

A new record of *Pulvinaria hydrangeae* Steinweden, 1946 (Hemiptera: Coccoomorpha: Coccidae), a potentially damaging scale insect in Poland

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Abstract: A soft scale, *Pulvinaria hydrangeae* Steinweden, 1946 has been observed in large numbers on various host species in urban areas and natural habitats in Central Poland, and may be noteworthy as a potential pest of commercial and forest plants. Basic diagnostic information on this scale, as well as information on its life cycle, host range and distribution are provided. *Pulvinaria hydrangeae* resembles the cosmopolitan *P. floccifera* (Westwood, 1870), and the main characteristics that distinguish these two species from each other are discussed. A key to adult females of the *Pulvinaria* species found outdoors in Poland is also included.

Key words: Cottony hydrangea scale, diagnosis, key, host plants, pest

Introduction

The genus *Pulvinaria* Targioni-Tozzetti, 1866, type species *Coccus vitis* Linnaeus, 1758 is considered to belong to the tribe Pulvinariini within the subfamily Coccinae (Hodgson 1994), and currently it is one of the largest genus in the family Coccidae with 144 species found throughout the world (García Morales *et al.* 2016). Adult females of *Pulvinaria* species are recognized mainly by the presence of a white cottony ovisac secreted from under the body surface, small dorsal tubular ducts, dorsal tubercles present or absent, several types of ventral tubular ducts present in the medial and submarginal areas of the body, and tibio-tarsal articulatory sclerosis present on each leg (Hodgson 1994). This genus has recently been recognized as non-monophyletic by Choi & Lee (2020) based on molecular data, and a full revision of *Pulvinaria* is clearly needed.

Pulvinaria species are known from almost all zoogeographical regions, but have been mainly recorded from the Palearctic (67 species), followed by Neotropical (28), Nearctic (25), Afrotropical (23), Oriental (21) and Australasian (15) regions (García Morales

et al. 2016). Almost all species of *Pulvinaria* are restricted to woody or herbaceous plants. Most species have been recorded on various trees and bushes of Dicotyledones, either wild or cultivated, living mainly on leaves, stems, twigs, and sometimes on fruits (e.g. *Pulvinaria psidii* Maskell, 1893; *P. rhois* Ehrhorn, 1898) or roots of their hosts (e.g. *P. bigeloviae* Cockerell, 1893; *P. rizophila* Borchsenius, 1952; *P. terrestris* Borchsenius, 1953). Many *Pulvinaria* species are highly polyphagous, and some are economically important pests of commercial and wild plants.

To date, 15 outdoor species of *Pulvinaria* have been recorded from Europe (Łagowska *et al.* 2018). Among them, *P. vitis* (Linnaeus, 1758), *P. floccifera* (Westwood, 1870), *P. hydrangeae* Steinweden, 1946 and *P. regalis* Canard, 1968, are well-known species widely distributed in Europe, whereas *P. ampelopsidis* Savescu, 1983, *P. brachiungualis* Savescu, 1985, *P. cestri* (Bouché, 1833), *P. corni* Savescu, 1985, *P. salicis* Bouché, 1851, *P. savescui* Ben-Dov, 1993, *P. simplex* King in Hofer, 1903, and *P. vinifera* King in Hofer, 1903, have no longer been recorded since their descriptions and their taxonomic identity and status remain unclear.

The major revisionary work of the genus *Pulvinaria* in Poland was carried out by Łagowska (1996). The author, based on extensive morphological and biological studies and host-plant transfer techniques, concluded that only *P. vitis* occurred naturally in the wild in Poland. Years later, 2 alien, outdoor species were added to *Pulvinaria* in Poland, namely *P. floccifera* and *P. regalis* (Łagowska *et al.* 2017, 2018). At the same time, a short communication about the presence of *P. hydrangeae* in Poland was also published (Jankowska & Wojciechowicz-Żytko 2017). However, the identification of this species was based only on the external appearance of the adult female with ovisacs and the host plant species (*Hydrangea macrophylla* (Tunb.) Ser.) and this record is clearly questionable.

The present study reports the first valid record of *P. hydrangeae* in Poland, provides some basic diagnostic information on this species and an identification key of the *Pulvinaria* species so far recorded in Poland.

Material and Methods

Specimens were collected from different host plants species in natural habitats as well as from maple trees in the city of Warsaw (Czerniaków District). Samples of twigs and leaves were taken to the diagnostic laboratory of the Department of Plant Protection, University of Life Sciences, Lublin, for slide-mounting and identification. Specimens were mounted following the techniques developed by Hodgson & Henderson (2000), and were identified based on adult female morphology as described by Steinweden (1946) and Hodgson & Henderson (2000). Morphological character states used to diagnose *P. vitis* and *P. regalis* were taken from Hodgson (1994) and Canard (1968) respectively, while those for *P. floccifera* - from Tanaka & Amano (2007). The morphological features of adult females were consistent with those defined by Hodgson (1994). Morphological

observations of slide-mounted adult females and third instar nymphs were performed based on 15 specimens mounted on 12 slides. Both dry and mounted specimens were deposited at the Department of Plant Protection, University of Life Sciences, Lublin.

Results

The cottony hydrangea scale is reported for the first time from Poland, based on many specimens collected from a variety of host plants since 2018.

Material examined

Poland: Warsaw, Warsaw Uprising Mound (52°12'40"N 21°03'21"E); 10 adult females with ovisacs on *Acer negundo* L., 30.06.2018, B. Łagowska coll.; Warszawa, Nature Reserve Skarpa Ursynowska (52°09'54"N 21°03'09"E); 15 adult females with ovisacs on *Acer platanoides* L., *Cornus sanguinea* L., *Tilia cordata* Mill., 12.07.2019, B. Łagowska coll.; Educational trail Serock – Jadwisin (52°28'59"N 21°13'49"E); 20 old adult females with ovisacs and 30 third-instar nymphs on *Acer campestre* L., *A. platanoides*, *T. cordata*, and *C. sanguinea*, 14.10. 2019, B. Łagowska coll; 30 young adult females on *A. campestre*, 24.05. 2020, B. Łagowska coll.

Diagnosis

Pulvinaria hydrangeae Steinweden, 1946

Living individual. Young adult females elongate oval to almost oval, yellow or light brown in colour, rather flat. Ovipositing females become darker and shrunken with age. Ovisac up to about 17 mm long and 4.5 mm wide (Canard 1965b), white, flocculent, convex dorsally, with four longitudinal ridges in medial and lateral areas.

Slide-mounted adult female. Body elongate oval, 2.0–3.4 mm long, 1.6–2.9 mm wide with distinct stigmatic clefts. Dermal areolation present on entire dorsum. Dorsal tubercles absent. Dorsal setae small, sharply

Key to *Pulvinaria* species recorded in Poland, based on adult female morphology

1.	Marginal setae spinose, frayed, bifid or finely pointed; pregenital disc-pores with mainly 7 loculi	2
1A.	Marginal setae slender and pointed, never frayed or divided; pregenital disc-pores with mainly 10 loculi	3
2.	Dorsal tubercles present; dermal areolations absent; anal plates without setae in subdiscal position; small ventral tubular ducts a few or absent in submarginal area of head	<i>P. floccifera</i>
2A.	Dorsal tubercles absent; dermal areolations present; anal plate each with one seta in subdiscal position; small ventral tubular ducts present in a complete submarginal area of head	<i>P. hydrangeae</i>
3.	Tubular ducts present both on dorsum and venter, dorsal tubercles present or absent, claw with a small denticle	<i>P. vitis</i>
3A.	Tubular ducts present on venter only; dorsal tubercles absent, claw without a denticle	<i>P. regalis</i>

pointed, present throughout. Preopercular pores present in an elongate group of 10–60 anterior to anal plates. Dorsal tubular ducts and dorsal microducts scattered over entire dorsum. Anal plates, each with 3 fine setae near apex and 1 seta in subdiscal position. Marginal setae slender, slightly curved, mostly with an acute apex, a few with fimbriated or bifid tips. Stigmatic clefts with three spines, each median spine 2.5–3.0 times as long as lateral spines and bluntly pointed. Venter with multilocular disc-pores, each with mainly seven loculi, present in a dense group around genital opening, becoming much less frequent across anterior abdominal segments, with a group laterad to each meta- and mesocoxa. Ventral tubular ducts of three types present: (1) large ducts each with a developed outer ductule, broad inner ductule and a well-developed terminal gland; present frequently on medial area and submedially on head and thorax and sometimes on abdominal segments II and III; (2) intermediate ducts with a slender inner ductule and a well-developed terminal gland, distributed medially and mediolaterally on abdomen and laterad to type 1 on head and thorax; and (3) short ducts with a small terminal gland, present on outer submarginal area and forming a complete submarginal band. Ventral microducts mostly frequent on submargin. Antennae well developed, each 8-segmented, legs with a tibio-tarsal articulation and an articulatory sclerosis; claws without a denticle.

Comments. Among the *Pulvinaria* species currently recorded from Poland, the adult female of *P. hydrangeae* is most similar to *P. floccifera* sharing with it the following character states: (a) some marginal setae frayed or expanded; (b) multilocular disc-pores with mainly seven loculi; (c) presence of three types of ventral tubular ducts; (d) similar distribution of large and intermediate tubular ducts on the venter. *Pulvinaria hydrangeae* differs from *P. floccifera* (*P. floccifera* character states in brackets) as follows: (a) dorsal areolations present (absent); (b) dorsal tubercles absent (present); (c) one subdiscal seta on each anal plate (absent); (d) short ventral tubular ducts present in a complete, broad submarginal band including the head area (absent or a few in the submarginal area of head).

Adult females with ovisacs were observed on the underside of the leaves of *Acer*, *Cornus* and *Tilia*, while third-instar nymphs were found on the apical stems of host plants. Maple trees growing in Warsaw (Fig. 1) and natural habitats as well as dogwoods in reserves were most seriously infested by *P. hydrangeae*.

In the field, *Pulvinaria* species are most easily distinguished as adult females with white ovisacs. Some field characters, including oviposition site and the appearance of ovisacs can be useful identifying *Pulvinaria* species found outdoors in Poland. Both species of *P. hydrangeae* and *P. floccifera* oviposit on the under surface of foliage, but



Fig. 1. *Pulvinaria hydrangeae*, adult females with ovisacs on the leaves of a maple tree. (Photo by P. Ceryngier).

the latter produces longer ovisacs with roughly parallel sides lacking shallow grooves present in *P. hydrangeae* (Fig. 2a, b). The other two *Pulvinaria* species (*P. vitis* and *P. regalis*) produce large, strongly convex ovisacs and oviposit on woody parts of their hosts, but *P. vitis* oviposits usually on smaller branches, while *P. regalis* prefers the trunk and main branches of its hosts (Fig. 2c, d).

Discussion

Pulvinaria hydrangeae was originally described from adult females collected on *Hydrangea hortensis* in San Mateo, California (Steinweden 1946). Since then, several further descriptions of *P. hydrangeae* adult female were published by Canard (1965b), Williams & Kosztarab (1972), Qin & Gullan (1992), and more recently by Hodgson & Henderson (2000) and Choi & Lee (2017). According to Steinweden (1946) and Hodgson & Henderson (2000), this species can be easily identified by the subdiscal seta on each anal plate and the absence of dorsal tubercles. All adult females collected in Poland have no tubercles on the dorsum, but have four setae on each anal plate including one seta in the subdiscal position.

The origin of *P. hydrangeae* is unclear. This species was described from specimens collected in North America in 1935, although it was also reported in the same publication

to have been collected in Japan in 1895 (Steinweden 1946). Salisbury and Malumphy (2007) suggest that *P. hydrangeae* is native to temperate and subtropical regions of Asia.

Among the alien *Pulvinaria* species currently recorded from Poland, *P. floccifera*, *P. regalis* and *P. hydrangeae* have adapted to outdoor conditions over the past ten years (Łagowska *et al.* 2015, 2017; Łagowska & Golan 2018). The occurrence of these species in Poland is probably a consequence of foreign plant trade and climate change, which are potential drivers of the expansion of many exotic species towards northern Europe. In Europe, *P. hydrangeae* was first found in France (Canard 1965a) and has since been reported from 17 European countries as well as Australia, Asia, New Zealand and the United States (García Morales *et al.* 2016).

The cottony hydrangea scale is a polyphagous insect with more than 60 host plant species belonging to 28 families and 54 genera (García Morales *et al.* 2016). These species may attack various shrubs and trees, such as *Acer*, *Celtis*, *Cornus*, *Euonymus*, *Hydrangea*, *Lonicera*, *Populus*, *Tilia* and other ornamentals. In Poland, it was found on maple trees in urban areas and on lime, maple and dogwood in natural habitats. Infestation was extremely severe on all host plants, which can cause them vigor and leaf loss, and a huge number of white ovisacs may be considered as an aesthetic problem.

Pulvinaria hydrangeae is probably more widespread in Poland than the current study shows. This scale can quickly colonize neighbouring plants and new habitats because of its broad polyphagism, high fecundity and ability to spread rapidly as highly mobile first instar crawlers. So far, almost all alien species in Poland have been recorded on commercial plants in urban and rural areas (Łagowska *et al.* 2015, Łagowska & Golan 2018) but *P. hydrangeae* has also invaded natural habitats in Poland and poses a potential threat to many forest plant species. *Pulvinaria hydrangeae* develops one

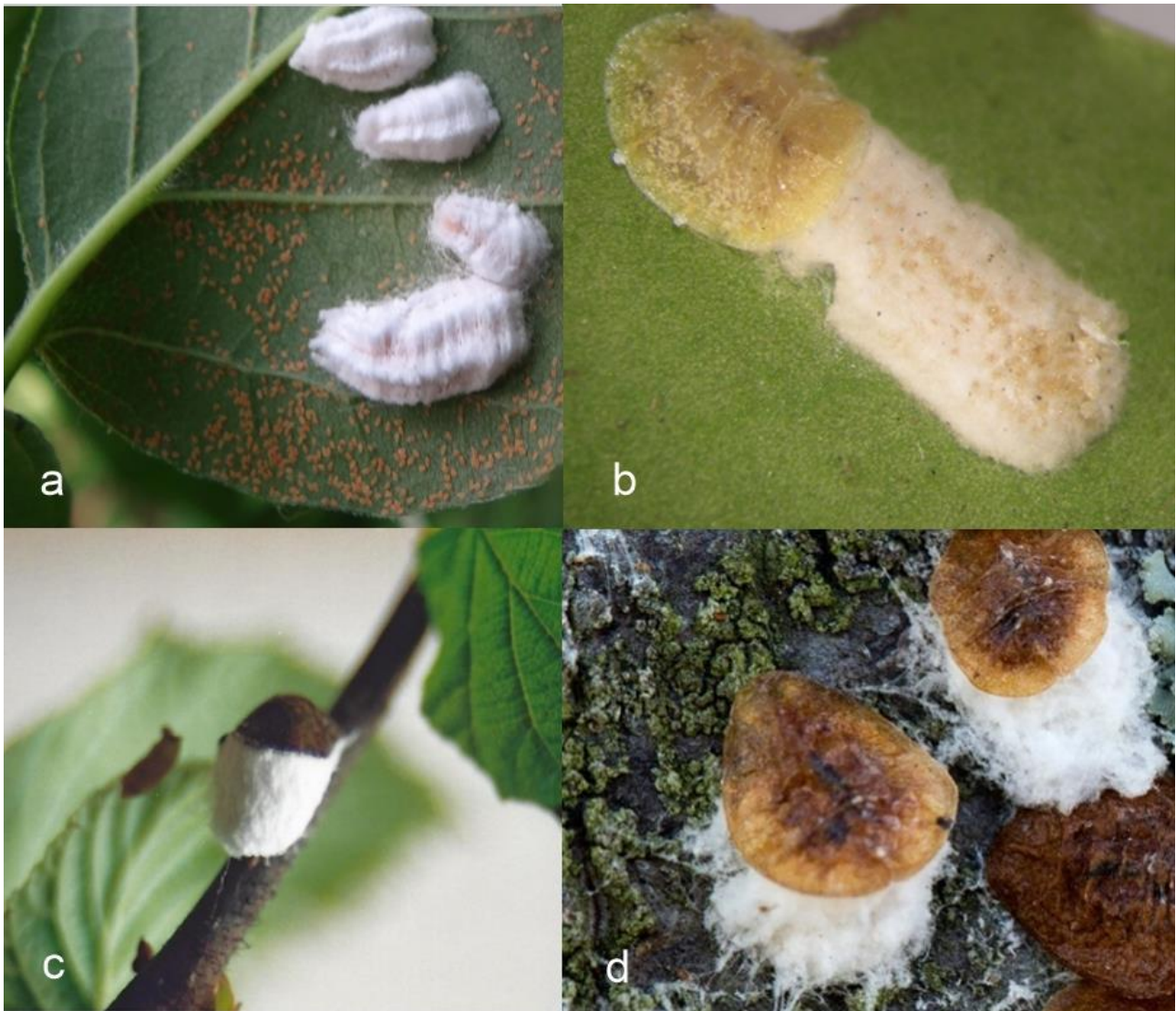


Fig. 2. Adult females with ovisacs of *Pulvinaria* species recorded in Poland: a. *Pulvinaria hydrangeae* ovisacs on *Acer negundo* (Photo by P. Ceryngier); b. *Pulvinaria floccifera* adult female with ovisac on *Ilex* sp. (Photo by K. Golan); c. *Pulvinaria vitis* adult female with ovisac on *Corylus* sp. (Photo by B. Lagowska); d. *Pulvinaria regalis* adult female with ovisac on *Acer* sp. (Photo by M. Michalski).

generation per year in its entire range and third-instar nymphs overwinter (Canard 1965b, Pellizzari Scaltriti 1976, Gill 1988, Graora *et al.* 2013). In Poland, overwintering third-instar nymphs have been observed in high densities on the tops of thin branches of maples and dogwoods. Adult development is completed during spring, mainly on the underside of host plant leaves, where adult females form ovisacs and lay eggs in early May in France. Each adult female can produce from 2 500 to 2 800 eggs (Canard 1965b). Adult females reproduce parthenogenetically, although males are occasionally present (Canard 1969). Crawlers

hatch from the second decade of June to early July and remain on the leaves, where they feed and reach the third instar. In October – November, third-instar nymphs move to the woody parts of plants to overwinter (Canard 1965b).

In recent years, the economic importance of *P. hydrangeae* appears to be increasing in Europe. It has become more abundant in Britain, and has extended its geographical distribution and host range (Salisbury & Malumphy 2017). This species has also been reported as a pest in urban areas in Belgium (Merlin *et al.* 1988), the Netherlands (Jansen 2000), Slovenia (Seljak 2007), France

(Germain 2008), Croatia (Masten Milek *et al.* 2009), Serbia (Graora *et al.* 2013), whereas in Florida, California, Australia and New Zealand it is not considered economically important (Hamon & Williams 1984, Gill 1988, Qin & Gullan 1992, Hodgson & Henderson 2000).

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