

2019

# MONOGRAPHS OF THE UPPER SILESIAN MUSEUM

No.

10



Jolanta Brożek  
Mariusz Kanturski  
Roland Dobosz

## Progress in Hemipterology



**Muzeum  
Górnośląskie  
w Bytomiu**

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UPPER SILESIAN MUSEUM

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Krzysztofa Frankowska-Piechowicz

**Manuscript submission:**

Department of Natural History, Upper Silesian Museum in Bytom

Plac Jana III Sobieskiego 2, 41-902 Bytom, Poland

tel./fax +48 32 281 34 01 #125

e-mail: [dobosz@muzeum.bytom.pl](mailto:dobosz@muzeum.bytom.pl)

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DMITRY G. ZHOROV<sup>1,2</sup>, SERGEY V. BUGA<sup>1,3</sup>

## Coccoidea fauna of Belarus and presence of nucleotide sequences of the scale insects in the genetic databases

<sup>1</sup> Department of Zoology, Belarusian State University, Nezavisimosti av. 4, 220030 Minsk, Republic of Belarus<sup>2</sup> dmitrii.zhorov.89@mail.ru; <sup>3</sup> sergey.buga@gmail.com

**Abstract:** The results of studies of the fauna of the Coccoidea of Belarus are overviewed. To the present data, 22 species from 20 genera of Ortheziidae, Pseudococcidae, Margarodidae, Steingeliidae, Eriococcidae, Cryptococcidae, Kermesidae, Asterolecaniidae, Coccidae and Diaspididae are found in the natural habitats. Most of them are pests of fruit- and berry-producing cultures or ornamental plants. Another 15 species from 12 genera of Ortheziidae, Pseudococcidae, Rhizoecidae, Coccidae and Diaspididae are registered indoors only. All of them are pests of ornamental plants. Comparison between fauna lists of neighboring countries allows us to estimate the current species richness of native Coccoidea fauna of Belarus in 60–65 species.

Scale insects of the Belarusian fauna have not been DNA-barcoding objects till this research. International genetic on-line databases store marker sequences of species collected mostly in Chile, China, and Australia. The study was partially supported by the Belarusian Republican Foundation for Fundamental Research (project B17MC-025).

**Key words:** Biodiversity, scale insects, DNA-barcoding, fauna.

### Introduction

Scale insects belong to the superfamily Coccoidea, one of the most species-rich in the order Sternorrhyncha (Hemiptera). According to ScaleNet (GARCÍA MORALES *et al.* 2016) there is known about 8000 recent species in the world fauna. According to Fauna Europaea (de JONG Y. *et al.* 2014) 14 species of scale insects are known for Belarus. But ScaleNet database (GARCÍA MORALES *et al.* 2016) contents 2 species, *Physokermes piceae* (SCHRANK, 1801) and *Steingelia gorodetskia* NASONOV, 1908, only.

Scale insects, in general, are among of the most important and well known pests of the ornamental and agricultural plants. The increasing trade interactions between countries and the imports of plant sapling and cut blossoms have created great potential for spreading of Coccoidea species across Europe, including Belarus. Scale insects are the most economic important invasive pests which extremely difficult to control under the indoor or outdoor conditions (PELLIZZARI & GERMAIN 2010).

The Coccoidea of Belarus is a comparatively poorly studied group of insects. The first information on scale insects of Belarus presents in the article published by N.V. Nasonov (NASONOV 1908), which contains the descriptions of *Steingelia gorodetskia* sp. n. on the base of specimens collected in Gorodok district. The first list of scale insects of Bialowieza Primeval Forest was published by H. Wünn (WÜNN 1919). For Belarusian part of the forest only 9 species of Coccoidea have been noted.

Reviews of Coccoidea fauna of the Soviet Union and Russia contain data on a few rare or common species of scale insects: *Porphyrophora polonica* LINNAEUS, 1758 and *S. gorodetskia* in “Soft and armoured scale insect (Coccoidea) of the USSR” (BORCHSENIUS 1950); *Parthenolecanium corni* (BOUCHÉ, 1844), *Physokermes piceae* (SCHRANK, 1801), *Pulvinaria betula* LINNAEUS, 1758 and *Physokermes latipes* BORCHSENIUS, 1957 in “Rhynchota. Suborder Coccoidea. Family Coccidae – mealybugs” (BORCHSENIUS 1957) published by N.S. Borchsenius.

The apple mussel scale (*Lepidosaphes ulmi* LINNAEUS, 1758) is known as a dangerous pest of fruit and berry plants in Belarus. More detailed study on Coccoidea as pests of horticultural crops in Belarus fulfilled by O.V. Paramonova. Her publications reported on 9 species such as *Phenacoccus aceris* (SIGNORET, 1875), *Eulecanium douglasi* (SULC, 1895), *Eulecanium mali* SCHRANK, 1781, *Eulecanium tiliae* (LINNAEUS, 1758), *Parthenolecanium corni* (BOUCHÉ, 1844), *Pulvinaria ribesiae* SIGNORET, 1873, *Sphaerolecanium prunastri* (BOYER de FONSCOLOMBE, 1834), *Chionaspis salicis* (LINNAEUS, 1758) and *Lepidosaphes ulmi* LINNAEUS, 1758 (PARAMONOVA 1976).

The most substantial contribution was made by S.V. Gorlenko, A.I. Blintsov and N.A. Pan'ko, who listed 12 species of Coccoidea: *Pseudococcus longispinus* TARGIONI-TOZZETTI, 1867 (as *Pseudococcus adonidum* L.), *Pseudococcus maritimus* (EHRHORN, 1900), *Vryburgia amaryllidis* (BOUCHÉ, 1837) (as *Pseudococcus amaryllidis* BOUCHÉ), *Coccus hesperidum* LINNAEUS, 1758, *Parthenolecanium corni* (BOUCHÉ, 1844) (as *Eulecanium corni* BOUCHÉ), *Saissetia coffeae* (WALKER, 1852) (as *Saissetia hemisphaerica* TARG.), *Aonidia lauri* (BOUCHÉ, 1833), *Aspidiotus nerii* BOUCHÉ, 1833, *Diaspis boisduvalii* SIGNORET, 1869, *Lepidosaphes ulmi* LINNAEUS, 1758, *Gossyparia spuria* (MODEER, 1778), *Pulvinaria vitis* (LINNAEUS, 1758) (as *Pulvinaria betulae* L.) (GORLENKO & PAN'KO 1967, 1972; GORLENKO *et al.* 1988).

## Material and methods

The annotated list (Table 1) was prepared on the base of bibliographic sources and collections made by the authors and provides information about outdoor and indoor species found in Belarus in the last 110 years, since the first article which contains data on Coccoidea collected on the territory of recent Republic of Belarus was published. The nomenclature used here follows the ScaleNet database (GARCÍA MORALES *et al.* 2016). Species identification of original samples of scale insects was conducted according to KOZÁR (2004).

## Results and discussion

The list of scale insect species known for Belarus fauna contains 37 species from 31 genera and representing 11 families is given in the Table 1.

**Table 1.** The list of scale insects of the fauna of Belarus.

| Family/Genus/Species                                       | Information source                                                                                                                              |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Family ORTHEZIIDAE</b>                                  |                                                                                                                                                 |
| <b>Genus <i>Arctorthezia</i> COCKERELL, 1902</b>           |                                                                                                                                                 |
| <i>Arctorthezia cataphracta</i> (OLAFSEN, 1772)            | Vitebsk Prov.: Gorodok Distr., near Zadrachje Vill. (N 55.789600; E 30.264215), 28 June 2016, blueberry pine forest, in mosses (leg. S. Buga)   |
| <b>Genus <i>Insignorthezia</i> KOZÁR, 2004</b>             |                                                                                                                                                 |
| <i>Insignorthezia insignis</i> (BROWNE, 1887)*             | as <i>Orthezia insignis</i> BROWNE, 1887 ( <a href="https://insecta-g2n.weebly.com/">https://insecta-g2n.weebly.com/</a> )                      |
| <b>Genus <i>Orthezia</i> BOSC, 1784</b>                    |                                                                                                                                                 |
| <i>Orthezia urticae</i> (LINNAEUS, 1758)                   | YANCHUREVICH <i>et al.</i> (2010)                                                                                                               |
| <b>Family PSEUDOCOCCIDAE</b>                               |                                                                                                                                                 |
| <b>Genus <i>Pseudococcus</i> WESTWOOD, 1840</b>            |                                                                                                                                                 |
| <i>Pseudococcus calceolariae</i> (MASKELL, 1879)*          | as <i>Pseudococcus gahani</i> (BYALYAUSKAYA 1984), GERMAIN & PELLIZZARI (2017)                                                                  |
| <i>Pseudococcus longispinus</i> (TARGIONI TOZZETTI, 1867)* | as <i>Pseudococcus adonidum</i> L. (GORLENKO & PAN'KO 1967)                                                                                     |
| <i>Pseudococcus maritimus</i> (EHRHORN, 1900)*             | GORLENKO & PAN'KO (1967)                                                                                                                        |
| <i>Pseudococcus viburni</i> (SIGNORET, 1875)*              | BUGA (2016)                                                                                                                                     |
| <b>Genus <i>Phenacoccus</i> COCKERELL, 1893</b>            |                                                                                                                                                 |
| <i>Phenacoccus aceris</i> (SIGNORET, 1875)                 | as <i>Phenacoccus aceris</i> (SIGNORET, 1875) (WÜNN (1919)), as <i>Phenocoeus mespili</i> SIGNORET, 1875 (BYALYAUSKAYA 1984), PARAMONOVA (1976) |
| <b>Genus <i>Vryburgia</i> DE LOTTO, 1967</b>               |                                                                                                                                                 |
| <i>Vryburgia amaryllidis</i> (BOUCHÉ, 1837)*               | as <i>Pseudococcus amaryllidis</i> BOUCHÉ (GORLENKO & PAN'KO 1967)                                                                              |
| <b>Family RHIZOECIDAE</b>                                  |                                                                                                                                                 |
| <b>Genus <i>Rhizoeus</i> KUNCKEL D'HERCULAI, 1878</b>      |                                                                                                                                                 |
| <i>Rhizoeus cacticans</i> (HAMBLETON, 1946)*               | PELLIZZARI & GERMAIN (2010), GERMAIN & PELLIZZARI (2017), ZHUDRIK (2008)                                                                        |
| <b>Genus <i>Spilococcus</i> FERRIS, 1950</b>               |                                                                                                                                                 |
| <i>Spilococcus mamillariae</i> (BOUCHÉ, 1844)*             | as <i>Phenacoccus mamillariae</i> (BYALYAUSKAYA 1984)                                                                                           |
| <b>Family MARGARODIDAE</b>                                 |                                                                                                                                                 |
| <b>Genus <i>Porphyrophora</i> BRANDT, 1833</b>             |                                                                                                                                                 |
| <i>Porphyrophora polonica</i> (LINNAEUS, 1758)             | BORCHSENIUS (1950), LOPATIN (1993), DANZIG (1964)                                                                                               |
| <b>Family STEINGELIIDAE</b>                                |                                                                                                                                                 |
| <b>Genus <i>Steingelia</i> NASONOV, 1908</b>               |                                                                                                                                                 |
| <i>Steingelia gorodetskia</i> NASONOV, 1908                | NASONOV (1908), TEREZNIKOVA (1975)                                                                                                              |
| <b>Family ERIOCOCCIDAE</b>                                 |                                                                                                                                                 |
| <b>Genus <i>Gossyparia</i> SIGNORET, 1875</b>              |                                                                                                                                                 |

| Family/Genus/Species                                    | Information source                                                                                                                                                                                                                                              |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Gossyparia spuria</i> (MODEER, 1778)                 | WÜNN (1919), as <i>Gossyparia spuria</i> BOUCHE (GORLENKO <i>et al.</i> 1988), GORLENKO & PAN'KO (1972), RYZHAYA & BUGA (2012)                                                                                                                                  |
| <b>Family CRYPTOCCIDAE</b>                              |                                                                                                                                                                                                                                                                 |
| <b>Genus <i>Pseudochermes</i></b> NITSCHKE, 1895        |                                                                                                                                                                                                                                                                 |
| <i>Pseudochermes fraxini</i> (KALTENBACH, 1860)         | as <i>Fonscolombea fraxini</i> (KHOT'KO <i>et al.</i> 1999)                                                                                                                                                                                                     |
| <b>Family KERMESIDAE</b>                                |                                                                                                                                                                                                                                                                 |
| <b>Genus <i>Kermes</i></b> BOITARD, 1828                |                                                                                                                                                                                                                                                                 |
| <i>Kermes quercus</i> (LINNAEUS, 1758)                  | <a href="https://insecta-g2n.weebly.com/">https://insecta-g2n.weebly.com/</a>                                                                                                                                                                                   |
| <b>Family ASTEROLECANIIDAE</b>                          |                                                                                                                                                                                                                                                                 |
| <b>Genus <i>Asterodiaspis</i></b> SIGNORET, 1877        |                                                                                                                                                                                                                                                                 |
| <i>Asterodiaspis variolosa</i> (RATZEBURG, 1870)        | WÜNN (1919)                                                                                                                                                                                                                                                     |
| <b>Family COCCIDAE</b>                                  |                                                                                                                                                                                                                                                                 |
| <b>Genus <i>Coccus</i></b> LINNAEUS, 1758               |                                                                                                                                                                                                                                                                 |
| <i>Coccus hesperidum</i> (LINNAEUS, 1758)*              | GORLENKO & PAN'KO (1967), BYALYAYUSKAYA (1983)                                                                                                                                                                                                                  |
| <b>Genus <i>Eulecanium</i></b> COCKERELL, 1893          |                                                                                                                                                                                                                                                                 |
| <i>Eulecanium douglasi</i> (SULC, 1895)                 | PARAMONOVA (1976)                                                                                                                                                                                                                                               |
| <i>Eulecanium tiliae</i> (LINNAEUS, 1758)               | WÜNN (1919), PARAMONOVA (1976), as <i>Eulecanium mali</i> SCHRANK, 1781 (PARAMONOVA 1976), BYALYAYUSKAYA (1983), KOLTUN (2016)                                                                                                                                  |
| <b>Genus <i>Neomolecanium</i></b> BORCHSENIUS, 1955     |                                                                                                                                                                                                                                                                 |
| <i>Neomolecanium adventicum</i> BORCHSENIUS, 1955       | TIMOFEeva <i>et al.</i> (2014)                                                                                                                                                                                                                                  |
| <b>Genus <i>Parthenolecanium</i></b> SULC, 1908         |                                                                                                                                                                                                                                                                 |
| <i>Parthenolecanium corni</i> (BOUCHÉ, 1844)            | WÜNN (1919), BORCHSENIUS (1957), PARAMONOVA (1976), BYALYAYUSKAYA (1983), as <i>Eulecanium corni</i> L. (GORLENKO & PAN'KO 1972), as <i>Eulecanium corni</i> BOUCHÉ (GORLENKO & PAN'KO 1967, 1972), GORLENKO <i>et al.</i> (1988), KHOT'KO <i>et al.</i> (1999) |
| <i>Parthenolecanium fletcheri</i> (COCKERELL, 1893)     | GALYNSKAYA & GARANOVICH (2009), TIMOFEeva <i>et al.</i> (2014)                                                                                                                                                                                                  |
| <b>Genus <i>Physokermes</i></b> TARGIONI TOZZETTI, 1868 |                                                                                                                                                                                                                                                                 |
| <i>Physokermes piceae</i> (SCHRANK, 1801)               | WÜNN (1919), BYALYAYUSKAYA (1983), KHOT'KO <i>et al.</i> (1999), TIMOFEeva <i>et al.</i> (2014), as <i>Physokermes latipes</i> BORCHSENIUS, 1957 (BORCHSENIUS 1957)                                                                                             |
| <b>Genus <i>Pulvinaria</i></b> TARGIONI TOZZETTI, 1866  |                                                                                                                                                                                                                                                                 |
| <i>Pulvinaria vitis</i> (LINNAEUS, 1758)                | as <i>Pulvinaria betulae</i> L. (BYALYAYUSKAYA 1983), GORLENKO <i>et al.</i> 1988), as <i>Pulvinaria betula</i> (BORCHSENIUS 1957), as <i>Pulvinaria ribesiae</i> SIGNORET, 1873 (PARAMONOVA 1976)                                                              |
| <b>Genus <i>Saissetia</i></b> DEPLANCHE, 1859           |                                                                                                                                                                                                                                                                 |
| <i>Saissetia coffeae</i> (WALKER, 1852)*                | as <i>Saissetia hemisphaerica</i> TARG. (GORLENKO & PAN'KO 1967)                                                                                                                                                                                                |

| Family/Genus/Species                                        | Information source                                                                                                                                                          |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Genus <i>Sphaerolecanium</i> SULC, 1908</b>              |                                                                                                                                                                             |
| <i>Sphaerolecanium prunastri</i> (BOYER de FONSCOMBE, 1834) | PARAMONOVA (1976)                                                                                                                                                           |
| <b>Family DIASPIDIDAE</b>                                   |                                                                                                                                                                             |
| <b>Genus <i>Aonidia</i> TARGIONI TOZZETI, 1898</b>          |                                                                                                                                                                             |
| <i>Aonidia lauri</i> (BOUCHÉ, 1833)*                        | GORLENKO & PAN'KO (1967), DANZIG (1993)                                                                                                                                     |
| <b>Genus <i>Leucaspis</i> SIGNORET 1869</b>                 |                                                                                                                                                                             |
| <i>Leucaspis lowi</i> (COLVEE, 1882)                        | as <i>Anamaspis lowi</i> (COLVEE, 1882) (WÜNN 1919)                                                                                                                         |
| <b>Genus <i>Aspidiotus</i> BOUCHÉ, 1833</b>                 |                                                                                                                                                                             |
| <i>Aspidiotus nerii</i> (BOUCHÉ, 1833)*                     | GORLENKO & PAN'KO (1967), ZHUDRIK (2008)                                                                                                                                    |
| <b>Genus <i>Aulacaspis</i> COCKERELL, 1893</b>              |                                                                                                                                                                             |
| <i>Aulacaspis rosae</i> (BOUCHÉ, 1833)*                     | BEREZKO (2004)                                                                                                                                                              |
| <b>Genus <i>Chionaspis</i> SIGNORET, 1869</b>               |                                                                                                                                                                             |
| <i>Chionaspis salicis</i> (LINNAEUS, 1758)                  | WÜNN (1919), PARAMONOVA (1976), KHOT'KO <i>et al.</i> (1999), TIMOFEEVA <i>et al.</i> (2014)                                                                                |
| <b>Genus <i>Diaspis</i> COSTA, 1828</b>                     |                                                                                                                                                                             |
| <i>Diaspis boisduvalii</i> (SIGNORET, 1869)*                | GORLENKO & PAN'KO (1967), ZHUDRIK (2008)                                                                                                                                    |
| <b>Genus <i>Diaspidiotus</i> BERLESE, 1896</b>              |                                                                                                                                                                             |
| <i>Diaspidiotus gigas</i> (FERRIS, 1941)                    | MELESHKO <i>et al.</i> (2004)                                                                                                                                               |
| <b>Genus <i>Lepidosaphes</i> SHIMER, 1898</b>               |                                                                                                                                                                             |
| <i>Lepidosaphes gloverii</i> (PACKARD, 1869)*               | BUGA (2016)                                                                                                                                                                 |
| <i>Lepidosaphes ulmi</i> (LINNAEUS, 1758)                   | WÜNN (1919), GORLENKO & PAN'KO (1967, 1972), PARAMONOVA (1976), GORLENKO <i>et al.</i> (1988), MELESHKO <i>et al.</i> (2004), TIMOFEEVA <i>et al.</i> (2014), KOLTUN (2016) |
| <b>Genus <i>Pinnaspis</i> COCKERELL, 1892</b>               |                                                                                                                                                                             |
| <i>Pinnaspis buxi</i> (BOUCHÉ, 1851)                        | ZHOROV <i>et al.</i> (2016)                                                                                                                                                 |

\* – Coccoidea species registered indoors only

The results of the studies of the taxonomic structure of Coccoidea fauna of Belarus are presented. To the present date, 22 species from 20 genera of Ortheziidae, Pseudococcidae, Margarodidae, Steingeliidae, Eriococcidae, Cryptococcidae, Kermesidae, Asterolecaniidae, Coccidae and Diaspididae are found in the natural habitats. Most of them are pests of fruit- and berry-producing cultures or ornamental plants. Another 15 species from 12 genera of Ortheziidae, Pseudococcidae, Rhizoecidae, Coccidae and Diaspididae are registered indoors only. All of them are pests of ornamental plants.

A single species, *Arctorthezia cataphracta* (SHAW, 1794), has been registered in Belarus for the first time (Table 1). The geographic distribution *A. cataphracta* in neighboring for Belarus countries: Poland (MORRISON 1952), Russia (MORRISON 1925), Ukraine (SZITA *et al.* 2015). The species is unknown for Latvia, Lithuania and Estonia (de JONG Y. *et al.* 2014; <https://www.gbif.org/>).

The total number of species recorded in Belarus outdoor is relatively low. For example, 56 species of Coccoidea have been noticed outdoor in Lithuania, Latvia and Estonia (MALUMPHY & OSTRASKAS 2013) and 141 species have been noticed in Poland (GERTSSON 2013). According to ScaleNet (GARCÍA MORALES *et al.* 2016) 365 species of Coccoidea are known from Russia (including Asian part, indoor and outdoor) and 176 species are known from Poland (indoor and outdoor). The scale insects fauna of Belarus probably more diverse because the main part of the country is located in more southern latitude and it has more varied landscapes. Comparisons with fauna lists for neighboring countries allow us to estimate the current species richness of Coccoidea fauna of Belarus in 60–65 native species.

DNA-barcoding is a modern molecular genetics method of species identification using a short site of DNA from a standardized region of the genome (<http://www.ibol.org/phase1/about-us/what-is-dna-barcoding/>). To the present date, the international database of nucleotides (<https://www.ncbi.nlm.nih.gov/genbank/>; <http://www.boldsystems.org/>) contains records relating to 477 Coccoidea species. Scale insects of the fauna of Belarus have not been DNA-barcoding objects till now. The total number of COI sequences of Coccoidea from the fauna list for Belarus which obtained in another country is present in Table 2.

**Table 2.** The total number of COI sequences of Coccoidea known for the fauna list of Belarus fauna which obtained in different countries (according to <https://www.ncbi.nlm.nih.gov/genbank/>; <http://www.boldsystems.org/>).

| Species                          | France | Spain | USA | Brazil | Costa Rica | Chile | Iran | Israel | South Africa | India | China | Japan | Thailand | Malaysia | Korea |
|----------------------------------|--------|-------|-----|--------|------------|-------|------|--------|--------------|-------|-------|-------|----------|----------|-------|
| <i>Pseudococcus calceolariae</i> | 2      | –     | –   | –      | –          | 9     | –    | –      | –            | –     | 4     | –     | –        | –        | –     |
| <i>Pseudococcus longispinus</i>  | 2      | 2     | 7   | 1      | 1          | 7     | –    | –      | 1            | 1     | 4     | 1     | 2        | –        | –     |
| <i>Pseudococcus maritimus</i>    | –      | –     | 4   | –      | –          | 1     | –    | –      | –            | –     | 2     | –     | –        | –        | –     |
| <i>Pseudococcus viburni</i>      | 4      | 2     | 3   | 18     | –          | 6     | 2    | –      | –            | –     | 33    | –     | –        | –        | –     |
| <i>Phenacoccus aceris</i>        | 1      | –     | –   | –      | –          | –     | –    | –      | –            | –     | 1     | –     | –        | –        | 10    |
| <i>Kermes quercus</i>            | –      | –     | –   | –      | –          | –     | –    | 3      | –            | –     | –     | –     | –        | –        | –     |
| <i>Coccus hesperidum</i>         | –      | 1     | 6   | –      | –          | 21    | –    | –      | 2            | –     | 8     | 2     | –        | 1        | 1     |
| <i>Parthenolecanium corni</i>    | –      | –     | 1   | –      | –          | 6     | –    | –      | –            | –     | 22    | –     | –        | –        | –     |
| <i>Pulvinaria vitis</i>          | –      | –     | –   | –      | –          | –     | –    | –      | –            | –     | 5     | –     | –        | –        | –     |
| <i>Saissetia coffeae</i>         | –      | –     | –   | –      | –          | 5     | –    | –      | –            | –     | 5     | –     | –        | –        | –     |
| <i>Leucaspis loewi</i>           | –      | –     | 1   | –      | –          | –     | –    | –      | –            | –     | –     | –     | –        | –        | –     |
| <i>Aspidiotus nerii</i>          | –      | –     | 8   | –      | –          | 97    | –    | 1      | –            | –     | –     | –     | –        | –        | –     |
| <i>Aulacaspis rosae</i>          | –      | –     | 3   | –      | –          | –     | –    | –      | –            | –     | –     | –     | –        | –        | –     |

| Species                        | France   | Spain    | USA       | Brazil    | Costa Rica | Chile      | Iran     | Israel   | South Africa | India    | China     | Japan    | Thailand | Malaysia | Korea     |
|--------------------------------|----------|----------|-----------|-----------|------------|------------|----------|----------|--------------|----------|-----------|----------|----------|----------|-----------|
| <i>Chionaspis salicis</i>      | –        | –        | 1         | –         | –          | –          | –        | –        | –            | –        | –         | –        | –        | –        | –         |
| <i>Diaspis boisduvalii</i>     | –        | –        | 1         | –         | –          | –          | –        | –        | –            | –        | –         | –        | –        | –        | –         |
| <i>Diaspidiotus gigas</i>      | –        | –        | 1         | –         | –          | –          | –        | –        | –            | –        | –         | –        | –        | –        | –         |
| <i>Lepidosaphes gloverii</i>   | –        | –        | 1         | –         | –          | –          | 1        | –        | –            | –        | –         | –        | –        | –        | –         |
| <i>Lepidosaphes ulmi</i>       | –        | –        | –         | –         | –          | 4          | –        | –        | –            | –        | –         | –        | –        | –        | –         |
| <i>Pinnaspis buxi</i>          | –        | –        | 2         | –         | –          | –          | –        | –        | –            | –        | –         | –        | –        | –        | –         |
| <b>Number of COI sequences</b> | <b>9</b> | <b>5</b> | <b>39</b> | <b>19</b> | <b>1</b>   | <b>156</b> | <b>3</b> | <b>4</b> | <b>3</b>     | <b>1</b> | <b>84</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>11</b> |

Continuation of the **Table 2**.

| Species                          | South Korea | Australia | New Zealand | Sweden | Colombia | Ghana | Poland | Papua New Guinea | Greece | Taiwan | United Kingdom | Turkey | Benin | Italy |
|----------------------------------|-------------|-----------|-------------|--------|----------|-------|--------|------------------|--------|--------|----------------|--------|-------|-------|
| <i>Pseudococcus calceolariae</i> | 7           | –         | 2           | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Pseudococcus longispinus</i>  | 13          | –         | 10          | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Pseudococcus maritimus</i>    | –           | –         | –           | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Pseudococcus viburni</i>      | 3           | –         | 1           | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Phenacoccus aceris</i>        | 1           | –         | –           | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Kermes quercus</i>            | –           | –         | –           | 3      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Coccus hesperidum</i>         | –           | 58        | –           | –      | 2        | 1     | 1      | 1                | 1      | 5      | 7              | 1      | 1     | –     |
| <i>Parthenolecanium corni</i>    | –           | –         | –           | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Pulvinaria vitis</i>          | –           | –         | –           | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Saissetia coffeae</i>         | –           | 2         | –           | –      | –        | –     | –      | –                | –      | 2      | –              | –      | –     | –     |
| <i>Leucaspis loewi</i>           | –           | –         | –           | –      | –        | –     | –      | –                | –      | –      | –              | –      | –     | –     |
| <i>Aspidiotus nerii</i>          | 3           | 4         | –           | –      | –        | –     | –      | –                | –      | –      | –              | 1      | –     | 4     |

| Species                        | South Korea | Australia | New Zealand | Sweden   | Colombia | Ghana    | Poland   | Papua New Guinea | Greece   | Taiwan   | United Kingdom | Turkey   | Benin    | Italy    |
|--------------------------------|-------------|-----------|-------------|----------|----------|----------|----------|------------------|----------|----------|----------------|----------|----------|----------|
| <i>Aulacaspis rosae</i>        | –           | –         | –           | –        | –        | –        | –        | –                | –        | –        | –              | –        | –        | –        |
| <i>Chionaspis salicis</i>      | –           | –         | –           | 1        | –        | –        | –        | –                | –        | –        | –              | –        | –        | –        |
| <i>Diaspis boisduvalii</i>     | –           | –         | –           | –        | –        | –        | –        | –                | –        | –        | –              | –        | –        | –        |
| <i>Diaspidiotus gigas</i>      | –           | –         | –           | –        | –        | –        | –        | –                | –        | –        | –              | –        | –        | –        |
| <i>Lepidosaphes gloverii</i>   | –           | –         | –           | –        | –        | –        | –        | –                | –        | –        | –              | –        | –        | –        |
| <i>Lepidosaphes ulmi</i>       | –           | –         | –           | –        | –        | –        | –        | –                | –        | –        | –              | –        | –        | –        |
| <i>Pinnaspis buxi</i>          | –           | –         | –           | –        | 1        | –        | –        | –                | –        | –        | –              | –        | –        | –        |
| <b>Number of COI sequences</b> | <b>27</b>   | <b>64</b> | <b>13</b>   | <b>4</b> | <b>3</b> | <b>1</b> | <b>1</b> | <b>1</b>         | <b>1</b> | <b>7</b> | <b>7</b>       | <b>2</b> | <b>1</b> | <b>4</b> |

International genetic on-line databases keep marker sequences of species collected mostly in Chile, China and Australia.

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