exotic natural enemies were undoubtedly imported accidentally into New Zealand with their hosts while others were deliberately introduced (Hill 1989; Charles et al. 1995). There remain many more candidates for importation with the potential to substantially improve control of the existing exotic fauna. Regardless of whether future programmes to control pest Diaspididae continue to rely on pesticides or natural enemies, a

significant improvement in our knowledge of their applied ecology will be required for success. Comparative studies of the developmental ecology on different hosts, and mortality through natural enemies in both modified and native habitats will provide vital information on these fascinating insects.

ANNOTATED LIST OF EXOTIC SPECIES OF DIASPIDIDAE IN NEW ZEALAND

The original name, author, and reference to the first publication of the name and description is given for each current species, followed by a list of selected synonyms derived from names used in the New Zealand literature at various times. Each synonym is followed immediately by the author of that synonymy or change of combination, and subsequent author citations on the same line refer to New Zealand records and relevant catalogue entries.

Aonidiella aurantii (Maskell)

Aspidiotus aurantii Maskell, 1879: 199.
Aspidiotus coccineus Gennadius, 1881: 189; Maskell 1884, p. 120; 1887, p. 42; Kirk & Cockayne 1909, p. 276.
Chrysomphalus aurantii (Maskell), Cockerell, 1899: 396; Myers 1922, p. 201.
Aonidiella aurantii (Maskell), Berlese, 1895: 83; Fernald 1903, p. 288; Borchsenius 1966, p. 292.

GLOBAL DISTRIBUTION: Occurs in most citrus growing areas of the world, probably originating from Asia.

FIRST RECORD IN NEW ZEALAND: 1878 (Maskell 1879, 1892).

NEW ZEALAND DISTRIBUTION: North Island and north of South Island, wherever *Citrus* is grown.

HOST PLANTS: Polyphagous. Prefers *Citrus* or ornamental, evergreen shrubs.

LIFE CYCLE IN NEW ZEALAND: Biparental with (probably) 3–4 overlapping generations a year (Cottier 1956).

COMMON NAME: California red scale.

COMMENTS: California red scale in New Zealand probably originated from infested oranges and lemons imported from Sydney. It attacks leaves, fruit, and wood and can cause leaf discoloration, fruit distortion and premature fruit drop, and branch die-back. It seems to prefer exposed rather than shaded positions on trees, and populations are often higher on unhealthy trees. It is common in the warmer parts of the North Island, but is usually only a minor pest in well managed orchards.

Aspidiotus nerii Bouché

Chermes hederae Vallot, 1829: 30; Ben-Dov & Matile-Ferrero 1999 (*nomen dubium*, erroneous attribution).
Aspidiotus nerii Bouché, 1833: 52; Maskell 1882, p. 217; 1887, p. 44; Borchsenius 1966, p. 261; Wise 1977, p. 112.
Aspidiotus epidendri Bouché, 1844: 293; Maskell 1879, p. 197; 1887, p. 44.
Aspidiotus budleiae Signoret, 1869a: 115; Maskell 1879, p. 198; 1887, p. 40; 1895, p. 2.
Aspidiotus atherospermae Maskell, 1879: 198; Borchsenius 1966, p. 264 (synonymy); Deitz & Tocker 1980, p. 33.
Aspidiotus dysoxyli Maskell, 1879: 198; Deitz & Tocker 1980, p. 36; Henderson 2001, p. 89 (synonymy).

Aspidiotus sophorae Maskell, 1884: 121; Borchsenius 1966, p. 264 (synonymy); Deitz & Tocker 1980, p. 42.
Aspidiotus carpodeti Maskell, 1885: 21; 1887, p. 41; Lidgett 1902, p. 44; Borchsenius 1966, p. 264 (synonymy); Deitz & Tocker 1980, p. 34.
Aspidiotus hederae (Vallot); Fernald 1903, p. 260; Ward 1968, p. 50 (for *A. nerii*).

GLOBAL DISTRIBUTION: Cosmopolitan, possibly originating from Mediterranean countries.

FIRST RECORD IN NEW ZEALAND: 1879 (Maskell 1879).

NEW ZEALAND DISTRIBUTION: Throughout the North and South Islands.

HOST PLANTS: Extremely polyphagous, known from c. 300 plant species worldwide.

LIFE CYCLE IN NEW ZEALAND: Mostly uniparental (parthenogenetic) with two major overlapping generations a year (Tomkins et al. 1992). Biparental populations are occasionally found (Maskell 1887; NZAC).

COMMON NAME: oleander scale.

COMMENTS: Ben-Dov & Matile-Ferrero (1999) showed that Vallot (1829) did not publish the name *Chermes hederae* or a description of oleander scale, so that subsequent usage of the combination *Aspidiotus hederae* (Vallot), e.g., in Fernald's (1903) catalogue, was erroneous. Oleander scale is a significant pest of kiwifruit, other fruit crops, and indoor and outdoor ornamental plants. It may be found on the trunk, branches, leaves, or fruits of host plants. Even in the 19th century it showed a propensity to invade native bush, where it attacked a wide range of native plants such as *Coprosma* spp., *Corynocarpus laevigatus* (karaka), and *Sophora tetraptera* (kowhai) (Maskell 1887). Specimens lodged in the NZAC and FRNZ have been recorded from 19 species of native plants in 16 families:
Apocynaceae: *Parsonsia* sp. Araliaceae: *Pseudopanax arboreus*, *P. ferox*. Arecaceae: *Rhopalostylis sapida*. Asteraceae: *Brachyglottis repanda*, *Olearia furfuracea*. Corynocarpaceae: *Corynocarpus laevigatus*. Loganiaceae: *Geniostoma* sp. Lomandraceae: *Cordyline australis*. Malvaceae: *Plagianthus divaricatus*. Meliaceae: *Dysoxylum spectabile*. Monimiaceae: *Laurelia novae-zelandiae*. Myoporaceae: *Myoporum laetum*. Pittosporaceae: *Pittosporum* sp. Ripogonaceae: *Ripogonum scandens*. Rubiaceae: *Coprosma grandifolia*, *C. robusta*. Sapindaceae: *Dodonaea viscosa*. Sapotaceae: *Pouteria costata*.

Aulacaspis rosae (Bouché)

Aspidiotus rosae Bouché, 1833: 53; 1834, p. 14.
Diaspis rosae (Bouché), Signoret, 1869b: 441; Maskell 1879, p. 201; 1887, p. 47.
Aulacaspis rosae (Bouché), Cockerell, 1896: 259; Fernald 1903, p. 236; Borchsenius 1966, p. 139.

GLOBAL DISTRIBUTION: Cosmopolitan, possibly from Europe.

FIRST RECORD IN NEW ZEALAND: 1891 (NZAC; the later of two Maskell slides labelled *Diaspis rosae*, remounted and identification confirmed (RCH)).

NEW ZEALAND DISTRIBUTION: Throughout New Zealand.

HOST PLANTS: *Rosa* spp., *Rubus* spp.

LIFE CYCLE IN NEW ZEALAND: Unknown but biparental. Probably 1–3 generations a year in different parts of the country.

COMMON NAME: rose scale.

COMMENTS: Established in New Zealand from Europe. It is found on leaves and wood or canes of its rosaceous hosts, where it may build up to large numbers and weaken the plant or cause die-back.

Aulacaspis rosarum Borchsenius

Aulacaspis rosarum Borchsenius, 1958: 165; Williams & Watson 1988, p. 72.
Aulacaspis thoracica (Robinson 1917: 22), Tang 1986, p. 215; Danzig & Pellizzari 1998, p. 200 (incorrect synonymy).

GLOBAL DISTRIBUTION: Described from China and known from SE Asia and the South Pacific (Williams & Watson 1988).

FIRST RECORD IN NEW ZEALAND: 1877 (the earlier of two Maskell slides in NZAC labelled *Diaspis rosae* from rose, re-identified as *A. rosarum* by L. L. Deitz (Archibald et al. 1979)).

NEW ZEALAND DISTRIBUTION: North and South Islands.

HOST PLANTS: *Rosa* spp. and *Rubus* spp.

LIFE CYCLE IN NEW ZEALAND: Unknown but biparental.

COMMON NAME: Asiatic rose scale.

COMMENTS: Both *A. rosarum* and *A. rosae* are represented in the NZAC, among slides originally labelled as *A. rosae*. The earliest NZAC record of *A. rosarum* is a Maskell slide dated 1877, with no provenance, but as pointed out by Archibald et al. (1979), these may be the specimens Maskell (1879) recorded from Governors Bay, Christchurch. The next two records in NZAC are 1939 from Tauranga and 1940 from Auckland on rose. Beardsley (1975) reported that all the specimens in Hawaii had been re-identified as *A. rosarum* and that New Zealand was among countries where it occurred. It seems likely that *A. rosarum* has been in New Zealand since early European colonisation. The most recent NZAC specimens indicate that Asiatic rose scale may now be more common in New Zealand than rose scale.

Carulaspis juniperi (Bouché)

Aspidiotus juniperi Bouché, 1851: 112.
Diaspis juniperi (Bouché), Signoret, 1869b: 437.
Carulaspis visci (Schrank, 1781); Helson 1952, p. 27; Deitz 1979, p. 459 (misidentification).
Carulaspis juniperi (Bouché), Boratynski, 1957: 249; Borchsenius 1966, p. 161.

GLOBAL DISTRIBUTION: Europe (native), Africa, North and South America.

FIRST RECORD IN NEW ZEALAND: 1942 (Deitz 1979).

NEW ZEALAND DISTRIBUTION: North and South Islands.

HOST PLANTS: On leaves and fruit of many conifer species in Cupressaceae, Pinaceae, and Taxodiaceae (Zahradnik 1990). In New Zealand, *Juniperus* sp., *Cupressus* spp., *Cryptomeria japonica*, and *Sequoiadendron giganteum* (Deitz 1979).

LIFE CYCLE IN NEW ZEALAND: Biparental and probably univoltine.

COMMON NAME: juniper scale.

COMMENTS: Juniper scale causes leaf chlorosis and sometimes kills branches in the United States (Gill 1997). It is commonly found on exotic gymnosperms in the South Island, but does little serious damage.

Chionaspis angusta Green

Here reinstated.
Chionaspis angusta Green, 1904: 67.
Chionaspis candida Green, 1905: 6 **new synonymy**
Duplachionaspis candida (Green), MacGillivray, 1921: 332.
Phenacaspis candida (Green), Ferris, 1956: 68.
Phenacaspis angusta (Green); MacGillivray 1921, p. 351; Ferris 1955, p. 45; 1956, pp. 68, 73.

Examination of the type material (held in the BMNH) of *C. angusta* and *C. candida* showed them to be conspecific and both correctly placed in *Chionaspis* (RCH). Green wrote "=angusta" on his type slide of *C. candida*, but never formally published the synonymy.

GLOBAL DISTRIBUTION: Australia and New Zealand.

FIRST RECORD IN NEW ZEALAND: 1890 (NZAC; Maskell 1891, p. 8 as *Chionaspis dubia* small form (misidentification)).

NEW ZEALAND DISTRIBUTION: Auckland, East Cape, Palmerston North, Nelson, Canterbury, Wanaka, and Dunedin.

HOST PLANTS: *Callistemon* spp. (Australia and New Zealand), *Kunzea ericoides*, *Leptospermum* spp. (Australia and New Zealand) (Myrtaceae).

LIFE CYCLE IN NEW ZEALAND: Biparental in Australia, probably univoltine.

COMMON NAME: none.

COMMENTS: It is uncertain whether this species is native to both Australia and New Zealand or if the New Zealand population is from successive introductions over a considerable time. Within New Zealand forests all records are from *Kunzea ericoides*, a native tree, whereas the records from *Callistemon* are within urban gardens in Auckland and Dunedin.

Diaspidiotus ostreaeformis (Curtis)

Aspidiotus ostreaeformis Curtis, 1843: 805; Fernald 1903, p. 268.
Quadraspidiotus ostreaeformis (Curtis), MacGillivray, 1921: 410; Borchsenius 1966, p. 334; Helson 1952, p. 5; Richards 1960, p. 693; 1962, p. 95.
Diaspidiotus ostreaeformis (Curtis), Danzig, 1980: 403; 1993, p. 182.

GLOBAL DISTRIBUTION: Cosmopolitan from the Palaearctic.

FIRST RECORD IN NEW ZEALAND: 1939 (NZAC) (Richards 1960).

NEW ZEALAND DISTRIBUTION: South Island.

HOST PLANTS: Polyphagous.

LIFE CYCLE IN NEW ZEALAND: Biparental and univoltine (McLaren 1989), with crawler release from mid December–April in Central Otago.

COMMON NAME: oystershell scale (in New Zealand).

COMMENTS: We have accepted Danzig's (1980) new combination, but recognise that both this species and San José scale are commonly placed in the genus *Quadraspidiotus*, especially by agricultural researchers. Oystershell scale was reportedly "present in New Zealand for the first time" by Richards (1960), but it had been previously recorded by Helson (1952), and specimens in NZAC date from 1939. Oystershell scale gradually replaces San José scale in the South Island south of Nelson and Marlborough (Emms & McLaren 1984). It is a significant and increasing pest of pip and stone fruits, especially as orchardists move away from broad-spectrum insecticides and towards more sustainable production systems. There is no effective chemical control for oystershell scale under organic management systems, but population growth may be curtailed to some extent by parasitoids, as it is elsewhere (e.g., Kozar 1990).

Diaspidiotus perniciosus (Comstock)

Aspidiotus perniciosus Comstock, 1881: 304; Kirk & Cockayne 1909, p. 276.
Quadraspidiotus perniciosus (Comstock); Ferris 1938, p. 259; Helson 1952, p. 4; Cottier 1956, p. 317; Borchsenius 1966, p. 336; Richards 1960, p. 693.

Diaspidiotus perniciosus (Comstock), Danzig, 1980: 405; 1993, p. 191.
GLOBAL DISTRIBUTION: Cosmopolitan from the eastern Palaearctic.
FIRST RECORD IN NEW ZEALAND: 1908 (Kirk & Cockayne 1909).
NEW ZEALAND DISTRIBUTION: Throughout New Zealand, becoming less common in the South Island where it overlaps with, and is gradually replaced by, *D. ostreaeformis* (Emms & McLaren 1984).

HOST PLANTS: Polyphagous, but prefers deciduous fruit and nut trees in the Rosaceae.

LIFE CYCLE IN NEW ZEALAND: Biparental with 2–3.5 overlapping generations a year (Collyer & van Geldermalsen 1975; Wearing 1989).

COMMON NAME: San José scale.

COMMENTS: The first serious damage by San José scale was recorded on apples in Nelson in 1908 (Kirk & Cockayne 1909), and by 1909 it was recognised from "isolated locations in other parts of both islands" (Thomson 1922). It has been the most significant scale insect pest of pipfruit from at least 1959 (Richards 1960). It is found predominantly on wood, but large populations may lead to fruit infestation (as does oystershell scale). Feeding on both wood and fruit causes discoloration of the plant tissue around the stylets, and, eventually, tree death. San José scale is likely to become an even more serious pest of fruit crops in the future, for the same reasons as oystershell scale.

Diaspis boisduvalii Signoret

Diaspis boisduvalii Signoret, 1869b: 432; Maskell 1879, p. 200; Ward 1968, p. 50.

GLOBAL DISTRIBUTION: Cosmopolitan, probably New World origin (Gill 1997).

FIRST RECORD IN NEW ZEALAND: 1879 (Maskell 1879).

NEW ZEALAND DISTRIBUTION: Auckland, Tauranga, Hastings, Levin (Ward 1968).

HOST PLANTS: Polyphagous, but prefers orchids, especially *Cymbidium* and *Cattleya*. Also found on palms and wattle.

LIFE CYCLE IN NEW ZEALAND: Unknown, but biparental. Multivoltine in the United States.

COMMON NAME: Boisduval's scale.

COMMENTS: Boisduval's scale was an early pest of hothouse plants (Maskell 1879) and remains an occasional pest. It is found mainly on leaves, but also on pseudobulbs of orchids, and the bark of acacia (Miller 1925). Low numbers discolour orchids, and high numbers may kill them (Gill 1997).

Hemiberlesia cyanophylli (Signoret)

Aspidiotus cyanophylli Signoret 1869a: 119.
Hemiberlesia cyanophylli (Signoret), Ferris, 1938: 237; Danzig 1993, p. 170.
Abgrallaspis cyanophylli (Signoret), Balachowsky, 1948: 306; Manson 1968, p. 46; Gill 1997, p. 33.

GLOBAL DISTRIBUTION: Tropicopolitan and in glasshouses elsewhere, possibly from the New World.

FIRST RECORD IN NEW ZEALAND: 1934 (NZAC; Manson 1968).

NEW ZEALAND DISTRIBUTION: Auckland, Levin, and Nelson.

HOST PLANTS: Generally polyphagous; on cactus and a palm in New Zealand.

LIFE CYCLE IN NEW ZEALAND: Unknown. Biparental elsewhere.

COMMON NAME: cyanophyllum scale.

COMMENTS: Cyanophyllum scale has not universally been adopted as a *Hemiberlesia* species, and may be reverted to *Abgrallaspis*. It has damaged *Psidium guajava* in Fiji, and tea in Papua New Guinea, where a severe infestation caused leaf chlorosis (Williams & Watson 1988).

Hemiberlesia lataniae (Signoret)

Aspidiotus lataniae Signoret, 1869a: 124.
Aspidiotus cydoniae var. *tecta* Maskell, 1897b: 240; Maskell 1898, p. 224 (Hawaii); Borchsenius 1966, p. 306.
Hemiberlesia lataniae (Signoret), Cockerell, 1905: 202; Danzig 1993, p. 174.

GLOBAL DISTRIBUTION: Cosmopolitan.

FIRST RECORD IN NEW ZEALAND: 1979 (Morales 1988).

NEW ZEALAND DISTRIBUTION: North Island.

HOST PLANTS: Polyphagous.

LIFE CYCLE IN NEW ZEALAND: Uniparental with two overlapping generations a year.

COMMON NAME: latania scale.

COMMENTS: Latania scale was regularly intercepted by quarantine officials on imported plants from at least 1951. It has now established widely through the North Island and is found on a wide variety of fruit crops on wood, leaves, and fruits. It is likely to be an increasing pest of fruit crops such as kiwifruit, avocado, and mandarins. It was first recorded on native plants in unmodified forests in 1998. Native hosts recorded to date in NZAC (5 species in 5 families) are:
Asteraceae: *Ozothamnus leptophyllus*. Escalloniaceae: *Carpodetus serratus*. Podocarpaceae: *Dacrycarpus dacrydioides*. Rosaceae: *Rubus australis*. Tiliaceae: *Entelea arborescens*.

Hemiberlesia rapax (Comstock)

Aspidiotus camelliae Signoret, 1869b: 117 (not Boisduval, 1867); Comstock 1883, pp. 56, 67; Maskell 1879, p. 200; Fernald 1903, p. 276 (preoccupied).
Aspidiotus rapax Comstock, 1881: 307; Maskell 1891, p. 3; Fernald 1903, p. 276.
Diaspis santali Maskell, 1884: 122; 1885, p. 23; 1890, p. 135; Myers 1922, p. 201 (synonymy, as *Aspidiotus rapax*).
Hemiberlesia camelliae (Signoret), MacGillivray, 1921: 435.
Aspidiotus (*Hemiberlesia*) *camelliae* (Signoret), Green, 1929: 377.
Hemiberlesia rapax (Comstock), Ferris, 1938: SII–244; Danzig, 1993, p. 172.

GLOBAL DISTRIBUTION: Cosmopolitan, probably from Europe.

FIRST RECORD IN NEW ZEALAND: 1879, as *Aspidiotus camelliae* (Maskell 1879)

NEW ZEALAND DISTRIBUTION: North Island, and South Island south to Canterbury.

HOST PLANTS: Polyphagous.

LIFE CYCLE IN NEW ZEALAND: Uniparental with two major overlapping generations a year (Ferguson 1979; Tomkins et al. 1992).

COMMON NAME: greedy scale.

COMMENTS: Described by Maskell (1884) as *Diaspis santali*, a new native species from maire, *Nestegis cunninghamii* (as *Santalum cunninghamii*). A year later it was reported as a pest of pear, plum, and other fruit trees (Maskell 1885). Greedy scale is now found on the wood, leaves, and fruits of many hosts in New Zealand and is a significant pest of subtropical

fruit crops in the North Island. It is widespread on native plants, with NZAC specimens from 42 species in 30 families:
Araliaceae: *Pseudopanax laetus*, *Schefflera digitata*. Asteraceae: *Brachyglottis repanda*, *Olearia ranii*, *O. solandri*. Cornaceae: *Corokia cotoneaster*. Corynocarpaceae: *Corynocarpus laevigatus*. Cunoniaceae: *Weinmannia silvicola*. Fabaceae: *Carmichaelia australis*, *Sophora* sp. Griseliniaceae: *Griselinia littoralis*. Lauraceae: *Beilschmiedia tawa*. Lomandraceae: *Cordyline* sp. Loranthaceae: *Tupeia antarctica*. Malvaceae: *Plagianthus divaricatus*, *Plagianthus* sp. Monimiaceae: *Laurelia novae-zelandiae*. Moraceae: *Streblus smithii*. Myoporaceae: *Myoporum laetum*. Myrtaceae: *Leptospermum* sp., *Lophomyrtus bullata*, *L. obcordata*, *Metrosideros fulgens*, *Syzygium maire*. Oleaceae: *Nestegis lanceolata*, *N. montana*. Pittosporaceae: *Pittosporum* sp. Onagraceae: *Fuchsia excorticata*. Podocarpaceae: *Prumnopitys taxifolia*. Piperaceae: *Macropiper excelsum*. Protaceae: *Knightia excelsa*. Rhamnaceae: *Pomaderris phylicifolia*. Ripogonaceae: *Ripogonum scandens*. Rubiaceae: *Coprosma propinqua*, *C. robusta*, *C. rotundifolia*, *Nertera depressa*. Rutaceae: *Leionema nudum*. Santalaceae: *Mida salicifolia*. Sapindaceae: *Alectryon excelsus*, *Dodonaea viscosa*. Sapotaceae: *Pouteria costata*. Solanaceae: *Solanum aviculare*. Verbenaceae: *Vitex lucens*.

Kuwanaspis pseudoleucaspis (Kuwana)

Leucaspis bambusae Kuwana, 1902: 74; Fernald 1903, p. 244; Borchsenius 1966, p. 91.
Chionaspis pseudoleucaspis Kuwana, 1923: 323 (replacement name); Takagi 1985, p. 48.
Tsukushiaspis pseudoleucaspis (Kuwana), Kuwana 1928: 31.
Kuwanaspis pseudoleucaspis (Kuwana), Lindinger, 1935: 139; Ferris 1941, p. SIII–288; Dekle 1976, p. 98; Archibald et al. 1979, p. 205; Gill 1997, p. 165.

GLOBAL DISTRIBUTION: Japan, China, Europe, United States.

FIRST RECORD IN NEW ZEALAND: 1976 (NZAC; Archibald et al. 1979, p. 205).

NEW ZEALAND DISTRIBUTION: Auckland.

HOST PLANTS: Bamboo: *Bambusa nitis*, *Phyllostachys* sp., *Pleioblastus* sp.

LIFE CYCLE IN NEW ZEALAND: Unknown. Both uniparental and biparental populations are known from elsewhere.

COMMON NAME: bamboo scale.

COMMENTS: Known in New Zealand only from Auckland. It is usually found on stems or canes, especially under bud scales at the nodes (Gill 1997). All 15 species of *Kuwanaspis* are known only from species of bamboo (Ben-Dov 1990).

Lepidosaphes beckii (Newman)

Coccus beckii Newman, 1869: 217.

Aspidiotus citricola Packard, 1869: 257.

Mytilaspis citricola (Packard); Maskell 1890, p. 135; 1895, p. 48; Thomson 1922, p. 332.

Cornuaspis beckii (Newman), Borchsenius, 1963: 1168; 1966, p. 57; Williams & Watson 1988, p. 146 (synonymy).

Lepidosaphes beckii (Newman), Fernald, 1903: 305; Myers 1922, p. 201; Danzig 1993, p. 279; Gill 1997, p. 169.

GLOBAL DISTRIBUTION: Cosmopolitan, possibly from the Oriental region.

FIRST RECORD IN NEW ZEALAND: 1895 (Maskell 1895).

NEW ZEALAND DISTRIBUTION: North Island and north of South Island.

HOST PLANTS: Prefers *Citrus*. Also ornamental evergreens such as fig, croton, grapefruit, *Banksia*, *Taxus*, etc.

LIFE CYCLE IN NEW ZEALAND: Unknown. Biparental and multivoltine elsewhere.

COMMON NAME: purple scale.

COMMENTS: *L. beckii* is found on wood, leaves, and fruit, and is usually regarded as one of the most serious pests of *Citrus* throughout the world. It is infrequently found and not considered a pest in New Zealand.

Lepidosaphes multipora (Leonardi)

Mytilaspides multipora Leonardi, 1904: 87; Green 1905, p. 6.
Lepidosaphes multipora (Leonardi), Sanders, 1906: 17; MacGillivray 1921, p. 285; Laing 1929, p. 36; Borchsenius 1966, p. 50; Thomson 1922, p. 332 (as *Lepidosaphes nullipora*, Wise 1977, p. 108).
Mytilaspis eucalypti Froggatt, 1914: 610; Froggatt 1915, p. 39 **new synonymy**.
Lepidosaphes eucalypti (Froggatt), Myers, 1922: 201; Green 1929, p. 377; Wise 1977, p. 107.
Lepidosaphes ulmi var. *novozealandica* Green, 1929: 378 **new synonymy**.
Lepidosaphes novozealandica Green, Borchsenius, 1966: 50.

Examination of the type material of the three synonymised species at the Natural History Museum, London, has shown that they are conspecific (RCH).

GLOBAL DISTRIBUTION: Australia and New Zealand.

FIRST RECORD IN NEW ZEALAND: 1904 (Leonardi 1904).

NEW ZEALAND DISTRIBUTION: Auckland, South Island.

HOST PLANTS: *Acacia* spp., apricot, *Eucalyptus* spp., *Pittosporum undulatum*, walnut.

LIFE CYCLE IN NEW ZEALAND: Biparental, probably univoltine.

COMMON NAME: eucalyptus mussel scale.

COMMENTS: Leonardi (1904) described *L. multipora* from Auckland, New Zealand, on *Pittosporum undulatum*. Froggatt (1914, 1915) described *L. eucalypti* from Mittagong, Australia, on *Eucalyptus piperita* and Green (1929) described *L. novozealandica* from Governors Bay, Christchurch, New Zealand, on apricot. The host range indicates a probable Australian origin.

Lepidosaphes pallida (Maskell)

Mytilaspis pallida var.? Maskell, 1895: 46.
Mytilaspis pallida var. *maskelli* Cockerell, 1897: 704; Borchsenius 1937, p. 77 (unjustified replacement name).
Lepidosaphes maskelli (Cockerell), Balachowsky, 1954: 87; McKenzie 1956, p. 123.
Lepidosaphes newsteadi (Šulc, 1895: 8, 19), Ferris, 1938: 146; McKenzie 1956, p. 123 (misidentification).
Insulaspis pallida (Maskell), Williams, 1969a: 60; 1969b, p. 114.
Lepidosaphes pallida (Maskell), Zimmerman, 1948: 418; Danzig 1993, p. 265.

GLOBAL DISTRIBUTION: North America, China, Japan, Hawaii.

FIRST RECORD IN NEW ZEALAND: 2001 (NZAC).

NEW ZEALAND DISTRIBUTION: Auckland.

HOST PLANTS: *Cryptomeria japonica* in New Zealand.

LIFE CYCLE IN NEW ZEALAND: Unknown.

COMMON NAME: Maskell scale.

COMMENTS: *L. pallida* was recently discovered (by RCH) at one site on the summit of Mt Albert (Auckland city), and is here recorded in New Zealand for the first time. This small scale insect had caused no noticeable damage, and it is not possible to say how long its presence had gone undetected. Elsewhere it is found on a wide range of conifers (Gill 1997).

Lepidosaphes pinnaeformis (Bouché)

Aspidiotus pinnaeformis Bouché, 1851: 111.
Mytilaspis pinnaeformis (Bouché), Signoret, 1870: 97; Maskell 1892, p. 70.
Mytilaspis machili Maskell, 1898: 230; Borchsenius 1966, p. 58.
Eucornuaspis pinnaeformis (Bouché); Borchsenius 1966, p. 58.
Lepidosaphes machili (Maskell), Takagi, 1970: 13; Dekle 1976, p. 102; Ward 1968, p. 50; Deitz & Tocker 1980, p. 39; Gill 1997, p. 174.
Lepidosaphes pinnaeformis (Bouché), Kirkaldy, 1902: 110; Fernald 1903, p. 313; Danzig 1993, p. 256.
Cornimytilis pinnaeformis; Dymock & Holder, 1996: 251 (unjustified combination, ?in error for *Eucornuaspis pinnaeformis*).

GLOBAL DISTRIBUTION: North America, Hawaii, Guyana, Australia, Russia.

FIRST RECORD IN NEW ZEALAND: 1965 (Ward 1968).

NEW ZEALAND DISTRIBUTION: North and South Islands.

HOST PLANTS: *Cymbidium* spp. (Ward 1968).

LIFE CYCLE IN NEW ZEALAND: Unknown.

COMMON NAME: cymbidium scale.

COMMENTS: All records are from "hothouse orchids" where it is found on leaves and pseudobulbs. The records in Ward (1968) are the first for establishment, despite previous interceptions on orchids from Australia, and it appears to have persisted at low numbers, at least in the North Island.

Lepidosaphes ulmi (Linnaeus)

Coccus ulmi Linnaeus, 1758: 69.
Aspidiotus pomorum Bouché, 1851: 110.
Mytilaspis pomorum (Bouché), Signoret, 1870: 98; Maskell 1879, p. 192; 1887, p. 51; Fernald 1903, p. 314.
Fiorinia grossulariae Maskell, 1884: 123 **new synonymy**.
Lepidosaphes ulmi (Linnaeus), Fernald, 1903: 314; Danzig 1993, p. 251; Gill 1997, p. 175.

The four specimens on the syntype slide of *Fiorinia grossulariae* Maskell, have been remounted and determined as misidentifications of *Lepidosaphes ulmi* (Linnaeus) (RCH).

GLOBAL DISTRIBUTION: Cosmopolitan, probably native to Eurasia.

FIRST RECORD IN NEW ZEALAND: 1879 (Maskell 1879).

NEW ZEALAND DISTRIBUTION: Throughout lowland New Zealand where pomefruits are grown.

HOST PLANTS: Polyphagous.

LIFE CYCLE IN NEW ZEALAND: Univoltine (although there may be a partial second generation in some warmer North Island locations). Both uniparental and biparental populations are present in New Zealand (Thomas 1981).

COMMON NAME: apple mussel scale (oystershell scale in United States).

COMMENTS: *L. ulmi* was already found on a wide host range of fruit trees and other exotic plants by 1879. By the early 1900s it was regarded as the most common scale insect species in New Zealand orchards, and a much more serious pest of all kinds of deciduous fruits than the then recently introduced San José scale (Kirk & Cockayne 1909). It is found predominantly on wood, but may move to fruits if populations are large.

Leucaspis cordylinidis Maskell

Leucaspis cordylinidis Maskell, 1893: 209; Myers 1922 (in part, in error as *Mytilaspis cordylinidis*), p. 200; Green 1929, p. 383; Brittin 1937, p. 293; Wise 1977, p. 111; Deitz & Tocker 1980, p. 35.

GLOBAL DISTRIBUTION: Australia and New Zealand.

FIRST RECORD IN NEW ZEALAND: Recorded only once, in 1921.

NEW ZEALAND DISTRIBUTION: Auckland.

HOST PLANTS: palm tree.

LIFE CYCLE IN NEW ZEALAND: Unknown.

COMMON NAME: None.

COMMENTS: Described by Maskell (1893) from Australia, and recorded once in New Zealand from a palm tree in Auckland in 1921 by Myers (Green 1929). Other collections in New Zealand (NZAC) are misidentifications, including that described by Brittin in 1937. This species may or may not still be present in New Zealand.

Lindingaspis rossi (Maskell)

Aspidiotus rossi Maskell, 1891: 3; 1892, p. 11; 1897a, p. 296.
Chrysomphalus rossi (Maskell), Fernald, 1903: 293.
Aspidiotus (*Chrysomphalus*) *rossi* (Maskell), Green, 1929: 377.
Lindingaspis rossi (Maskell), Ferris, 1938: 246; Borchsenius 1966, p. 344; Takagi 1970, p. 138; Deitz & Tocker 1980, p. 42.

GLOBAL DISTRIBUTION: Almost cosmopolitan in tropics/subtropics, probably native to Australia.

FIRST RECORD IN NEW ZEALAND: 1895 (Thomson 1922).

NEW ZEALAND DISTRIBUTION: North Island and offshore islands, and north of South Island.

HOST PLANTS: Polyphagous.

LIFE CYCLE IN NEW ZEALAND: Apparently univoltine (on *Pinus*) (Timlin 1964a).

COMMON NAME: Ross's black scale, circular black scale.

COMMENTS: First reported in New Zealand from olives in Whangarei, it was "common and very troublesome in the northern parts of New Zealand" by 1922 (Thomson 1922). In 1964, apples were contaminated by drifting larvae, blown from *Pinus radiata* shelter belt trees (Timlin 1964a). It feeds on the upper and lower surfaces of leaves and fruit. It may be a serious economic pest of *Araucaria* and California redwood in California, causing serious chlorosis and general debilitation, but is seldom found on *Araucaria* in New Zealand despite these trees being common in the North Island. Specimens in NZAC have been recorded from 17 species of native plants in 13 families:
Araliaceae: *Meryta sinclairi*, *Pseudopanax arboreus*. Arecaceae: *Rhopalostylis sapida*. Cornaceae: *Corokia* sp. Elaeocarpaceae: *Aristotelia* sp. Loganiaceae: *Geniostoma* sp. Malvaceae: *Hoheria* sp. Monimiaceae: *Laurelia novae-zelandiae*. Myrtaceae: *Leptospermum*

scoparium, *Lophomyrtus obcordata*. Protaceae: *Toronia toru*. Ripogonaceae: *Ripogonum scandens*. Rubiaceae: *Coprosma rhamnoides*, *Coprosma* sp. Rutaceae: *Leionema nudum*, *Melicope simplex*. Sapotaceae: *Pouteria costata*.

Parlatoria desolator McKenzie

Parlatoria pergandii Comstock, 1881: 327; Morrison 1939, p. 19 (doubtful record); Helson 1952, p. 5 (misidentification); Borchsenius 1966, p. 196 (doubtful record); Spiller & Wise 1982, p. 176 (misidentification).
Parlatoria camelliae Comstock, 1883: 114; McKenzie 1960, p. 206 (senior synonym of *Parlatoria virescens* Maskell); Spiller & Wise 1982, p. 176 (misidentification).
Parlatoria proteus var. *virescens* Maskell, 1897a: 300.
Parlatoria virescens Maskell, McKenzie, 1945: 75; Richards 1960, p. 694.
Parlatoria desolator McKenzie, 1960: 206; Borchsenius 1966, p. 191; Henderson 2000, p. 51.

GLOBAL DISTRIBUTION: Amoy and Hong Kong, China, New Zealand.

FIRST RECORD IN NEW ZEALAND: 1936 (Henderson 2000).

NEW ZEALAND DISTRIBUTION: Auckland and Tauranga.

HOST PLANTS: Apple, pear, plum (New Zealand); pear and "myrtle" (China) (McKenzie 1960).

LIFE CYCLE IN NEW ZEALAND: Unknown.

COMMON NAME: None.

COMMENTS: Early records and identifications in New Zealand confused *P. desolator* with either *P. pergandii*, a cosmopolitan pest, or *P. virescens* described by Maskell from China (Henderson 2000). McKenzie (1960) determined that the material from China contained two species, *P. virescens* Maskell, a junior synonym of *P. camelliae* Comstock, and a previously undescribed species, *P. desolator*, which agreed with the New Zealand specimens.

Parlatoria fulleri Morrison

Parlatoria viridis Fuller, 1897: 1344 (*nomen nudum*); Fuller 1899, p. 467; Fernald 1903, p. 322.
Parlatoria fuller Morrison, 1939: 13 (replacement name for *viridis*, preoccupied); McKenzie 1945, p. 64; Henderson 2000, p. 52.

GLOBAL DISTRIBUTION: Australia, France (Morrison 1939).

FIRST RECORD IN NEW ZEALAND: 1956 (Henderson 2000).

NEW ZEALAND DISTRIBUTION, Auckland.

HOST PLANTS: *Pinus* spp., *Eleagnus* sp., *Callistemon* spp., *Phoenix canariensis*.

LIFE CYCLE IN NEW ZEALAND: Biparental and univoltine.

COMMON NAME: None.

COMMENTS: An Australian species, known in New Zealand only from Auckland, from collections in 1956 and since 1999 (Henderson 2000).

Parlatoria pittospori Maskell

Parlatoria pittospori Maskell, 1891: 11; McKenzie 1945, p. 71; Borchsenius 1966, p. 196; Henderson 2000, p. 52.
Parlatoria myrtus Maskell, 1891: 12; Borchsenius 1966, p. 196 (synonymy).

GLOBAL DISTRIBUTION: Australia, South Africa, South America, California.

FIRST RECORD IN NEW ZEALAND: 1921 (Green 1929).

NEW ZEALAND DISTRIBUTION: North and South Islands.

HOST PLANTS: Polyphagous.

LIFE CYCLE IN NEW ZEALAND: Biparental and apparently univoltine in Nelson, although it developed much more rapidly on apple (4 months) than on *Pinus radiata* (10 months) (Timlin 1964b).

COMMON NAME: mauve pittosporum scale.

COMMENTS: In New Zealand, *P. pittospori* feeds on leaves of *Pinus radiata*. It has been a pest in Nelson and Marlborough orchards when crawlers have been blown from *P. radiata* shelter belt trees onto apple trees below. Although experimentally it can develop on apple wood, it is usually only found on fruits (Timlin 1964b).

Pinnaspis aspidistrae (Signoret)

Chionaspis aspidistrae Signoret, 1869b: 443.
Pinnaspis aspidistrae (Signoret), Lindinger, 1912: 79; Ferris & Rao 1947, p. 30; Archibald et al. 1979, p. 206; Williams & Watson 1988, p. 212; Gill 1997, p. 230.

GLOBAL DISTRIBUTION: Cosmopolitan, but *Pinnaspis* originates in the Oriental region, especially India and Ceylon (Ferris & Rao 1947).

FIRST RECORD IN NEW ZEALAND: 1935 (NZAC).

NEW ZEALAND DISTRIBUTION: Hastings, Palmerston North, Wanganui, and Nelson.

HOST PLANTS: Polyphagous but prefers ferns; three instances on ferns and one on *Eugenia myrtifolia*, in New Zealand.

LIFE CYCLE IN NEW ZEALAND: Unknown, biparental.

COMMON NAME: fern scale.

COMMENTS: Fern scale has been recorded four times in New Zealand, in 1935, 1968, 1973, and 1978, and these sporadic occurrences may have been separate introductions. The "first report" by Newstead (1900) noted by Archibald et al. (1979) was apparently in error, and was subsequently clarified (Newstead 1901, p. 189). There is no indication of its spread or of its becoming a pest here. Taxonomically, *P. aspidistrae* can be difficult to separate from *Pinnaspis strachani* (Cooley), and there has been some doubt about the identification of some of the New Zealand specimens, partly because so few have been collected. Current knowledge suggests that *P. aspidistrae* and *P. strachani* may be a species complex, or a highly variable species, or more than two species, and that sometimes a few specimens are impossible to determine using the key combinations of characters (D. R. Miller pers. comm.). None of the specimens included in New Zealand records can be assigned to *P. strachani* with complete assurance, and we conclude that the latter species is not present here.

Pseudaulacaspis brimblecombei Williams

Pseudaulacaspis brimblecombei Williams, 1973: 89.

GLOBAL DISTRIBUTION: Australia and New Zealand.

FIRST RECORD IN NEW ZEALAND: 1938 (NZAC).

NEW ZEALAND DISTRIBUTION: North and South Islands.

HOST PLANTS: *Telopea speciosissima* (waratah), *Embothrium* sp. (Chilean firebush).

LIFE CYCLE IN NEW ZEALAND: Unknown but biparental.

COMMON NAME: waratah scale (New Zealand), Macadamia white scale (Australia).

COMMENTS: *P. brimblecombei* was not separated taxonomically from *P. eugeniae* (q.v.) until 1973, when it was described from Macadamia. Early records in New Zealand of *P. eugeniae* may have been either *P. brimblecombei* or *P. eugeniae*. We have allocated the common name "waratah scale" to *P. brimblecombei* because waratah (*Telopea speciosissima*) is its most common host. *P. eugeniae*, on the other hand, has not been found on waratah. *P. brimblecombei* may be a serious pest of ornamentals. High numbers may lead to distortion and discoloration of young growth (Cottier 1956). A record on grape from a MAF (December 1994) survey cannot be validated and may be a misidentification.

Pseudaulacaspis eugeniae Maskell

Chionaspis eugeniae Maskell, 1892: 14; Green 1929, p. 382.
Chionaspis xerotidis Maskell, 1895: 50; Froggatt 1915, p. 63; Ferris 1955, p. 54 **new synonymy**
Phenacaspis xerotidis (Maskell), Fernald, 1903: 239.
Pseudaulacaspis xerotidis (Maskell), Deitz & Tocker, 1980: 44; Takagi, 1985: 50.
Phenacaspis eugeniae (Maskell), Cockerell, 1899: 398; Cottier 1956, p. 322 (misidentification).
Pseudaulacaspis eugeniae (Maskell), Deitz & Tocker, 1980: 36; Takagi 1985, p. 45.

The lectotypes and additional syntype material of *Chionaspis eugeniae* and *Chionaspis xerotidis* have been examined and they are conspecific (RCH).

GLOBAL DISTRIBUTION: Australia and New Zealand. Froggatt (1915, p. 62) gives also from China, Japan, Ceylon, and the Hawaiian Islands, but we consider the validity of these records uncertain.

FIRST RECORD IN NEW ZEALAND: 1922 (Green 1929).
NEW ZEALAND DISTRIBUTION: Mainly in the North Island. One South Island record from Invercargill.

HOST PLANTS: Polyphagous.

LIFE CYCLE IN NEW ZEALAND: Unknown but biparental.

COMMON NAME: white palm scale (waratah scale of Cottier 1956).

COMMENTS: Maskell described white palm scale from Australian specimens and it has been validated from *Eugenia elliptica* from the 1892 Maskell dry collection at NZAC. Myers collected it on a palm tree in Invercargill (associated with *A. nerii*, as *A. hederae*) (Green 1929). New Zealand records of *P. eugeniae* in NZAC are from *Agonis* sp., *Beilschmiedia tawa*, *Eugenia elliptica*, *Feijoa sellowiana*, *Ficus elastica*, *Ficus rubiginosa*, *Melaleuca* sp., and *Phoenix canariensis*.

Pseudoparlatoria parlatorioides (Comstock)

Aspidiotus parlatorioides Comstock, 1883: 64.
Pseudoparlatoria parlatorioides (Comstock), Cockerell, 1897: 383; Borchsenius 1966, p. 164; Ward 1968, p. 50; Gill 1997, p. 243.

GLOBAL DISTRIBUTION: Cosmopolitan probably from the New World.

FIRST RECORD IN NEW ZEALAND: 1962 (NZAC), 1965 (Ward 1968).

NEW ZEALAND DISTRIBUTION: Auckland, Hastings, New Plymouth.

HOST PLANTS: *Cyprepedium* sp. and *Begonia* sp. in New Zealand, polyphagous elsewhere (McKenzie 1956).

LIFE CYCLE IN NEW ZEALAND: Unknown.

COMMON NAME: false parlatoria scale.

COMMENTS: The only two specimens in NZAC are dated 1962, from an Auckland glasshouse and New Plymouth nursery. Ward's (1968) record was also from a glasshouse on *Cyprepedium* sp. leaves. These habitats are quite ephemeral, and *P. parlatorioides* may not now be present in New Zealand.

Trullifiorinia acaciae (Maskell)

Fiorinia acaciae Maskell, 1892: 16; Fernald 1903, p. 246.
Trullifiorinia acaciae (Maskell), Leonardi, 1906: 43; Borchsenius 1966, p. 148; Deitz & Tocker 1980, p. 32.

GLOBAL DISTRIBUTION: Australia and New Zealand.

FIRST RECORD IN NEW ZEALAND: 1922 (NZAC).

NEW ZEALAND DISTRIBUTION: North Island (Auckland) and South Island (Nelson).

HOST PLANTS: *Acacia* sp., *Paraserianthes lophantha* (brush wattle).

LIFE CYCLE IN NEW ZEALAND: Unknown but biparental.
COMMON NAME: None.

COMMENTS: Known only from specimens in the NZAC, collected in 1922 and 1999–2001.

SPECIES OF DIASPIDIDAE ERRONEOUSLY RECORDED FROM NEW ZEALAND

Brief synonymic lists are given for all eight species, followed by the reasons for considering them absent.

Aspidiotus destructor Signoret

Aspidiotus destructor Signoret, 1869a: 120; Maskell 1892, p. 12; 1897a, p. 297; Fernald 1903, p. 257.
Temnaspidiotus destructor (Signoret), Borchsenius, 1966: 270; Wise 1977, p. 113.

COMMON NAME: coconut scale, transparent scale.

COMMENTS: Maskell (1892, 1897a) reported *A. destructor* from the Laccadive Islands (India) and Hong Kong, not New Zealand. There are no verified records of *A. destructor* from New Zealand, which is not too surprising as this is a predominantly tropical insect. Although some host plants do grow in New Zealand, the current winter climate would probably prevent permanent establishment of this pest.

Ischnaspis longirostris (Signoret)

Ischnaspis longirostris (Signoret, 1882: 35); Fernald 1903, p. 318; Wise 1977, p. 109.
Ischnaspis filiformis Douglas, 1887: 21; Maskell 1895, p. 52; Borchsenius 1966, p. 77.

COMMON NAME: black thread scale.

COMMENTS: Maskell identified *I. longirostris* (as *I. filiformis*) from palms in a hothouse in Adelaide, South Australia, not New Zealand. There are no verified records of *I. longirostris* from New Zealand.

Lepidosaphes flava (Targioni Tozzetti)

Lepidosaphes flava (Targioni Tozzetti, 1868: 737), Borchsenius, 1966: 54; Fernald 1903, p. 308; Wise 1977, p. 107.
Mytilaspis flava var. *hawaiiensis* Maskell, 1895: 47; 1898, p. 230; Fernald 1903, p. 309; Deitz & Tocker 1980, p. 38.

COMMON NAME: De Stefan scale.

COMMENTS: Maskell's (1895, 1898) records of *L. flava* var. *hawaiiensis* were from the Sandwich Islands (Hawaii) and China, respectively, and there are no verified records from New Zealand.

Parlatoria pergandii Comstock

Parlatoria pergandii Comstock, 1881: 327; Morrison 1939, p. 11 (footnote), 19; Borchsenius 1966, p. 196; Wise 1977, p. 111; Henderson 2000, p. 51 (doubtful record + misidentification).
Parlatoria sinensis Maskell, 1897b: 241; 1898, p. 228; Morrison 1939, p. 18; Borchsenius 1966, p. 196.

COMMON NAME: chaff scale.

COMMENTS: This species was recorded by Maskell from Hong Kong on orange, and was apparently intercepted at quarantine in the United States from citrus shipped via New Zealand (Morrison 1939). All other records from New Zealand are based on misidentifications of *P. desolator* (q.v.) (Henderson 2000).

Parlatoria ziziphi (Lucas)

Parlatoria ziziphi (Lucas, 1853: 28); Maskell 1896, p. 386; 1897a, p. 301; Morrison 1939, p. 11 (footnote), 28; Borchsenius 1966, p. 199; Wise 1977, p. 111 (as *ziziphus*); Henderson 2000, p. 51 (status assessment).

COMMON NAME: black parlatoria scale.

COMMENTS: Maskell (1896) reported *P. ziziphi* from Western Australia on lemons and oranges imported from Sicily, and in 1897 received specimens from Hong Kong on orange. *P. ziziphi* was also intercepted at quarantine, United States, from citrus shipped via New Zealand (original source uncertain) (Morrison 1939, p. 11 footnote). There are no verified records of *P. ziziphi* from New Zealand (Henderson 2000).

Pinnaspis strachani (Cooley)

Hemichionaspis minor var. *strachani* Cooley, 1899: 54.
Pinnaspis strachani (Cooley), Ferris & Rao, 1947: 39; Nakahara 1982, p. 70 (erroneous distribution); Williams & Watson 1988, pp. 212, 218.

COMMON NAME: lesser snow scale.

COMMENTS: Nakahara (1982) included New Zealand in the distribution records for *P. strachani* because of early confusion surrounding the names *Chionaspis minor* Maskell and *H. minor* var. *strachani* Cooley, and which taxa they represented. Ferris & Rao (1947, p. 36) pointed out that Maskell had misidentified specimens sent to him from the West Indies by Cockerell as *C. minor*, and Cooley used this name for a short time until he nominated the subspecies *strachani*. Later workers, unaware of the error and correction, continued to use combinations of *minor* to refer to *strachani* (see Williams & Watson 1988, p. 212). The New Zealand distribution record in Nakahara (1982) is based on unverified literature records of *Pinnaspis minor* (of authors) and *H. minor* var. *strachani*. The original *C. minor* Maskell (1885) is now a junior synonym of the native *Pinnaspis dysoxyli* (Maskell) (Henderson 2001). In NZAC, Maskell's dry collection of *C. minor* contains three different species, probably because Maskell habitually added new material to his named collections if he thought they were the same. We conclude that slide-mounted specimens of *P. strachani* taken from this mixed collection are part of the misidentified material sent by Cockerell. There are no verified records of *P. strachani* in New Zealand.

Pseudaulacaspis pentagona (Targioni Tozzetti)

Pseudaulacaspis pentagona (Targioni Tozzetti, 1886: 184); Fernald 1903, p. 234.
Diaspis lanatus Cockerell, 1893: 247; Maskell 1895, p. 45 (as *lanata*).
Diaspis amygdali Tryon, 1889: 89; Maskell 1895, p. 5, 44; 1897b, p. 241.
?*Chionaspis prunicola*, Maskell, 1895: 49.

COMMON NAME: peach white scale.

COMMENTS: Maskell's specimens of *P. pentagona* were sent from Australia (as *D. lanata* (*-us*), Maskell 1894, and *D. amygdali*, Maskell 1894, 1897b), the Sandwich Islands (Hawaii) (as *C. prunicola*, Maskell 1894), and Hong Kong, Japan, Amoy, and Ceylon (as *D. amygdali*, Maskell 1887). Maskell himself (1894) noted "I have not yet heard of it on peaches in New Zealand." There are no verified records of *P. pentagona* from New Zealand.

Unaspis citri (Comstock)

Chionaspis citri Comstock, 1883: 100; Maskell 1885, p. 23; 1887, p. 54; 1893, p. 211; Thomson 1922, p. 331.
Unaspis citri (Comstock), Fernald 1903, p. 214.

COMMON NAME: citrus snow scale.

COMMENTS: Maskell (1884, 1887) reported that *U. citri* (as *C. citri*) "...occurs here sparingly on oranges imported from Sydney...", and later reported it from Tonga and Sydney (1892). Subsequent specimens in NZAC are clearly identified as intercepted at the New Zealand border. There is no evidence that it has ever established, even temporarily, in New Zealand. Thomson (1922) reported *C. citri* as "originally imported from America" and "found on species of citrus in the north of the North Island", but almost certainly referred to Californian red scale, *Aondiella aurantii* (q.v.).

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