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# Zoogeography, faunistics and scales of economic importance

## Invasive scale insects (Hemiptera: Coccoidea) recorded from France

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**Abstract:** This paper provides a list of scale insect species (Coccoidea) considered to be invasive to France. The list was compiled from the literature, with some additional recent data from the Entomology Unit, LNPV. The period covered is from the middle of the 19th century to the present. For each species, the list includes: the date of introduction, along with a bibliographical reference; whether established; pest status; principal hosts, and probable zoogeographical region of origin. Of the approximately 400 scale insect species presently known from France, about a quarter are regarded as potentially invasive.

**Key words**: France, invasive species, Margarodidae, Pseudococcidae, Eriococcidae, Coccidae and Diaspididae.

### Introdution

Lists of invasive species for various parts of the world are currently being prepared (Jansen, 1995; Miller *et al*., 2002, 2005). The present work lists those scale insect species that might be regarded as invasive to mainland France and Corsica.

We consider a species to be invasive if it does not originate from Western Europe. This definition differs slightly from that given by Miller *et al.* (2005). We have not excluded species that are known only from under glass. Our definition differs also from that of the DAISIE program (Delivering Alien Invasive species Inventories for Europe), which considers that only species introduced directly or indirectly by man are invasive, not those spread in a natural way.

The scale insect fauna of France is thought to be approximately 400 species. The most recent list (Foldi, 2001) had 381 species but there have been several more recent additions (Germain *et al.,* 2002; Matile-Ferrero & Germain, 2004; Kreiter & Germain, 2005; Germain & Matile-Ferrero, 2006). From a bibliographical review covering the period 1850-2007 plus some recent records from the Entomology Unit, LNPV, we have produced a table including 96 invasive species (Table 1). These species represent a quarter of the scale insect species known from France.

For each of the species considered to be invasive in Table 1, the year of discovery is given, with a relevant bibliographical reference. However, for cosmopolitan species such

as *Coccus hesperidum* Linnaeus, the date of introduction is 'previous', where the first mention of its presence in France is not thought to indicate the year of discovery. The other data are: whether it has become established or not; its present pest status; its principal hosts, and its probable zoogeographical area of origin. The latter is sometimes doubtful due to a possible choice of several regions, i.e. Tropical.

The zoogeographical origin of the 96 species is varied (Fig. 1). Thirty-one species (including 19 of the Oriental area) have come from Asia. Twenty-five are from the New World (15 Neotropical, 8 Nearctic and 2 uncertain), 10 are of Afrotropical origin, 3 of Australasian origin, and the remaining 27 species are of more general "Tropical origin", where the exact source is uncertain.

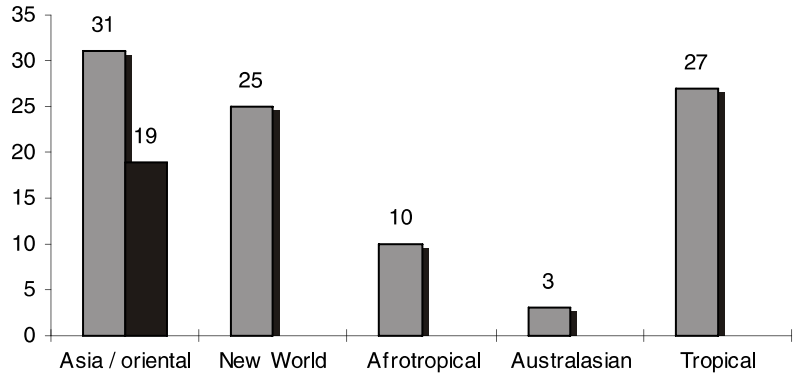


**Figure 1**. Geographical origin of the invasive species.

These invasive species belong to five families (Fig. 2). The Pseudococcidae is the most species rich family in France, with 138 species of which 24 (17%) are regarded as invasive. The family Diaspididae is second in abundance, with 99 species, including 45 (45%) considered to be invasive. Third is the Coccidae with 68 species, including 17 (25%) invasive species. The Eriococcidae has 48 species but only 3 (6%) are regarded as invasive, but this includes *Eriococcus williamsi* Danzig, the most recently observed new species in France (Corsica), found in February 2007. Among the Margarodidae, 3 (20%) of the 15 species known from France are considered to be invasive, particularly *Icerya seychellarum* (Westwood), a species first noted in France at the end of 2006 (Germain *et al*., 2007).

The timing of the introduction of these new species to France is relatively evenly distributed. Figure 3 shows the period since 1850, divided into 25 year intervals. The flow of new species is relatively constant, with around 10 species per 25 years since 1850, apart from the period 1926-1950, when 25 species were added, corresponding to the publication of several of the works of Balachowsky (1930a, 1930b, 1931, 1932a). However, there is a distinct peak at the beginning of twenty-first century, when 27 species were recorded between 2001 and 2005, plus a further 3 species in 2006 and another already in 2007. The development of the international trade in plants and the improvement in quarantine inspection can explain most of this increase.

Although few of recent introductions can be classified as significant pests, some are worrying. For instance, the diaspidid *Unaspis yanonensis* (Kuwana), which remained restricted

to the Alpes-Maritimes for a long time after it was first discovered in 1969, has recently been expanding its range and has now colonised the entire French Mediterranean coast from Menton (East) to Perpignan (West). Another example is the pseudococcid *Pseudococcus comstocki* (Kuwana), first discovered in 2004 but now increasingly present in the orchards of southern France, where it is almost as injurious as *Pseudococcus viburni* (Signoret). A further mealybug, *Phenacoccus madeirensis* Green, a polyphagous species, will surely become a problem on ornamentals, along with the diaspidid *Aulacaspis yasumatsui* Takagi on Cycadaceae. Another example of a species with a very limited distribution at present but which could become very dangerous is the mealybug *Crisicoccus pini* (Kuwana). This is presently only known from Monaco, but would be devastating if it spread to pine trees in southern Europe.

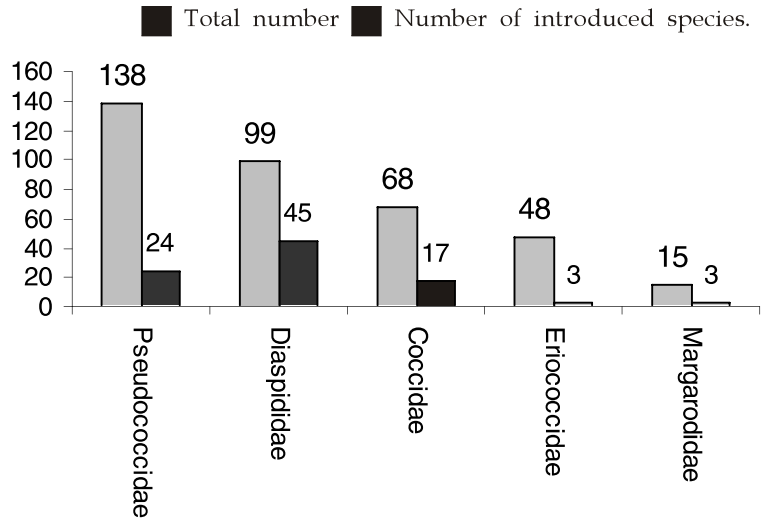


**Figure 2**. Number of species per family in France.

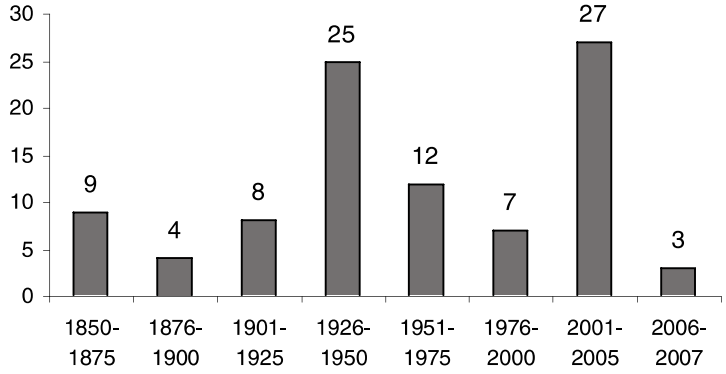


**Figure 3**. Number of species introduced since 1850.

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**Table 1.** List of invasive species in France.

| Family and Species | Date of introduction | References | Pest or threat status | Principle hosts | Origin |
|---|---|---|---|---|---|
| **Asterolecaniidae** | | | | | |
| *Bambusaspis bambusae* (Boisduval)* | 2002 | Germain *et al.* 2002 | minor pest[a] | *Bambusa* | Oriental (OR) |
| *Bambusaspis miliaris* (Boisduval)* | 2002 | Germain *et al.* 2002 | minor pest | *Bambusa* | Oriental |
| **Coccidae** | | | | | |
| *Ceroplastes floridensis* Comstock | 1930 | Balachowsky 1930b | pest[a] | Polyphagous | Neotropical (NE) |
| *Ceroplastes japonicus* Green | 1930 | Pellizzari & Camporese 1994 | pest[a] | Polyphagous | Oriental |
| *Ceroplastes sinensis* Del Guercio | 1928 | Balachowsky 1932a | pest[a] | Polyphagous | Neotropical? |
| *Coccus hesperidum* Linnaeus | previous 1931 | Balachowsky 1931 | minor pest[a] | Polyphagous | Tropical |
| *Coccus longulus* (Douglas) | 2001 | Foldi 2001 | minor pest | Polyphagous | Tropical |
| *Coccus pseudomagnoliarum* (Kuwana) | 1974 | Ben-Dov 1980 | minor pest[a] | *Citrus, Celtis autralis, Laurus nobilis, Nerium oleander* | Oriental |
| *Eucalymnatus tessellatus* (Signoret) | previous 1932 | Balachowsky 1932b | minor pest[a] | Polyphagous | Neotropical |
| *Neopulvinaria innumerabilis* (Rathvon) | 1961 | Hodgson 1994 | minor pest[a] | Polyphagous | Nearctic (NE) |
| *Parasaissetia nigra* (Nietner) | 1933 | Foldi 2001 | minor pest[a] | Polyphagous | Afrotropical? |
| *Parthenolecanium fletcheri* (Cockerell) | previous 2001 | Foldi 2001 | minor pest[a] | Cupressaceae, *Taxus* | Nearctic |
| *Protopulvinaria pyriformis* Cockerell | previous 1991 | Canard 1997 | pest[a] | Polyphagous | OR or NT for USA |
| *Pulvinaria floccifera* (Westwood) | 1889 | Marchal 1907 | pest[a] | Polyphagous | East Palearctic? |
| *Pulvinaria hydrangeae (Steinweden)* | previous 2001 | Foldi 2001 | pest[a] | Polyphagous | Nearctic |
| *Pulvinaria regalis Canard* | previous 1968 | Canard 1968 | pest[a] | Polyphagous | Asia |
| *Pulvinariella mesembryanthemi (Vallot)* | 1918 | Balachowsky 1932a | minor pest[a] | Aizoaceae and Chenopodiaceae | Afrotropical |
| *Saissetia coffeae* ( Walker) | 1929 | Balachowsky 1932a | pest[a] | Polyphagous | Afrotropical? |
| *Saissetia oleae* (Olivier) | 1929 | Balachowsky 1930a | pest[a] | Polyphagous | Afrotropical |

Table 1. Continued

| Family and Species | Date of introduction | References | Pest or threat status | Principle hosts | Origin |
|---|---|---|---|---|---|
| **Diaspididae** | | | | | |
| *Abgrallaspis cyanophylli* (Signoret) | 1904 | Balachowsky 1932a | minor pest [a] | Polyphagous | Tropical |
| *Acutaspis perseae* (Comstock) | 2001 | Foldi 2001 | minor pest | Polyphagous | Neotropical |
| *Aonidiella aurantii* (Maskell) | 1929 | Balachowsky 1932a | Pest [a] | Polyphagous pest on *Citrus* | Ethiopian or Oriental |
| *Aonidiella citrina* (Coquillett)* | previous 2002 | Germain & Bertaux 2002 | minor pest [a] | Polyphagous, Citrus | Tropical |
| *Aonidiella taxus* Leonardi | 1929 | Balachowsky 1948 | minor pest [a] | *Cephalotaxus*, *Podocarpus*, *Taxus* | Oriental? |
| *Aspidiotus destructor* Signoret* | 2002 | Chapin & Germain 2005 | minor pest | Polyphagous | Tropical |
| *Aspidiotus nerii* (Bouché) | 1867 | Boisduval 1867 | pest [a] | Polyphagous | Afrotropical? |
| *Aulacaspis yasumatsui* Takagi* | 2001 | Germain 2002 | threat | Cycadaceae | Oriental |
| *Chrysomphalus aonidum* (Linnaeus) | previous 1935 | Balachowsky & Mesnil 1935 | pest [a] | Polyphagous, *Citrus* | Neotropical |
| *Chrysomphalus dictyospermi* (Morgan) | 1899 | Cockerell 1900 | pest [a] | Polyphagous, *Citrus* | Tropical |
| *Comstockiella sabalis* (Comstock)* | 2005 | Germain & Matile-Ferrero, 2006 | threat | Palmae | Nearctic |
| *Diaspidiotus perniciosus* (Comstock) | 1935 | Balachowsky 1950 | pest [a] | Polyphagous | East Palearcti |
| *Diaspis boisduvalii* Signoret | 1869 | Balachowsky 1954 | pest [a] | Polyphagous | Neotropical |
| *Diaspis bromeliae* (Kerner) | previous 1954 | Balachowsky 1954 | pest [a] | Polyphagous, Bromeliaceae | Neotropical |
| *Diaspis echinocacti* (Bouché) | 1929 | Balachowsky 1932a | pest [a] | Especially Cactaceae | Neotropical |
| *Fiorinia fioriniae* (Targioni Tozzetti) | 1868 | Boisduval 1868 | pest [a] | Polyphagous | Oriental? |
| *Furchadaspis zamiae* (Morgan) | 1929 | Balachowsky 1930b | pest [a] | Especially Cycadaceae | Afrotropical |
| *Gymnaspis aechmeae* Newstead | 1929 | Balachowsky 1930b | pest [a] | Especially Bromeliaceae | Tropical |
| *Hemiberlesia lataniae* (Signoret) | 1869 | Signoret 1869a | pest [a] | Polyphagous | Tropical |
| *Hemiberlesia rapax* (Comstock) | 1921 | Balachowsky 1932a | pest [a] | Polyphagous | Tropical |
| *Howardia biclavis* (Comstock) | previous 1954 | Balachowsky 1954 | minor pest | Polyphagous | Tropical |
| *Ischnaspis longirostris* (Signoret) | previous 1954 | Balachowsky 1954 | minor pest [a] | Polyphagous | Tropical |

**Table 1.** Continued

| Family and Species | Date of introduction | References | Pest or threat status | Principle hosts | Origin |
|---|---|---|---|---|---|
| *Kuwanaspis pseudoleucaspis* (Kuwana) | 1908 | Balachowsky 1932a | minor pest [a] | Poaceae | Oriental |
| *Lepidosaphes beckii* (Newman) | 1926 | Balachowsky 1932a | pest [a] | Polyphagous, especially *Citrus* | Tropical |
| *Lepidosaphes gloverii* (Packard) | 1930 | Balachowsky 1932a | minor pest [a] | Polyphagous | Tropical |
| *Lindingaspis rossi* (Maskell) | previous 1951 | Balachowsky 1951 | minor pest [a] | Polyphagous | Tropical |
| *Odonaspis secreta* (Cockerell) | 1929 | Balachowsky 1930b | minor pest [a] | Poaceae | Oriental |
| *Opuntiaspis philococcus* (Cockerell) | 1929 | Balachowsky 1932a | minor pest [a] | Especially Cactaceae | Neotropical |
| *Parlatoria blanchardi* Targioni Tozzetti | 2001 | Foldi 2001 | minor pest | Especially Palmae | Middle-East |
| *Parlatoria camelliae* Comstock | previous 2001 | Foldi 2001 | minor pest [a] | Polyphagous | Oriental |
| *Parlatoria crotonis* Douglas | previous 1953 | Balachowsky 1953 | minor pest [a] | Polyphagous | Tropical |
| *Parlatoria pergandii* Comstock | 1929 | Balachowsky 1932a | pest [a] | Polyphagous especially *Citrus* | Tropical |
| *Parlatoria proteus* (Curtis) | 1939 | Morrison 1939 | minor pest [a] | Polyphagous | Tropical |
| *Parlatoria theae* Cockerell | previous 1953 | Balachowsky 1953 | minor pest [a] | Polyphagous | Tropical |
| *Parlatoria ziziphi* (Lucas) | 1853 | Lucas 1853 | minor pest [a] | Especially *Citrus* | Oriental |
| *Pinnaspis aspidistrae* (Signoret) | 1869 | Signoret 1869b | minor pest [a] | Polyphagous | Oriental |
| *Pinnaspis buxi* (Bouché)* | 2002 | Germain *et al.* 2002 | minor pest [a] | Polyphageous | Tropical |
| *Pinnaspis strachani* (Cooley)* | 2002 | Germain *et al.* 2002 | minor pest [a] | Polyphagous | Tropical |
| *Pseudaulacaspis cockerelli* (Cooley) | 2000 | Picart & Matile-Ferrero 2000 | minor pest [a] | Polyphagous | Oriental |
| *Pseudaulacaspis pentagona* (Targioni Tozz.) | 1918 | Vayssière 1918 | pest [a] | Polyphagous | Oriental |
| *Pseudoparlatoria ostreata* Cockerell | previous 1954 | Balachowsky 1954 | not a pest [a] | Polyphagous | Neotropical |
| *Pseudoparlatoria parlatorioides* (Comstock) | previous 1954 | Balachowsky 1954 | not a pest [a] | Polyphagous | Neotropical |
| *Rutherfordia major* (Cockerell)* | 2002 | Germain *et al.* 2002 | minor pest [a] | Polyphagous | Tropical |
| *Unaspis euonymi* (Comstock) | 1886 | Signoret 1886 | pest [a] | Polyphagous | East Palearctic |
| *Unaspis yanonenis* (Kuwana) | 1969 | Benassy 1969 | pest [a] | Rutaceae | Oriental |

**Table 1.** Continued

| Family and Species | Date of introduction | References | Pest or threat status | Principle hosts | Origin |
|---|---|---|---|---|---|
| **Eriococcidae** | | | | | |
| *Eriococcus coccineus* (Cockerell) | 1930 | Balachowsky 1932a | minor pest [a] | Cactaceae | Nearctic |
| *Eriococcus williamsi* Danzig* | 2007 | Germain *et al.* 2007 | not a pest [a] | Buxus | Palearctic (PA) |
| *Ovaticoccus agavium* (Douglas) | 1912 | Balachowsky 1932a | minor pest [a] | Agavaceae | Nearctic |
| **Margarodidae** | | | | | |
| *Icerya formicarum* Newstead | 2001 | Foldi 2001 | minor pest | Polyphagous | Oriental |
| *Icerya purchasi* Maskell | 1912 | Marchal 1913 | pest [a] | Polyphagous | Australasian (AU) |
| *Icerya seychellarum* (Westwood)* | 2006 | Germain *et al.* 2007 | threat | Polyphagous | Asia |
| ***Ortheziidae*** | | | | | |
| *Insignorthezia insignis* (Browne) | previous 1925 | Morrison 1925 | not a pest [a] | Polyphagous | NT or NE |
| **Phoenicococcidae** | | | | | |
| *Phoenicococcus marlatti* Cockerell | previous 1930 | Balachowsky 1930b | pest [a] | Especially Palmae | Tropical |
| **Pseudococcidae** | | | | | |
| *Antonina crawi* Cockerell | 1937 | Goux 1937 | not a pest [a] | Especially Poaceae | East Palearctic |
| *Antonina graminis* (Maskell) | 2000 | Foldi 2000 | not a pest [a] | Especially Poaceae | Oriental |
| *Balanococcus diminutus* (Leonardi) | 2001 | Foldi 2001 | minor pest [a] | Agavaceae | Australasian |
| *Chorizococcus rostellum* (Lobdell) | 2001 | Foldi 2001 | minor pest [a] | Especially Poaceae | NT or NE |
| *Crisicoccus pini* (Kuwana)* | 2006 | Germain & Matile-Ferrero 2006 | threat [a] | Pinaceae | East Palearctic |
| *Delottococcus euphorbiae* (Ezzat & McConnell) | 1983 | Matile-Ferrero 1983 | minor pest [a] | Polyphagous | Afrotropical |
| *Ferrisia virgata* (Cockerell) | 2000 | Foldi 2000 | minor pest [a] | Polyphagous | NT or PA |

**Table 1.** Continued

| Family and Species | Date of introduction | References | Pest or threat status | Principle hosts | Origin |
|---|---|---|---|---|---|
| *Geococcus coffeae* Green | | | | | |
| *Hypogeococcus pungens* Granara de Willink* | 2002 | Ben-Dov & Matile-Ferrero 2002 | minor pest [a] | Cactaceae | Neotropical |
| *Palmicultor palmarum* (Ehrhorn)* | 2004 | Chapin & Germain 2005 | minor pest | Palmae | Tropical |
| *Phenacoccus defectus* Ferris* | 2005 | Germain & Matile-Ferrero 2006 | threat | Polyphagous | Neotropical |
| *Phenacoccus madeirensis* Green* | 2003 | Matile-Ferrero & Germain 2004 | major threat [a] | Polyphagous | Neotropical |
| *Phenacoccus pumilus* Kiritchenko | 1948 | Goux 1948 | not a pest [a] | Polyphagous | Centre Palearctic |
| *Planococcus citri* (Risso) | 1813 | Risso 1813 | pest [a] | Polyphagous | Oriental |
| *Pseudococcus comstocki* (Kuwana)* | 2004 | Kreiter & Germain 2005 | major threat [a] | Polyphagous | East Palearctic |
| *Pseudococcus longispinus* (Targioni Tozz.) | 1875 | Signoret 1875a | pest [a] | Polyphagous | Australasian |
| *Pseudococcus microcirculus* McKenzie | 2000 | Picart & Matile-Ferrero 2000 | minor pest [a] | Orchidaceae | Neotropical |
| *Pseudococcus viburni* (Signoret) | 1875 | Signoret 1875b | pest [a] | Polyphagous | Nearctic |
| *Rhizoecus dianthi* Green* | 2001 | Germain *et al.* 2002 | minor pest [a] | Polyphagous | Au ou PA? |
| *Spilococcus mamillariae* (Bouché) | 1929 | Balachowsky 1930a | not a pest [a] | Cactaceae | Nearctic |
| *Trionymus angustifrons* Hall | 2001 | Foldi 2001 | minor pest | Especially Compositae | Middle-East? |
| *Trochiscococcus speciosus* (De Lotto) | 2000 | Picart & Matile-Ferrero 2000 | minor pest [a] | Liliaceae | Afrotripical |
| *Vryburgia amaryllidis* (Bouché) | 2001 | Foldi 2001 | minor pest [a] | Polyphagous | Afrotropical |
| *Vryburgia rimariae* Tranfaglia | 2001 | Foldi 2001 | minor pest [a] | Especially Crassulaceae | Afrotropical |

* new species since Foldi, 2001; [a] established species

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