

Records of *Ceroplastes* Gray 1828 in Europe, with an identification key to species in the Palaearctic Region

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Abstract

The genus *Ceroplastes* (Hemiptera Coccoidea Coccidae) in Europe is reviewed. Surveys of Hungarian nurseries, greenhouses and flower shops found plants infested with *Ceroplastes* scale insects. Among them, *Ceroplastes rubens* Maskell 1893 was identified. Since there is constant invasion of European markets by species of *Ceroplastes*, a key is presented to separate the species currently known to occur in the Palaearctic Region.

Key words: wax scales, introduced pests, distribution, taxonomy, Palaearctic Region, Hungary, identification key.

Introduction

The establishment of several invasive scale insects (Hemiptera Coccoidea) has been reported in Europe in the last years (Pellizzari and Germain, 2010; Pellizzari and Kozár, 2011; Fetykó and Szita, 2012). This has increased the number of species established outdoors, in greenhouses and on house plants.

The increase in the number of species of the genus *Ceroplastes* Gray 1828 (Hemiptera Coccoidea Coccidae Ceroplastinae) in the Palaearctic region is remarkable. According to the ScaleNet database (Ben-Dov *et al.*, 2012) 13 species have been recorded from the Palaearctic Region, 8 of them from Europe. Seven species are established outdoors in several southern Mediterranean countries, and some have been recorded from indoors in Central and Northern Europe.

In Italy, the invasive *Ceroplastes japonicus* Green was recorded in 1984 and *Ceroplastes ceriferus* (F.) in 2001 (Kozár *et al.*, 1984; Mori *et al.*, 2002). Then *C. japonicus* started to spread to other European countries like Bulgaria, Croatia, France, Slovenia and Turkey (Panis, 1981; Pellizzari and Camporese, 1994; Jancar *et al.*, 1999; Foldi, 2001; Mori *et al.*, 2002; Masten-Milek *et al.*, 2007; Kaydan and Kondo, 2008; Trencheva *et al.*, 2010). In Hungary, *Ceroplastes rusci* (L.) was found on *Ficus* spp. before 1917 (Kozár, 2005); *Ceroplastes hodgsoni* (Matile-Ferrero et Le Ruyet) was found on *Ficus benjamina* L. plants in a greenhouse (Kozár, 2005). The Hungarian scale insect fauna in indoor and outdoor conditions has been treated in detail (Kosztarab and Kozár, 1988; Kozár, 2005; Fetykó and Szita, 2012).

In Europe, *Ceroplastes stellifer* (Westwood) *sensu* Peronti *et al.*, 2008 (= *Vinsonia stellifera* Westwood) is known only from interception records (Jansen, 1995; Pellizzari and Russo, 2005). The polyphagous *Ceroplastes rubens* Maskell has been intercepted by quarantine services in UK and Netherlands (Jansen, 1995; 2004; Malumphy, 2010); a Pest Risk Analysis (PRA) was prepared by Malumphy (2011), which showed the world-wide distribution of this species in both tropical and Mediterranean countries. In the Palaearctic region it

has been recorded also from China, Egypt, Japan and South Korea (Ben-Dov *et al.*, 2012).

The aim of the present work was to study the *Ceroplastes* species in Central Europe and to construct an identification key to those known from the Palaearctic Region.

Materials and methods

A survey was conducted between 2006 and 2012 in some Central European greenhouses, botanical gardens, nurseries and on house plants; 75 samples of scale insects were collected and studied in the laboratory. The specimens were slide-mounted according to method given by Kosztarab and Kozár (1988) and have been deposited in the scale insect collection of the Plant Protection Institute, Centre for Agricultural Research, Hungarian Academy of Sciences, Budapest, Hungary (PPI).

In this paper we follow the nomenclature of Ben-Dov *et al.* (2012). Terminology used in the key follows mostly that used by Gimpel *et al.* (1974), Williams and Watson (1990), Ben-Dov *et al.* (2000), and Hodgson and Peronti (2012). Detailed descriptions with useful drawings can be found in works of Gimpel *et al.* (1974), Hodgson and Peronti (2012), Pellizzari and Camporese (1994), Tang (1991), and Williams and Watson (1990). A detailed new taxonomic illustration of *C. japonicus* was published in Kaydan and Kondo (2008), and photographs of *C. rubens* were provided by Kondo (2008).

Results and discussion

The species of *Ceroplastes* known from the Palaearctic are listed in table 1. In Central Europe (Hungary), the first report of the genus *Ceroplastes* was *C. rusci* on *Ficus* spp. in the middle of the country (Simontornya, before 1917) (Kozár, 1989); however, no voucher specimens of this record are known. In 1994, *F. benjamina* plants infected with *C. hodgsoni* were found in a Hungarian greenhouse; the infestation was probably

Table 1. A list of *Ceroplastes* species recorded from the Palearctic Region.

Species	Distribution in the Palearctic Region	Habitat	References	*Remarks
<i>Ceroplastes actiniformis</i> Green 1896	Canary Islands, Egypt, Israel	Outdoor species	Ben-Dov <i>et al.</i> (2012)	1
<i>Ceroplastes centroroseus</i> Chen 1974	China	Outdoor species	Ben-Dov <i>et al.</i> (2012)	
<i>Ceroplastes ceriferus</i> (F. 1798)	Canary Islands, China, Italy, Japan, Netherlands, UK	Intercepted several times in North Europe; Outdoor pest species in the Mediterranean region	Mori <i>et al.</i> (2002) Pellizzari <i>et al.</i> (2004) Ben-Dov <i>et al.</i> (2012) Malumphy and Badmin (2012)	2
<i>Ceroplastes cirripediformis</i> Comstock 1881	Greece, Italy	Outdoor species	Ben-Dov <i>et al.</i> (2012)	
<i>Ceroplastes cistudiformis</i> Cockerell 1893	UK	In greenhouse	Malumphy (2010)	3
<i>Ceroplastes destructor</i> Newstead 1910	UK (eradicated)	In botanical collection	Malumphy (2010)	
<i>Ceroplastes eugeniae</i> Hall 1931	Algeria (Sahara Central)	On Asclepiadaceae	Hodgson and Peronti (2012)	4
<i>Ceroplastes floridensis</i> Comstock 1881	Azores, China, Canary Islands, Crete, Cyprus, Egypt, France, Greece, Iran, Israel, Italy, Japan, Jordan, Lebanon, Libya, Madeira Islands, Malta, Netherlands, Oman, Saudi Arabia, Syria, Tunisia, Turkey	Outdoor species in the southern zone of the Palearctic Region, often intercepted in UK	Kozár <i>et al.</i> (1996) Malumphy (2010) Franco <i>et al.</i> (2011) Ben-Dov <i>et al.</i> (2012) Hodgson and Peronti (2012)	
<i>Ceroplastes hodgsoni</i> (Matile-Ferrero et Le Ruyet 1985)	Hungary	In greenhouse	Kozár (2005)	5
<i>Ceroplastes japonicus</i> Green 1921	Armenia, Bulgaria, China [(Henan (=Honan) Shanxi (=Shansi)], Croatia, France, Georgia, Hungary, Italy, Japan, Netherlands, Russia, (Caucasus), Slovenia, South Korea, UK (England, eradicated)]	Outdoor species in Oriental and Palearctic regions, intercepted several times in UK; found in a nursery in Hungary	Pellizzari and Camporese (1994) Malumphy (2010) Ben-Dov <i>et al.</i> (2012) Klupács and Volent (2012)	6
<i>Ceroplastes kunmingensis</i> (Tang et Xie in Tang 1991)	China	Outdoor species	Ben-Dov <i>et al.</i> (2012)	
<i>Ceroplastes pseudoceriferus</i> Green 1921	China [Xizang (=Tibet)], Japan	Outdoor species	Ben-Dov <i>et al.</i> (2012)	7
<i>Ceroplastes rubens</i> Maskell 1893	China [Henan (=Honan), Shanxi (=Shansi), Xizang (=Tibet)], Egypt, Japan, South Korea	Outdoor species, intercepted and found in greenhouses in Netherlands; and several times intercepted in recent years in the UK; now found in a nursery in Hungary	Jansen (2004) Malumphy (2010) Ben-Dov <i>et al.</i> (2012)	8
<i>Ceroplastes rusci</i> (L. 1758)	Albania, Afghanistan, Algeria, Azores, Canary Islands, Corsica, Crete, Croatia, Cyprus, Egypt, France, Greece, Hungary, Iran, Iraq, Israel, Italy, Jordan, Libya, Lebanon, Madeira Islands, Malta, Morocco, Netherlands, Portugal, Sardinia, Saudi Arabia, Sicily, Spain, Syria, Tunisia, Turkey	Outdoor species in the Mediterranean region, often intercepted in UK	Kozár (1989; 2005) Kozár <i>et al.</i> (1996) Malumphy (2010) Franco <i>et al.</i> (2011) Ben-Dov <i>et al.</i> (2012)	9
<i>Ceroplastes sinensis</i> Del Guercio 1900	Azores, Canary Islands, Corsica, Crete, Croatia, Cyprus, Egypt, France, Georgia, Greece, Iran, Italy, Netherlands, Madeira Islands, Malta, Morocco, Portugal, Russia (Caucasus), Sardinia, Sicily, Spain, Turkey	Outdoor species in the southern zone of the Palearctic Region, often intercepted in UK	Malumphy (2010) Franco <i>et al.</i> (2011) Ben-Dov <i>et al.</i> (2012)	
<i>Ceroplastes stellifer</i> (Westwood 1871)	Italy, Netherlands; UK (eradicated)	Introduced in Italy, and intercepted in the Netherlands and UK	Jansen (1995; 2004) Malumphy (2010) Ben-Dov <i>et al.</i> (2012)	
<i>Ceroplastes xishuangensis</i> Tang et Xie in Tang 1991	China	Outdoor species	Ben-Dov <i>et al.</i> (2012)	

*Remarks: **1)** According to Hodgson and Peronti (2012) all African material deposited in the BMNH are misidentifications, so its presence in Mediterranean is questionable. These specimens are probably *Ceroplastes rusci*; **2)** The spread in Central Europe is likely; **3)** Probably died out (Malumphy, 2010); **4)** The identity of this record is not clear (Hodgson and Peronti, 2012); **5)** Probably died out; **6)** The spread in Central Europe is likely; **7)** The mention of *C. pseudoceriferus* in the Checklist of Korean insects, probably represents a misidentification of *C. ceriferus*. Lee *et al.* (2012) examined 143 specimens labelled as *C. pseudoceriferus*, deposited at the National Academy of Agricultural Science, Korea and determined that they were actually *C. ceriferus*; **8)** Dekle (2001) mentioned this species from Italy, also; **9)** The establishment in Hungary was not verified.

successfully eradicated. *C. japonicus* was recorded on *Ilex* sp. in a Hungarian nursery by Klupács and Volent (2012). Recently, *C. rubens* was collected on *Schefflera* sp. in a nursery (Budapest Botanical Garden, by K. Fetykó) in March, 2012. These new introductions necessitate a new identification key to *Ceroplastes* species in the Palaearctic region, which is presented below.

Distribution

The genus *Ceroplastes* contains 142 species, of which 73 appear to be endemic to the Neotropics, 58 to the Ethiopian Region (Hodgson and Peronti, 2012), and only 4 or 5 to other zoogeographical regions. Those recorded from the Mediterranean part of the Palaearctic and from the Nearctic are mostly introduced, cosmopolitan species (Kozár and Ben-Dov, 1997; Ben-Dov *et al.*, 2012).

The presence and distribution of *Ceroplastes* species in the Palaearctic Region is shown in table 1. The distribution records show a circum-Mediterranean natural

distribution of species in the southern zone of the Palaearctic region; and a great number of introduction records are known, especially in north-western Europe. Some species are probably restricted to the eastern part of the Palaearctic region (China, Japan, and Korea). Species found in the Mediterranean and in the northern part of the Palaearctic region have been introduced from different tropical and Mediterranean parts of the world. Distribution maps of some species in Italy (Pellizzari and Camporese, 1994) could serve as an insect thermometer, showing the distributional capability of those species. The introduced species in northern Italy (*C. japonicus* and *C. ceriferus*) are a significant threat to Central Europe in outdoor conditions.

Genus: *Ceroplastes* Gray 1828

The genus *Ceroplastes* Gray 1828 (type species: *Coccus (Ceroplastes) janeirensis* Gray 1828) was described in detail by Gimpel *et al.* (1974) and Hodgson and Peronti (2012).

Key to species of *Ceroplastes* in the Palaearctic Region based on slide-mounted adult females, based on Gimpel *et al.* (1974), Hodgson and Peronti (2012), Pellizzari and Camporese (1994), Tang (1991), and Williams and Watson (1990), with changes and additions

1	- Tibia and tarsus fused	2
--	- Tibia and tarsus not fused	3
2	- Stigmatic setae of two kinds, bullet-like and hemispherical; inter-antennal setae numbering two on each side	<i>C. rubens</i> Maskell
--	- Stigmatic setae of one kind, bullet-like; inter-antennal setae numbering 7-10 on each side	<i>C. stellifer</i> (Westwood)
3	- Antennae 7 segmented	4
--	- Antennae 6 segmented	6
4	- Ventral margin with a row of filamentous ducts	<i>C. sinensis</i> Del Guercio
--	- Ventral margin without filamentous ducts	5
5	- Stigmatic setae forming 3 irregular rows; all spiracular setae robust, conical, each twice as long as wide	<i>C. cirripediformis</i> Comstock
--	- Stigmatic setae forming 5-6 irregular rows; all spiracular setae short, each as long as wide	<i>C. cistudiformis</i> Cockerell
6	- Venter with a submarginal band of tubular ducts	7
--	- Venter without any submarginal band of tubular ducts	10
7	- Multilocular pores present near base of anterior coxa	8
--	- Multilocular pores absent from near base of anterior coxa	<i>C. centroroseus</i> Chen
8	- Stigmatic setae forming a continuous row along thoracic margin, with only 1-3 flagellate setae interspersed among them	<i>C. japonicus</i> Green
--	- Anterior and posterior stigmatic setae on thoracic margin separated by a row of 5+ flagellate marginal setae	9
9	- Claw digitules equal in size; dorsal quinquelocular pores absent	<i>C. floridensis</i> Comstock
--	- Claw digitules unequal in size; dorsal quinquelocular pores present	<i>C. kunningensis</i> (Tang et Xie in Tang)
10	- Tibio-tarsal articulatory scleritis present; stigmatic spines (spiracular setae) extending along margin beyond spiracular clefts	11
--	- Tibio-tarsal articulatory scleritis absent; stigmatic spines restricted to stigmatic clefts	12
11	- Dorsal setae conical and pointed; quinquelocular pores in spiracular furrow forming a narrow band, 2-3 pores wide	<i>C. xishuangensis</i> Tang et Xie in Tang
--	- Dorsal setae bullet-like and blunt; quinquelocular pores in spiracular furrow forming a wide band, 5-10 pores wide	<i>C. rusci</i> (L.)
12	- Claw digitules equal in length; all stigmatic setae short, wide and rounded	<i>C. hodgsoni</i> (Matile-Ferrero et Le Ruyet)
--	- Claw digitules unequal in length; all stigmatic setae bullet-like and pointed	13
13	- Dorsal and ventral submarginal filamentous ducts present; anal process short, not protruberant, less than 1/5 of length of body	14
--	- Dorsal and ventral submarginal filamentous ducts absent; anal process long, protruding, about 1/3 of length of body	<i>C. destructor</i> Newstead
14	- With about 50 enlarged setae in each stigmatic group	<i>C. ceriferus</i> (F.)
--	- With about 130 enlarged setae in each stigmatic group	<i>C. pseudoceriferus</i> Green

Conclusions

The number of *Ceroplastes* species in the Palaearctic Region now totals 16. In recent years, several introductions and establishments were recorded in Europe. Most of the new introductions originated from the Nearctic and Ethiopian regions or from South-East Asia. Climate change may have aided in the establishment of these new pest species, and contributed to their outbreaks and northern spread in outdoor conditions and in greenhouses in Central and Northern Europe.

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