

SCALE INSECTS AND WHITEFLIES (HEMIPTERA: COCCOIDEA AND ALEYRODOIDEA) OF BEDFORDSHIRE

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ABSTRACT

This is the first account of the scale insects and whiteflies (Hemiptera: Coccoidea and Aleyrodoidea) of Bedfordshire, based primarily on samples collected by the author and records obtained from the Royal Horticultural Society. Collection details for 34 species of scale insect (27 native and naturalised species, seven introduced species established on indoor plantings) and eight species of whitefly (six native and naturalized, two introduced species established on indoor plantings) are provided.

INTRODUCTION

National and regional checklists are essential as baseline data from which faunistic changes due to factors such as climate change and international trade can be monitored and accurately assessed. The purpose of this communication is to record the scale insects and whiteflies (Hemiptera: Coccoidea and Aleyrodoidea) found in Bedfordshire (Watsonian Vice County 30), based primarily on samples collected by the author and unpublished records obtained from the Royal Horticultural Society (RHS). The latter records are mostly based on samples submitted by RHS members to the RHS Advisory Services for identification. A small number of samples were collected by the Plant Health and Seeds Inspectorate (PHSI) of Defra during statutory plant health inspections at commercial nurseries, and a few records were received in response to an illustrated article on the scale insects of Bedfordshire posted on the Bedfordshire Natural History Society (BHNS) website in June 2009 (<http://www.bnhs.org.uk/>).

Prior to the 1990s there appear to have been no scale insects specifically recorded from Bedfordshire in the extensive and disparate literature on British Coccoidea (the main authors being J.W. Douglas who published British records between 1881–1895, R. Newstead 1889–1904, E. E. Green 1895–1934, K. L. Boratynski 1951–1982 and D. J. Williams 1962–1997. At the time of publication complete bibliographies were available online on ScaleNet, <http://www.sel.barc.usda.gov/scalenet/scalenet.htm>). Since the 1990s some brief notes on the scale insects of Bedfordshire have appeared in the newsletter of the BNHS *Muntjac* (Baker & Baker, 1991; Malumphy, 1992, 1993, 2009c, 2010b). However, only records of two species found in Bedfordshire have been published in more widely available journals: *Asterodiaspis quercicola* (Bouché) (Malumphy, 2009d) and *Physokermes hemicyrphus* (Dalman) (Malumphy, 2009a). Apart from two brief notes on whiteflies in Bedfordshire in the *Muntjac* (Malumphy, 1992, 2010b), there appears to be no specific references to whiteflies present in the county in the literature on British Aleyrodidae. Trehan (1940) and Mound (1966) reviewed the early literature of British whiteflies; recent works recording species new to Britain include Dolling & Martin (1985), Bink-Moenen (1989) and Malumphy (2003, 2005b).

Compiling the current list of the scale insects and whiteflies of Bedfordshire has been complicated by the fact that these are among the arthropod groups most commonly dispersed between countries as a consequence of international trade

(Malumphy, 2007); and non-native species of scale insect and whitefly are continually being accidentally introduced to Bedfordshire (and most other counties in Britain) on imported plant material. Scale insects are one of the most successful arthropod groups in terms of invading new geographical areas (Pellizzari & Dalla Montá, 1997; Thomas, 2004; Smith *et al.*, 2005) and many species have become cosmopolitan due to anthropogenic activities. Previous British checklists of scale insects (Boratynski & Williams, 1964) and whiteflies (Mound, 1966) have included all species found in association with imported plant material. Non-native species found only on imported produce, however, are excluded from this work as they are unlikely to survive for long and their inclusion has little scientific value. Large numbers of species of both scale insects and whiteflies have been found on imported citrus, custard apple, guava, mango and pineapple fruit in England (including Bedfordshire) and Wales by the Plant Health and Seeds Inspectorate.

METHODS

Collecting was carried out by searching visually in the field. Apical twigs and bark were also collected randomly and examined under a low power microscope in order to find cryptic scale insect species, for example *Asterodiaspis* spp. that occur on oaks and *Diaspidiotus* spp. that occur on apple, heather, oaks, pear and plum. Collecting scale insects was possible throughout the winter, as the post-reproductive adults of many species (particularly the Coccidae and Diaspididae) remain attached to the host plant long after they have died, in some cases for more than a year. Adult whiteflies of the genus *Aleyrodes* spp. may also be found throughout the winter, particularly on brassica and bramble plants in sheltered situations. Puparia of other whitefly species may be found on fallen leaves throughout the winter.

All samples listed under 'Collection data' were collected and identified by the author unless stated otherwise. Scale insect specimens were slide-mounted according to the methods described by Malumphy (2002) and identified using the diagnostic keys provided by Kosztarab & Kozár (1987) and Williams & Watson (1988a, 1988b, 1990). Whitefly specimens were slide mounted according to methods given by Martin (1987) and identified using the diagnostic keys provided by Mound (1966) and Martin, Misfud & Rapisarda (2000). Slide-mounted specimens are deposited at The Food and Environment Research Agency (FERA). The nomenclature of the scale insects used here follows Ben-Dov, Miller & Gibson (2009) and of the whiteflies Martin & Mound (2007).

RESULTS

A total of 34 scale insect species (20 native, seven naturalised introductions, seven introduced species established on indoor plantings) and eight whitefly species (three native, three naturalised introductions, two introduced species established on indoor plantings) are recorded here for Bedfordshire. Examples of these species are shown on Plate 16. The scale insect and whitefly species have each been divided into two sections: native and introduced species that have become naturalized (they overwinter outdoors); non-native species found breeding under artificial conditions, e.g. on indoor plantings, which are likely to be present in Britain for the foreseeable future.

COCCOIDEA – Scale insects**NATIVE AND INTRODUCED NATURALIZED SPECIES****ORTHEZIIDAE** – ensign scales***Newsteadia floccosa*** (De Geer) – boreal ensign scale (Plate 16, Fig. 2)

A Palaearctic, woodland species that occurs in damp habitats. It is found among mosses or lichens and leaf litter, or on the roots of a wide range of herbaceous and woody plants. It has been rarely recorded in Britain.

Collection data: Rushmere, Heath Wood (SP915274), adult females with ovisacs and nymphs on the roots of mosses, sedges and birch, 16.viii.2009.

PSEUDOCOCCIDAE – mealybugs***Phenacoccus aceris*** (Signoret) – polyphagous tree mealybug

A Holarctic species that is polyphagous on trees and shrubs. It occurs widely and is locally common in Britain.

Collection data: Coopers Hill (TL027378), abundant on *Fagus sylvatica*, up to 20 ovisacs on each tree, 4.vii.2010; Dunstable Downs (TL006198), on *Crataegus* sp., 1.v.1993; Luton, Stockwood Park (TL085202), dead females and ovisacs on *F. sylvatica*, 30.vi.1994; Luton Hoo, near Lake (TL116186), parasitized dead females and ovisacs with eggs on *Acer pseudoplatanus*, 19.vi.1994; Rushmere, Heath Wood (SP911273), sparse on *Crataegus monogyna*, 16.viii.2009; Sandy RSPB Reserve (TL188477), sparse, dead females with ovisacs on *Hedera helix*, 2.vii.1994; Toddington (TL006291), sparse on *A. pseudoplatanus*, 16.viii.2009; Woburn (SP948333), abundant, ovisacs on *Tilia cordata*, 16.viii.2009; Westoning church (TL028328), single ovisac on *Sorbus aucuparia*, 4.vii.2010.

Balanococcus diminutus (Leonardi) – phormium mealybug

Syn. *Trionymus diminutus* (Leonardi)

This species originates from New Zealand and was introduced to England in the 1970s (Bartlett, 1981). It has naturalized widely in England and Wales on *Phormium tenax* and is occasionally a serious pest, killing susceptible plants.

Collection data: Maulden church (TL058381), dead adults and large amounts of waxy deposits at the base of leaves on a small *Phormium tenax*, 4.vii.2010.

COCCIDAE – soft scales

In addition to the 13 species listed below, two first instar coccids were collected from grass at Dallow Downs, Luton (TL073215), 23.vii.1994. There are several grass and sedge feeding coccids present in the UK. The most common species are assigned to the genera *Eriopeltis* spp. and *Luzulaspis* spp., although it is possible that they were incidental (i.e., they do not feed on grass).

Coccus hesperidum L. – brown soft scale

A cosmopolitan, broadly polyphagous species. It is commonly recorded on indoor plantings in Britain but is also widely naturalized on evergreen plants, mainly in urban areas on *Hedera helix*, *Ilex aquifolium* and *Laurus nobilis*. The RHS has records of *C. hesperidum* from Bedford, on *C. sinensis*, 15.ix.2006; Biggleswade, on *L. nobilis*, 28.ii.1966; Dunstable, on *Citrus sinensis*, 21.viii.1980, *Ficus* sp., 26.ix.1995 and *L. nobilis*, 3.ii.2003; Keysoe, on *Prunus persicae*, 22.x.1990; Leighton Buzzard, on an unspecified plant, 14.xi.2005; Luton, on *Citrus* sp., 1.vi.2009; and Shelton, on *L. nobilis*, 20.x.1965.

Collection data: Amphill (TL037382), sparse on *L. nobilis*, 4.vii.2010; Caddington (TL063194), abundant on *Citrus limon* and *Schefflera* sp. grown indoors, ix.1996 (leg. R. Hammon); Clophill (TL082377), sparse on *Ilex x altaclarensis*, 4.vii.2010; Luton, Winsdon Hill (TL085208), abundant on *Schefflera actinophylla* grown indoors, 25.i.1992; Sandy RSPB Reserve (TL188477), sparse on *H. helix* and *L. nobilis*, 2.vii.1994; Woburn (SP948333), sparse, all developmental stages, attended by the ant *Lasius niger* L. (Formicidae), on *L. nobilis*, 16.viii.2009.

Eulecanium douglasi (ulc) – currant soft scale

A polyphagous European species that is rarely recorded in Britain.

Collection data: Luton, Winsdon Hill (TL080210), two male tests and one adult female on *Prunus domestica*, 23.vii.1994.

Eulecanium tiliae (L.) – nut scale (Plate 16, Fig. 4)

A European species that also occurs in the Middle East and North Africa and has been introduced to North America and Tasmania. It is broadly polyphagous on woody plants, and is most frequently found on Rosaceae. It is widespread and locally common in Britain and occasionally enormous populations develop, which may damage woody ornamentals and fruit trees.

Collection data: Dunstable Downs (TL006198), *Crataegus* sp., 1.v.1993; Luton, Popes Meadow (TL087235), two post-reproductive females on *Crataegus monogyna*, 25.i.1992, Stockwood Park (TL085202), several dead females and male tests on *Carpinus betulus*, *C. monogyna* and *Malus sylvestris*, 30.vi.1994; Westoning, (TL032325), two adult females on *Sorbus aria*, 4.vii.2010; Whipsnade (TL008178), one adult female on *C. monogyna*, 24.vii.1994.

Lichtensia viburni (Signoret) – viburnum scale (Plate 16, Fig. 3)

A polyphagous European species that occurs most frequently on *Hedera* and *Viburnum*. It occasionally occurs in huge numbers, becoming a pest of ornamental plants.

Collection data: Amphill (TL037382), sparse ovisacs on *Hedera helix* and *Viburnum tinus*, 4.vii.2010; Aspley Heath (SP928353), ovisacs and male test on *V. tinus*, 16.viii.2009; Clifton (TL162390), abundant ovisacs on *Viburnum* sp. 24.vii.2010 (leg. A. Outen); Holywell (TL020169), abundant ovisacs on *H. helix*, 9.viii.2010 (leg. C. Baker); Westoning church (TL028328), abundant females and male tests on *H. helix*, 4.vii.2010.

Palaeolecanium bituberculatum (Targioni-Tozzetti) – bituberculate scale

A Western Palearctic species that feeds on Rosaceae. It occurs widely in Britain but is rarely recorded.

Collection data: Dunstable Downs (TL006198), sparse on *Crataegus* sp., 1.v.1993; Luton, Winsdon Hill (TL085210), sparse on *Crataegus* sp., 11.x.1992; Sharpenhoe Clappers (TL065295), several adult females on *Crataegus monogyna*, 27.ix.1992, sparse, male tests and post-reproductive females, 4.v.2009, post-reproductive females (adults were found in the same location after almost 17 years).

Parthenolecanium corni (Bouché) – European fruit lecanium

This species occurs widely in temperate regions and is broadly polyphagous on woody plants. It is locally common throughout Britain and a pest of numerous ornamental plants and fruit crops. The RHS has records of *P. corni* from Biggleswade, on *Pyracantha coccinea*, 4.xii.1968; and Leighton Buzzard on *Cercis* sp., vi.1950, *Cercis siliquastrum*, 29.vi.1960 and *Wisteria* sp., 28.v.2009.

Collection data: Ampthill (TL037382), several adults on *Rosa spinosissima* and *Wisteria sinensis*, hundreds of adults and thousands of first instars on *Viburnum × bodnantense*, 4.vii.2010; Clifton (TL162390), *Ribes nigrum*, 27.iv.2007, *Corylus avellana contorta*, 31.v.2010 (leg. A. Outen); Clophill (TL082377), sparse on *Malus domestica*, *Prunus laurocerasus* and *R. nigrum*, 4.vii.2010; Luton (TL086209), sparse, dead post-reproductive adults on *Lonicera nitida*, 30.vi.1994, unidentified shrubs, 14.vii.1992, 11.x.1992; Maulden church (TL058381), sparse on *C. avellana contorta*, 4.vii.2010; Sandy RSPB Reserve (TL188477), sparse on *P. coccinea*, 2.vii.1994; south Bedfordshire, dead post-reproductive adults on *Malus* sp., 31.vii.2009 (leg. PHSI); Westoning, (TL032325), several adults on *W. sinensis*, 4.vii.2010; Westoning church (TL028328), sparse on *P. coccinea*, 4.vii.2010.

***Parthenolecanium pomeranicum* (Fabr.) – yew scale**

A European species that feeds on *Taxus*. It occurs widely in Britain, but is rarely recorded. The RHS have records of *P. pomeranicum* from Bedford, on *Taxus* sp., 28.vii.2008; and Leighton Buzzard, on *Taxus* sp., 4.v.1951.

Collection data: all records are on *T. baccata*. Ampthill (TL037382), abundant, 4.vii.2010; Flitwick (TL029342), abundant, 4.vii.2010; Rushmere, Heath Wood (SP915275), abundant, 16.viii.2009; Sandy RSPB Reserve (TL190478), two adults, 2.vii.1994; Swiss Cottage (TL148447), sparse, 17.vii.1994; Westoning church (TL028328), sparse, 4.vii.2010.

***Parthenolecanium rufulum* (Cockerell) – oak soft scale**

A European species that is locally common in southern England and feeds exclusively on *Quercus*. Rarely recorded in Britain. In addition to the records below, a male coccid test suspected to be *P. rufulum* was also collected at Whipsnade (TL008178), on *Q. petraea*, 24.vii.1994.

Collection data: all records are on *Q. robur*. Coopers Hill (TL027378), several adults and nymphs, 4.vii.2010; Husborne Crawley (SP955360), abundant nymphs and dead post-reproductive adults, 4.vii.2010; Rushmere, Heath Wood (SP915274), one adult, 16.viii.2009; north Bedfordshire, plant nursery, several nymphs on foliage on trees imported from Germany and on trees of UK origin, 18.viii.2009 (leg. PHSI); South Bedfordshire, plant nursery, nymph on foliage, 31.vii.2009 (leg. PHSI).

***Physokermes hemicyphus* (Dalman) – small spruce bud scale**

A European species that has been introduced to North America. It feeds on *Picea*, and rarely on *Abies*. It occurs widely in Britain, but is rarely recorded. Malumphy (2009a) showed that many early records of *P. piceae* were actually *P. hemicyphus*.

Collection data: All records are on *Picea abies*. Clophill (TL082377), sparse, 4.vii.2010; Luton, Wardown Park (TL088229), sparse, 23.xi.1992, Winsdon Downs (TL080210), one adult female, 23.vii.1994; Luton Hoo, Birch Wood (TL115182), one parasitized female, 19.vi.1994.

***Pulvinaria floccifera* (Westwood) – cottony camellia scale**

A polyphagous Asian pest that has now become cosmopolitan. It is naturalized throughout Britain and appears to have increased its host plant range, and become far more abundant in England and Scotland during the last two decades (Malumphy & Badmin, 2007). It is a serious pest of rhododendron (Malumphy, 2009e). The RHS has records of *P. floccifera* from Great Gransden, on *Ilex* sp., 10.x.2002; Leighton Buzzard, on *Camellia* sp., 29.xi.2000 and unspecified plant, 14.xi.2005; Sandy, on *Ilex* sp., 1.xii.1986; and Wootton, on *Euonymus japonica*, 9.vi.1999.

Collection data: Ampthill (TL037382), abundant on *Ilex aquifolium* and *Taxus baccata*, 4.vii.2010; Clifton (TL162390), abundant on *I. aquifolium*, 10.viii.1999 (not present in subsequent years) (leg. A. Outen); Clophill (TL082377), sparse on *Ilex* × *altaclarensis*, 4.vii.2010; Coopers Hill (TL027378), abundant on *I. aquifolium*, 4.vii.2010; Rushmere, Heath Wood (SP913275), abundant on several widely dispersed *I. aquifolium*, 16.viii.2009; Westoning church (TL028328), sparse on *I. aquifolium* and *T. baccata*, 4.vii.2010.

Pulvinaria hydrangeae Steinweden – hydrangea scale

A polyphagous pest suspected to be of Asian origin that is widespread in Europe, North America, Australia and New Zealand. It was first detected in Britain in the 1980s and has since spread throughout England. It is a serious pest of *Hydrangea* sp., *Viburnum* sp. and many other woody ornamental plants. The RHS has a record of *P. hydrangeae* from Bedford, on *Morus* sp., 8.ix.2009.

Pulvinaria regalis Canard – horse-chestnut scale (Plate 16, Fig. 5)

A polyphagous pest suspected to be of Asian origin that has become widespread in central and northwest Europe since the 1960s, when it was first described from France (Canard, 1968; Kozár *et al.*, 1994). This species is likely to occur throughout Bedfordshire where suitable host plants are present, as it was found in all locations visited by the author. Only the earliest collection dates are listed for each locality in order to shorten the large number of records.

Collection data: Ampthill (TL037382), sparse on *Acer negundo* ‘*variegatum*’, *Acer pseudoplatanus* (including varieties with yellow and purple leaves), *Aesculus hippocastanum*, *Euonymus japonicus*, *Laurus nobilis*, *Skimmia japonica* and *Tilia cordata*, 4.vii.2010; Aspley Heath (SP928353), sparse on *A. pseudoplatanus*, 16.viii.2009; Bedford, city centre (TL0449, TL0549), abundant on *A. pseudoplatanus*, *A. hippocastanum*, 17.vii.1994, Bedford General Hospital (TL0449), *Tilia* sp., 26.vi.1999 (leg. A. Outen); Bigglesworth (TL2043), abundant on *A. hippocastanum* and *Tilia* sp., 2.vii.1994; Caddington (TL0619), adult females and third instars on *L. nobilis*, 23.iv.1992 (leg. R. Hammon); Clophill (TL082377), sparse on *Acer* sp. and *T. cordata*, 4.vii.2010; Coopers Hill (TL027378), abundant on *T. cordata*, 4.vii.2010; Dunstable Downs (TL006198), on *A. pseudoplatanus*, 1.v.1993; Flitwick (TL029342), abundant on *Tilia* × *vulgaris*, 4.vii.2010; Heath and Reach (SP924281), *T. cordata*, 16.viii.2009 (sparse); Hockliffe, church (SP966269), *Acer campestre* and *T. cordata*, 16.viii.2009 (sparse); Husborne Crawley (SP955360), abundant on *Acer platanoides* and *A. hippocastanum*, 4.vii.2010; Leighton Buzzard (SP921250), abundant on *A. hippocastanum*, 11.vii.1994; Maulden (TL051380), sparse on *A. pseudoplatanus* and *A. hippocastanum*, 4.vii.2010; Maulden (TL051380), sparse on *T. cordata*, 4.vii.2010; Rushmere, Heath Wood and Field (SP916273, SP911273), sparse on *A. pseudoplatanus*, 16.viii.2009; Luton (TL0720, 0820, 0822, 0920, 0721, 0821, 0921, 1021), abundant, very common throughout the south and centre of the town, including Farley Hill, Stockwood Park, Wardown Park and Winsdon Hill, *A. platanoides*, *A. pseudoplatanus*, *Acer* sp., *A. hippocastanum*, *Tilia* sp., *Ulmus* sp. and unidentified trees and shrubs, 11.x.1992, various dates vi-vii.1994, Popes Meadow (TL087235), overwintering nymphs on *A. hippocastanum*, *Hedera helix* and *Tilia* sp., 25.i.1992; Luton Hoo, Lake and Warren Drive (TL115183), abundant, females with ovisacs, active first instars on *A. pseudoplatanus* and *Ulmus* sp., 19.vi.1994; Old Linslade, cemetery (SP909268), abundant on *T. cordata*, 16.viii.2009; Sandy RSPB Reserve (TL191481), sparse on *A. pseudoplatanus*, 2.vii.1994; Swiss Cottage (TL148447), sparse on *A. pseudoplatanus* and *Ulmus* sp., 17.vii.1994;

Tebworth (SP990267), sparse on *A. pseudoplatanus*, 16.viii.2009; Toddington (TL006291), sparse on *A. pseudoplatanus*, 16.viii.2009; Westoning (TL032325), abundant on *A. platanoides*, *A. pseudoplatanus* and *Ulmus procera*, 4.vii.2010; Westoning church (TL028328), sparse on *A. pseudoplatanus*, *Acer* sp., *A. hippocastanum* and *T. × vulgaris*, 4.vii.2010; Whipsnade (TL008178), abundant on *A. pseudoplatanus* and *A. hippocastanum*, 24.vii.1994; Woburn (SP948333), sparse on *A. pseudoplatanus*, abundant on *T. cordata*, 16.viii.2009.

***Pulvinaria vitis* (L.)** – woolly vine scale

A polyphagous Palaearctic species that has been introduced to North America. It is locally common throughout Britain and occasionally a pest of grapevine, peach and currants. The RHS has a record of *P. vitis* from Luton, on an unspecified plant, 28.v.2002.

Collection data: Clophill (TL082377), several adults with ovisacs, some were unusually small being only 3 mm in length, on *Pyracantha coccinea*, 4.vii.2010; Flitwick (TL029342), single adult with ovisac on *Crataegus monogyna*, 4.vii.2010; Flitwick Moor (TL045351), single adult with ovisac on *C. monogyna*, 4.vii.2010; Luton, Stockwood Park (TL085202), one female on *C. monogyna*, 30.vi.1994; Winsdon Hill (TL085210), one parasitised female on *Crataegus* sp., 11.x.1992, 20.xi.1996; Luton Hoo, Lake and Warren Drive (TL115183), females with ovisacs and empty male tests on *C. monogyna*, 19.vi.1994; Sandy (TL193476), two adults with ovisacs on *C. monogyna*, 2.vii.1994; Toddington (TL006291), one female on *C. monogyna*, 16.viii.2009.

ERIOCOCCIDAE – felt scales

Cryptococcus fagisuga Lindinger – beech scale

A European species that has been introduced to North America. It feeds on *Fagus* and occurs throughout Britain, frequently in very high densities. It is associated with the transmission of a fungal beech bark disease caused by *Nectria coccinea* var. *faginata* Lohman, Watson & Ayers and *Neonectria galligena* (Bres.) Rossman & Samuels (Ascomycota: Hypocreales: Nectriaceae) (Kosztarab Kozár, 1987). The RHS has a record of *C. fagisuga* from Leighton Buzzard, on *Fagus* sp., 14.xii.1961.

Collection data: All records are on *F. sylvatica*. Ampthill (TL037382), abundant, 4.vii.2010; Clophill (TL082377), massive population infesting the trunks, smaller branches and apical twigs (diameter 2 mm) of several plants in a pruned beech hedge and appearing similar to white fungal growth, 4.vii.2010; Coopers Hill (TL027378), massive populations on the main trunks of many mature trees, 4.vii.2010; Luton, Popes Meadow (TL087235), 25.i.1992, Stockwood Park (TL085202), abundant, 30.vi.1994, Winsdon Hill (TL085210), 11.x.1992; Luton Hoo, Birch Wood (TL115182), abundant, 19.vi.1994; Rushmere, Heath Wood (SP916274), sparse, 16.viii.2009; Sandy RSPB Reserve (TL188477), abundant, 2.vii.1994; Swiss Cottage (TL148447), 17.vii.1994, abundant; Tebworth (SP990267), abundant, 16.viii.2009; Whipsnade (TL008178), abundant, 24.vii.1994; Woburn (SP949331), abundant, 16.viii.2009.

Pseudochermes fraxini (Kaltenbach) – ash bark scale

A European species that feeds on *Fraxinus*. It occurs throughout Britain, frequently in very high densities together with the willow scale *Chionaspis salicis* (L.).

Collection data: All records are on *Fraxinus excelsior*. Ampthill (TL037382), abundant, 4.vii.2010; Aspley Heath (SP928353), sparse, 16.viii.2009; Clipstone

(SP946263), sparse, 16.viii.2009; Clophill (TL082377), sparse, 4.vii.2010; Dunstable Downs (TL006198), 1.v.1993; Flitwick (TL029342), massive population, 4.vii.2010; Luton, town centre (TL091212), abundant, 30.vi.1994, Winsdon Hill (TL085210), abundant, 11.x.1992, 14.vii.1994; Luton Hoo, Birch Wood (TL115182), abundant, 19.vi.1994; Sandy RSPB Reserve (TL188477), abundant, 2.vii.1994; Swiss Cottage (TL148447), sparse, 17.vii.1994; Westoning, (TL032325), sparse, 4.vii.2010; Whipsnade (TL008178), abundant, 24.vii.1994.

ASTEROLECANIIDAE – pit scales

Asterodiaspis quercicola (Bouché) – small pit scale

A western Palaearctic species that has been introduced to North America, South Africa, New Zealand and Mauritania. It feeds exclusively on *Quercus* and is common throughout Britain.

Collection data: All records are on *Q. robur*. Husborne Crawley (SP955360), abundant, thousands of first instars, 4.vii.2010; Luton, Stockwood Park (TL080199), sparse, 30.vi.1994, 2.vii.1994, Winsdon Hill (TL085210), 11.x.1992; Luton Hoo, Birch Wood (TL115182), sparse, adult females with eggs, 19.vi.1994; Sandy RSPB Reserve (TL188477), sparse, 2.vii.1994; Swiss Cottage (TL148447), sparse, 17.vii.1994; Westoning church (TL028328), 4.vii.2010.

Asterodiaspis variolosa (Ratzeburg) – golden pit scale (Plate 16, Fig. 1)

A western Palaearctic species that has spread so widely that it has become almost cosmopolitan. It feeds on *Quercus* and is very common throughout Britain.

Collection data: All records were on *Q. robur*. Rushmere, Heath Wood (SP916274), abundant, 16.viii.2009; north Bedfordshire, several, 18.viii.2009 (leg. PHSI); Sharpenhoe Clappers (TL065295), sparse, numerous empty pits, 4.v.2009.

DIASPIDIDAE – armoured scales

In addition to the seven species listed below, the RHS has records of *Carulaspis* sp. from Luton, on *Chamaecyparis lawsoniana*, 28.x.1992 and *Cupressocyparis leylandii*, 21.x.1997. There are two species of *Carulaspis* recorded on these host plants present in Britain, *C. juniperi* (Bouché) and *C. minima* (Targioni-Tozzetti).

Carulaspis minima (Targioni-Tozzetti) – minute cypress scale

A Mediterranean species that has been introduced to West Africa, Hawaii, North and South America, and the Caribbean. It feeds on Cupressaceae and was first detected in Britain by Newstead in 1898 at the Royal Botanic Gardens, Kew (Newstead, 1900, 1901).

Collection data: Sandy RSPB Reserve (TL188477), abundant on \times *Cupressocyparis leylandii*, 2.vii.1994.

Chionaspis salicis (L.) – willow scale

A Palaearctic species that has been introduced to parts of Asia and North America. It is polyphagous on woody plants and a minor pest of currant bushes and willow.

Collection data: Bedford, Priory Country Park (TL076493), sparse on *Salix* sp., 17.vii.1994; Clophill (TL082377), sparse on *Salix alba*, 4.vii.2010; Flitwick (TL029342), massive population on *Fraxinus excelsior*, 4.vii.2010; Flitwick Moor (TL045351), abundant on *Alnus glutinosa* and *Salix caprea*, 4.vii.2010; Hockliffe,

church (SP966269), sparse on *F. excelsior*, 16.viii.2009; Husborne Crawley (SP955360), massive population on *F. excelsior*, 4.vii.2010; Luton, town centre (TL0821, 0822, 0921, 0922), abundant on *Salix* sp. and *Tilia* sp., 30.vi.1994, Stockwood Park (TL085202), abundant on *Syringa* sp., *Tilia* sp. and unidentified trees, 30.vi.1994, Winsdon Hill (TL085210), abundant on *F. excelsior*, 11.x.1992, 14.vii.1994; Luton Hoo, Lake (TL116186), abundant on *Salix* sp., 19.vi.1994; Sandy RSPB Reserve (TL188477, TL191481), abundant, numerous male tests on *Salix* sp. and *Tilia* sp., 2.vii.1994; Sharpenhoe Clappers (TL065295), abundant on *F. excelsior*, 4.v.2009; Stockwood Grove County Park, lake (SP916289), sparse on *S. caprea*, 16.viii.2009; Swiss Cottage (TL148447), sparse on *Salix* sp., 17.vii.1994; Whipnade (TL008178), sparse on *Salix* sp., 24.vii.1994; Woburn (SP948335), abundant on *F. excelsior*, 16.viii.2009.

Diaspidiotus bavaricus (Lindinger) – blueberry armoured scale

A European species that feeds on members of the Ericaceae. It occurs widely in Britain but is rarely recorded, possibly because it is remarkably cryptic, often being hidden beneath peeling bark, bracts and algae growing on the stems of heather.

Collection data: Stockwood Grove County Park (SP912294), abundant on *Calluna vulgaris*, 16.viii.2009.

Diaspidiotus ostreaeformis (Curtis) – yellow plum scale

Almost cosmopolitan, broadly polyphagous on woody plants, and a pest of fruit trees, especially plum. It occurs widely in Britain but is rarely recorded, possibly because it is highly cryptic on the bark.

Collection data: Flitwick Moor (TL045351), numerous on the main trunks of *Betula alba*, 4.vii.2010; Woburn (SP950331), abundant on very old *Malus domestica*, 16.viii.2009.

Diaspidiotus zonatus (Frauenfeld) – zonate armoured scale

A European species that feeds on woody plants, but is most frequently found on *Quercus*. It occurs widely in Britain but is rarely recorded, possibly because it is highly cryptic.

Collection data: All records are on *Quercus robur*. Coopers Hill (TL027378), low numbers of larvae and dead adults,, 4.vii.2010; Husborne Crawley (SP955360), abundant post-reproductive adults on twigs and hundreds of first and second instars on foliage, 4.vii.2010; Rushmere, Heath Wood (SP915274), sparse, 16.viii.2009; Luton, Stockwood park (TL081199), several females on twigs, males on leaves, 2.vii.1994; Sharpenhoe Clappers (TL065295), sparse, 4.v.2009.

Lepidosaphes ulmi (L.) – mussel scale

A Palaearctic species that has spread widely throughout the temperate regions of the world. It is common throughout Britain and is broadly polyphagous on woody hosts, with a preference for plants belonging to the Rosaceae. It is a pest of apple, pear, cherry, walnut and many other trees and shrubs. The RHS has records of *L. ulmi* from Bedford and Biddenham, on *Malus* sp., 1.x.1963.

Collection data: Amphthill (TL037382), abundant on *Crataegus laevigata*, 4.vii.2010; Aspley Heath, woods (SP928353), sparse on *Sorbus aucuparia* 16.viii.2009; Bigglesworth (TL1942), abundant on bark and fruit of *Malus domestica*, ix.2009 (leg. R. Lawrence); Clifton (TL162390), on *Crataegus* sp., 1989 (leg. A. Outen); Clophill (TL082377), abundant on mature *M. domestica*, sparse on *Pyracantha coccinea*, 4.vii.2010; Coopers Hill (TL027378), abundant on *Calluna vulgaris*, 4.vii.2010;

Dunstable Downs (TL006198), on *Crataegus* sp., 1.v.1993; Flitwick (TL029342), abundant on *Crataegus monogyna*, 4.vii.2010; Flitwick Moor (TL045351), abundant on *C. monogyna* and *M. domestica*, 4.vii.2010; Luton, Popes Meadow (TL087235), *C. monogyna*, 25.i.1992, Stockwood Park (TL082198), abundant on *Sorbus aria*, 2.vii.1994, Winsdon Hill (TL085210), on *Crataegus* sp. and *Malus* sp., 11.x.1992; Luton Hoo, Warren Drive (TL115183), abundant on *C. monogyna* and *Prunus* sp., 19.vi.1994; Maulden church (TL058381), sparse on *Prunus spinosa*, 4.vii.2010; Old Linslade, cemetery (SP909268), abundant on *Malus* sp., 16.viii.2009; Rushmere, Heath Wood (SP911273), sparse on *C. monogyna*, 16.viii.2009; Sandy RSPB Reserve (TL188477), sparse on *Malus* sp., 2.vii.1994; Sharpenhoe Clappers (TL065295), abundant on *C. monogyna*, *Malus* sp. and *S. aria*, 4.v.2009; south Bedfordshire, abundant on *Malus* sp., 31.vii.2009 (leg. PHSI); Studham (TL 020170), on *M. domestica*, 2010 (leg. C. Baker); Toddington (TL006291), sparse on *C. monogyna* and *S. aria*, 16.viii.2009; Westoning, (TL032325), sparse on *Sorbus aria*, 4.vii.2010; Woburn (SP950331), abundant on *M. domestica*, 16.viii.2009.

Unaspis euonymi (Comstock) – euonymus scale

A polyphagous pest suspected to be of Asian origin that has spread widely in warm temperate regions. It has become locally naturalized in southern England since at least the 1950s (Dennis, 1969). It is a major pest of *Euonymus*, particular *E. japonica*, and often causes die back or even kills euonymus hedges in southern England. The RHS has a record of *U. euonymi* from Dunstable, on *Euonymus* sp., 27.iii.2006.

Collection data: Ampthill (TL037382), abundant, thousands of first instars, on *Euonymus japonica*, 4.vii.2010.

INTRODUCED SPECIES ESTABLISHED ON INDOOR PLANTINGS

MONOPLEBIDAE – giant scales

Icerya purchasi Maskell – cottony cushion scale

This species has recently become naturalized in the London area (Watson & Malumphy, 2004), but may be restricted to indoor plantings in Bedfordshire. The RHS has records of *I. purchasi* from Dunstable, on an unspecified plant, 10.v.2005; and Sandy, on *Acacia* sp., 1.vii.2008 and 28.iv.2009.

Collection data: North Bedfordshire, plant nursery, adults and nymphs, breeding at the site for several months on *Citrus limon* from Portugal, 23.i.2008 (leg. PHSI).

PSEUDOCOCCIDAE – mealybugs

Planococcus citri (Risso) – citrus mealybug

This is a cosmopolitan polyphagous pest that is very common on indoor plantings throughout Britain.

Collection data: Luton (TL086209), abundant on *Crassula portulacea*, 30.vi.1994.

Pseudococcus viburni (Signoret) – glasshouse mealybug

In addition to the record below, Alan Outen photographed mealybugs infesting *Adromischus marianae* and *Opuntia* sp. in his glasshouse in Clifton (TL162390) that are almost certainly this species. They were being eaten by the coccinellid, *Cryptolaemus montrouzieri* Mulsant.

Collection data: Caddington (TL063194), abundant on *Carpobrotus* sp., *Crassula portulaca* and *Graptopetalum bellum*, ix.1996 (leg. R. Hammon).

Rhizoecus sp. – a root mealybug

Suspected to be either *R. cacticans* (Hamilton) or *R. falcifer* Kunckel d’Herculais.

Collection data: Clifton (TL162390), on the roots of succulent plants (leg. A. Outen).

COCCIDAE – soft scales

Saissetia coffeae (Walker) – hemispherical scale

This species occurs widely in tropical and subtropical areas and is broadly polyphagous. It occurs widely in botanical collections in Britain.

Collection data: Caddington (TL063194), sparse on *Chlorophytum* sp., ix.1996 (leg. R. Hammon).

DIASPIDIDAE – armoured scales

Abgrallaspis cyanophylli (Signoret) – cyanophyllum scale

This is a polyphagous cosmopolitan species that occurs widely in Britain in botanical collections. It has also recently been found breeding outdoors in southern England. The RHS has a record of *A. cyanophyllum* from Bedford, on *Opuntia* sp., 3.x.1958.

Pinnaspis buxi (Bouché) – boxwood scale

This species is widespread in the tropics and subtropics and occurs on indoor plantings in cooler regions. It is broadly polyphagous, feeding on plants belonging to at least 46 families and is common on Arecaceae and Pandanaceae. It is established in botanical collections in Britain but rarely recorded.

Collection data: North Bedfordshire, commercial plant nursery, on *Cordyline* sp. imported from Costa Rica, 26.iv.2006 (leg. PHSI).

ALEYRODOIDEA – whiteflies

ALEYRODIDAE – whiteflies

NATIVE AND INTRODUCED NATURALIZED SPECIES

Aleurochiton aceris (Modeer) – Norway-maple whitefly (Plate 16, Fig. 6)

A European species that feeds exclusively on *Acer platanoides*. Although possibly native, the presence of *A. aceris* in Britain was not confirmed until 1976 (Martin, 1978) and it is now widespread and locally common in southern England. It has two generations annually and the puparia exhibit distinct dimorphism: winter puparia are dark with a dorsal dense coating of white wax, whereas the summer puparia are pale and translucent.

Collection data: Old Linslade (SP909268), on *A. platanoides*, winter puparia and vacated summer pupal cases (with high level of parasitism), first, second and third-instar nymphs, 16.viii.2009.

Aleurotuba jelinekii (Frauenfeld) – viburnum whitefly

A European species that appears to be restricted to *Viburnum tinus* and *Arbutus unedo* in Britain but on the continent it also feeds on *Arctostaphylos* sp., *Myrtus*

communis and *Viburnum* spp.. Apparently introduced into Britain in the 1930s (Mound, 1962) and now very common throughout England.

Collection data: in all cases there were low numbers of larvae on *V. tinus*. Ampthill (TL037382), 4.vii.2010; Aspley Heath (SP928353), 16.viii.2009; Flitwick (TL029342), 4.vii.2010; Hockliffe (SP977264), 16.viii.2009; Woburn (SP948333), 16.viii.2009.

Aleyrodes lonicerae Walker – honeysuckle whitefly

A broadly polyphagous European species that is common and widespread in Britain. It is an occasional pest of honeysuckle and strawberry.

Collection data: Flitwick Moor (TL045351), sparse on *Lonicera periclymenum*, 4.vii.2010; Rushmere, Heath Wood (SP915274), abundant on *L. periclymenum*, 16.viii.2009; Stockwood Grove Country Park (SP917289), abundant on *L. periclymenum*, 16.viii.2009; Westoning (TL032325), abundant on *L. periclymenum*, 4.vii.2010.

***Aleyrodes proletella* L.** – cabbage whitefly

A broadly polyphagous European species, preferring brassicas but also feeding on other plants that are (usually) smooth-leaved. It is common and widespread in Britain and a very common pest of *Brassica* spp. The puparia can often be found through the winter months.

Collection data: Ampthill (TL037382), abundant adults, eggs and larvae on *Brassica napus*, 4.vii.2010; Aspley Heath (SP928353), all stages abundant, mainly adults, on *Chelidonium majus* and *Sonchus arvensis*, 16.viii.2009; Clifton (TL162390), *Brassica* sp., 9.iv.1991, 2.iii.2008 (leg. A. Outen); Clophill (TL082377), abundant on *Sonchus* sp., 4.vii.2010; Flitwick (TL029342), abundant adults, eggs and larvae on *Sonchus* sp., 4.vii.2010; Heath and Reach (SP924282), eggs and larvae on *Brassica* sp., 16.viii.2009; Westoning, (TL032325), abundant on *Sonchus* sp. and other Compositae, sparse on adjacent *Lathyrus odoratus* and *Papaver* sp., 4.vii.2010.

Siphoninus immaculatus (Heeger) – ivy whitefly

A European species that feeds exclusively on *Hedera* spp. Widespread but rarely recorded in Britain. It was recently recorded damaging an ornamental ivy (Malumphy, 2010a).

Collection data: Luton, Winsdon Hill (TL085210), on *H. helix*, puparia, 2.v.1991; Sandy RSPB Reserve (TL188477), on *H. helix*, vacated pupal cases and abundant adults, 2.vii.1994.

Siphoninus phillyreae (Haliday) – ash whitefly

A species native to the Mediterranean region (Martin *et al.* 2000) that has spread widely in the warmer parts of the world. It is naturalised in southern England but rarely recorded (Mound, 1966). It is polyphagous, occurring most frequently on woody plants of the families Oleaceae, Punicaceae and Rosaceae.

Collection data: Clophill (TL082377), five empty pupal cases on *Pyracantha coccinea*, 4.vii.2010.

INTRODUCED SPECIES ESTABLISHED ON INDOOR PLANTINGS

ALEYRODIDAE – whiteflies

In addition to the whiteflies listed below, *Bemisia tabaci* (Gennadius) has been found on imported plants indoors at plant nurseries distributed throughout the county, for example on *Solidago* sp. from Zimbabwe 1996 and Israel 2004, 2005 and

2006; *Gypsophila* sp. from Israel, 2003; and *Trachelium* sp. from Israel 2006 and 2007. Eradicatory action was taken against *B. tabaci* in all cases when it was found on growing plants in Bedfordshire. It is a regulated quarantine pest in the European Union but is not established anywhere in the UK.

***Aleurothrixus floccosus* (Maskell) – woolly whitefly**

A Neotropical species that has spread throughout the tropical, subtropical and warmer temperate regions of the World. It is broadly polyphagous but shows a preference for *Citrus*. It has been found on many occasions breeding on indoor plantings at botanical gardens (Malumphy, 1995) and is regularly intercepted by the PHSI on *Citrus* plants imported from the Mediterranean. It has been found outdoors in London on one occasion during the summer. The RHS has a record of *A. floccosus* from Leighton Buzzard, on *Citrus* sp., 1.xii.1986.

***Trialeurodes vaporariorum* (Westwood) – glasshouse whitefly**

An extremely polyphagous cosmopolitan species. It is widespread and very common throughout Britain on indoor plantings and frequently occurs outdoors during the summer. The RHS has records of *T. vaporariorum* from Bedford, on *Fuchsia* sp., 23.x.1990; Biggleswade, on *Cucumis sativus*, iii.1934; Caddington, on *Solanum lycopersicum*, 2.viii.1982; Houghton Regis, on *Fuchsia* sp., *Pelargonium* sp. and *S. lycopersicum*, 14.iii.1994; Kempston, on *Fuchsia* sp., 23.x.1990; and Sharnbrook, on *C. sativus* and *S. lycopersicum*, 3.ix.1992.

Collection data: This species is so ubiquitous that it was rarely recorded when encountered by the author. It was, however, relatively common on *Fuchsia* sp., *S. lycopersicum*, and unspecified ornamental plants in indoor plantings in Luton in 1992–94. It was also common in a conservatory and green house in Cifton on *Fuchsia* sp. and *Pelargonium* sp., various dates vii.1984–iv.2010 (leg. A. Outen). Also found in commercial plant nurseries, on *Hypericum* sp. from Kenya, various dates i.2006–xii.2007; and on *Solidago* sp. from Kenya, 29.ix.2006 (leg. PHSI).

DISCUSSION

Twenty-seven native/naturalized species of scale insect and six native/naturalized species of whitefly are recorded here from Bedfordshire. There are likely, however, to be many more species of scale insect, and a few additional whitefly species actually present in the county, as only a few localities have been investigated. In particular, none of the large number of grass/sedge feeding coccid and pseudococcid species has been found. For comparison, the author recently recorded 39 native/naturalized scale insects and 8 native/naturalized whiteflies in Watsonian Yorkshire (Malumphy, 2009b, 2010a). Although Yorkshire covers a much larger area, it is located further north where a lower number of species would be expected to occur.

The most common and widespread native scale insects species in Bedfordshire are: *Asterodiaspis* spp., *Chionaspis salicis*, *Cryptococcus fagisuga*, *Eulecanium tiliae*, *Lepidosaphes ulmi*, *Parthenolecanium corni*, *Pseudochermes fraxini* and *Pulvinaria vitis*. These are the most common species to be found throughout England and Wales. There is insufficient collection data for the whiteflies to enable any conclusions to be drawn at this stage.

Six exotic species of scale insect and three exotic species of whitefly have been found breeding outdoors in Bedfordshire: *Aleurochiton aceris*, *Aleurotuba jelenikii*, *Balanococcus diminutus*, *Carulaspis minima*, *Coccus hesperidum*, *Pulvinaria floccifera*, *P. hydrangeae*, *P. regalis* and *Siphoninus phillyreae*. Two of these species, *P. floccifera*

and *P. regalis*, are common and widespread in the county. Climate change appears to be having an influence on the distribution of scale insects and whiteflies within Europe, as species once restricted to the Mediterranean are expanding their range into more northerly latitudes. Several exotic species have appeared in Greater London in recent years (for example, *Aonidia lauri* (Bouché) (Malumphy, 1997), *Bemisia afer* (Priesner & Hosny) (Malumphy, 2003) and *Eulecanium excrescens* (Ferris) (Malumphy, 2005a)) and it is possible that these and other species may expand their range northwards into Bedfordshire.

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