

## A CHECK-LIST OF WHITEFLIES (INSECTA: HEMIPTERA: ALEYRODIDAE) OF CROATIA

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A check list of whiteflies in Croatia is presented, with a list of references and the results by authors from the period 2005–2007, performed for the first time in Croatia (ŠIMALA, 2008). In the reference list, 10 species have been described. 31 different whitefly species were identified by our own faunistic investigations, 21 of which are new for the Croatian fauna. These are the following species: *Aleurochiton acerinus* Haupt, 1934; *Aleurochiton pseudoplatani* Visnya, 1936; *Aleuroclava hikosanensis* Takahashi, 1938; *Aleuroclava jasmimi* Takahashi, 1932; *Aleurolobus wunni* Ryberg, 1938; *Aleurotuba jelinekii* Frauenfeld, 1867; *Aleuroviggiianus adrianae* Iaccarino, 1982; *Aleyrodes asari* Schrank, 1801; *Aleyrodes elevatus* Silvestri, 1934; *Aleyrodes lonicerae* Walker, 1852; *Asterobemisia carpini* Koch, 1857; *Asterobemisia obenbergeri* Zahradnik, 1961; *Asterobemisia paveli* Zahradnik, 1961; *Bemisia afer* Priesner & Hosny, 1934; *Massilieurodes chittendeni* Laing, 1928; *Massilieurodes setiger* Goux, 1939; *Neopealius rubi* Takahashi, 1954; *Simplaleurodes hemisphaerica* Goux, 1945; *Siphoninus immaculatus* Heeger, 1856; *Tetraleurodes hederæ* Goux, 1939 and *Tetralicia ericae* Harrison, 1917. The check list contains 31 whitefly species from a single subfamily, Aleyrodinae, categorised in 18 genera.

**Key words:** check-list, whiteflies, Croatia

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Pregledom literaturnih podataka i faunističkih istraživanja autora u razdoblju od 2005–2007 napravljen je prvi popis štitaštih moljaca u Hrvatskoj (ŠIMALA, 2008). Pregledom literature utvrđena je prisutnost 10 vrsta. Vlastitim istraživanjima utvrđena je 31 različita vrsta štitaštih moljaca, od čega je 21 nova u fauni Hrvatske. To su slijedeće vrste: *Aleurochiton acerinus* Haupt, 1934; *Aleurochiton pseudoplatani* Visnya, 1936; *Aleuroclava hikosanensis* Takahashi, 1938; *Aleuroclava jasmimi* Takahashi, 1932; *Aleurolobus wunni* Ryberg, 1938; *Aleurotuba jelinekii* Frauenfeld, 1867; *Aleuroviggiianus adrianae* Iaccarino, 1982; *Aleyrodes asari* Schrank, 1801; *Aleyrodes elevatus* Silvestri, 1934; *Aleyrodes lonicerae* Walker, 1852; *Asterobemisia carpini* Koch, 1857; *Asterobemisia obenbergeri* Zahradnik, 1961; *Asterobemisia paveli* Zahradnik, 1961; *Bemisia afer* Priesner & Hosny, 1934; *Massilieurodes chittendeni* Laing, 1928; *Massilieurodes setiger* Goux, 1939; *Neopealius rubi* Takahashi, 1954; *Simplaleurodes hemisphaerica* Goux, 1945; *Siphoninus immaculatus* Heeger, 1856; *Tetraleurodes hederæ* Goux, 1939 i *Tetralicia ericae* Harrison, 1917. Popis štitaštih moljaca Hrvatske sadrži 31 vrstu iz 1 potporodice, Aleyrodinae svrstane u 18 rodova.

**Ključne riječi:** popis vrsta, štitašti moljci, Hrvatska

## INTRODUCTION

Whiteflies belong to the order Hemiptera and comprise a single superfamily, Aleyrodoidea, within the suborder Sternorrhyncha. They are all placed in a single family, Aleyrodidae, and are small, usually inconspicuous, sap-sucking insects. An updated latest check list of the world's extant whitefly species comprises 1556 species from 161 genera (MARTIN & MOUND, 2007). According to MARTIN *et al.* (2000) the whitefly fauna of Europe and the Mediterranean Basin comprises 56 species that are considered to be native or naturalized, accommodated within 25 genera.

The faunistics and systematics of the whitefly in Croatia have been poorly researched in the past. There is accordingly no detailed list of the whitefly species present in the country. Whitefly fauna was investigated to a limited extent by several domestic authors: NOVAK (1940), BAKARIĆ (1983), MATOŠEVIĆ (2004) and MATOŠEVIĆ *et al.* (2006). Some foreign authors, like TAKAHASHI (1940) and ZAHRADNIK (1963) published studies about whiteflies in the territory of the former Yugoslavia, including the territory of the present Croatia. The greatest contribution to knowledge about whiteflies in the middle Adriatic region of Croatia was made by ŽANIĆ (1999; 2004; 2006a;) and by ŽANIĆ *et al.* (2000; 2007a; 2007b; 2007c). The species *Trialeurodes vaporariorum* Westwood, 1856 is the most investigated whitefly in Croatia, but mainly only from the agricultural point of view (PAGLIARINI, 1979; 1983; 1985; 1988; PAGLIARINI & JASEK, 1989; PAGLIARINI & PEROVIĆ, 1992; PARADIKOVIĆ *et al.*, 2004). After the first record of *Bemisia tabaci* Gennadius, 1889 in Croatia in 2000 (ŽANIĆ *et al.*, 2001a), intensive investigation of its distribution and host plant range was carried out (ŽANIĆ *et al.*, 2001b; 2005; ŠIMALA *et al.*, 2002; ŠIMALA & MASTEN, 2003; ŽANIĆ *et al.*, 2003; MASTEN *et al.*, 2004).

The intention of this overview is to summarize records of whiteflies previously known to occur in Croatia and data from our own faunistic investigations for 2005–2007. Since knowledge of the diversity of whiteflies and their distribution in Croatia is still incomplete and in general poorly investigated, the current study represents an important contribution to the knowledge of whitefly fauna in Croatia.

## MATERIALS AND METHODS

A check list of whiteflies in Croatia was made on the basis of literature data of faunistic investigations and faunistic data from our own investigation.

Browsing the literature of faunistic investigations of whiteflies in Croatia involved a period from 1940 to 2007. We have used the complete available faunistic data relevant for Croatia. If literature data about whitefly species did not have the necessary parameters relevant for faunistic entry, such as the author who found the species, year of finding, host plant and distribution, we did not include it in the list. However, the minimum and the most important criteria was whitefly host plant.

Faunistic investigations were conducted in the period 2005–2007 on the entire territory of the Republic of Croatia, in all 21 counties (315 localities). Whiteflies were collected with the use of a visual survey of host plant leaves with the help of

a magnifying lens of 10 x magnification for the presence of puparia or pupal cases. Host plants were identified according to DOMAC (1967; 1994), LAKUŠIĆ (1988), MIŠIĆ & LAKUŠIĆ (1990) and ŠILIC (1988a; 1988b; 1988c; 1990), but also for some of them, especially for different pot and ornamental plants, our own observations were used. The leaf samples were placed and stored by the dry method in an envelope until whitefly preparation (MARTIN, 1987; 1999).

All collected whiteflies in leaf samples were identified to the species level on the basis of morphological characters of puparium and/or pupal case, using the classical identification method according to relevant morphological keys. Whitefly puparia and pupal cases were slide-mounted in Canada balsam as permanent microscopic slides, labelled with all data relevant for faunistic entry (sample number, whitefly species, host plant, locality, county and country, sampling date, mounting medium, collector's and identifier's name) according to a modified WATSON & CHANDLER (1999) method. For the identification the following keys were used: TAKAHASHI (1952; 1954), DANZIG (1964), MOUND (1966), DOBREANU & MANOLACHE (1969), HABIB & FARAG (1970), IACCARINO & TREMBLAY (1977), IACCARINO (1982), MARTIN (1985; 1987; 1999), LEHR (1988), BINK-MOENEN & GERLING (1990), BINK-MOENEN (1992), MIFSUD (1995), MARTIN *et al.* (2000) and HODGES & EVANS (2005). For an accurate identification, a stereomicroscope (Nikon SMZ 800) and a compound microscope (Olympus BX 50) were employed.

Verification of all identifications of whitefly species recorded by our own faunistic investigations was done by M.G.M. Jansen (Plant Protection Service, Wageningen, The Netherlands), except for the species *Siphoninus immaculatus* Heeger, 1856 which was confirmed by J.H. Martin (Natural History Museum, London, UK).

The check list of whitefly species has been systematised according to MARTIN & MOUND (2007). Synonyms have been also clarified according to MARTIN & MOUND (2007). The check list presents whitefly species with the name currently used, and if the species is mentioned under a different name, the synonym is given in parenthesis.

## RESULTS AND DISCUSSION

In the present review, the available data and records of whiteflies occurring in Croatia have been summarized. A check list of whiteflies derived from the literature contains 10 species. During faunistic research ŠIMALA (2008) identified 30 species, while *Siphoninus immaculatus*, the 31st whitefly species recorded in Croatia, in 2008 on *Hedera helix* L. (in Čakovec), by the same author, was not included in that study and no entry has been previously published. Twenty-one of them from 13 different genera are new for the whitefly fauna of Croatia. These are the following species: *Aleurochiton acerinus* Haupt, 1934; *Aleurochiton pseudoplatani* Visnya, 1936; *Aleuroclava hikosanensis* Takahashi, 1938; *Aleuroclava jasmini* Takahashi, 1932; *Aleurolobus wunni* Ryberg, 1938; *Aleurotuba jelinekii* Frauenfeld, 1867; *Aleuroviggianus adrianae* Iaccarino, 1982; *Aleyrodes asari* Schrank, 1801; *Aleyrodes elevatus* Silvestri, 1934; *Aleyrodes loniceræ* Walker, 1852; *Asterobemisia carpini* Koch, 1857; *Asterobemisia obenbergeri* Zahradnik, 1961; *Asterobemisia paveli* Zahradnik, 1961; *Bemisia afer* Priesner & Hosny,

1934; *Massilieuroides chittendeni* Laing, 1928; *Massilieuroides setiger* Goux, 1939; *Neopealius rubi* Takahashi, 1954; *Simplaleuroides hemisphaerica* Goux, 1945; *Siphoninus immaculatus* Heeger, 1856; *Tetraleuroides hederæ* Goux, 1939 and *Tetralicia ericæ* Harrison, 1917.

Thus the check list of whiteflies in Croatia comprises, including the 21 new whitefly species, 31 species. Compared with data from Europe and the Mediterranean Basin by MARTIN *et al.* (2000), this number probably represents about 60–70 % of the whole diversity of this insect group in Croatia. According to BINK-MOENEN & MOUND (1990), the number of whitefly species in Europe is closely correlated with latitude. On the basis of literature and the collecting data of Bink-Moenen, not including greenhouse and doubtful species, from 25 to 33 species possibly exist in Croatia (BINK-MOENEN & MOUND, 1990). The current number of recorded whitefly species in Croatia is very near to this estimate. Regarding the published data on whitefly fauna and the number of species recorded in some neighbouring countries, or European countries or climatically and geographically close to Croatia, for example, 18 species were recorded in Hungary (KOZÁR & BINK-MOENEN, 1988), 33 in Italy (BARBAGALLO *et al.*, 1995), 16 in Romania (DOBREANU & MANOLACHE, 1969) and 13 species on Malta (MIFSUD, 1995), Croatian whitefly fauna with 31 recorded spe-



Fig. 1. *Aleurochiton acerinus* Haupt, 1934, overwintering puparium, permanent microscopic slide (photo: M. Šimala)

cies seems to be very rich and biologically diverse. However, 3 of these species were recorded only on imported plants, *Aleuroclava hikosanensis*, *Aleuroclava jasmini* and *Massilieuodes chittendeni* (ŠIMALA, 2008). The possibility of their being naturalised in Croatia in the future will be the object of further studies.

Some whitefly species recorded for the first time are already widespread in Croatia, e.g. *Aleurochiton acerinus* (Fig. 1), *Aleyrodes lonicerae* (Fig. 2), *Asterobemisia carpini* (Fig. 3), *Massilieuodes setiger* (Fig. 4) and *Tetralicia ericae* (Fig. 5). There are several reasons why these species were not recorded before. First of all, fairly systematic faunistic work on whiteflies started only recently. An exception may represent some species recorded by faunistic research into a limited coastal part of Croatia (ŽANIĆ, 1999; 2006a; ŽANIĆ *et al.*, 2007a; 2007b; 2007c). In addition, faunistic investigations of whiteflies in Croatia were very often directed at agricultural plants (e.g. KOVAČEVIĆ, 1961; MACELJSKI, 1999; MACELJSKI *et al.*, 2004), while wild flora, forest trees and shrubs were not investigated to the same extent.

The synonyms for 4 whitefly species were clarified according to the latest systematic classification.

The check list of whitefly species in Croatia is reported below.

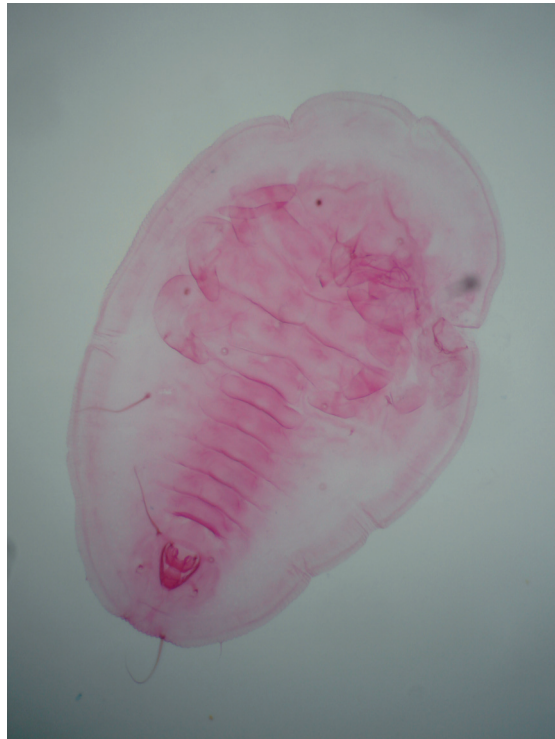
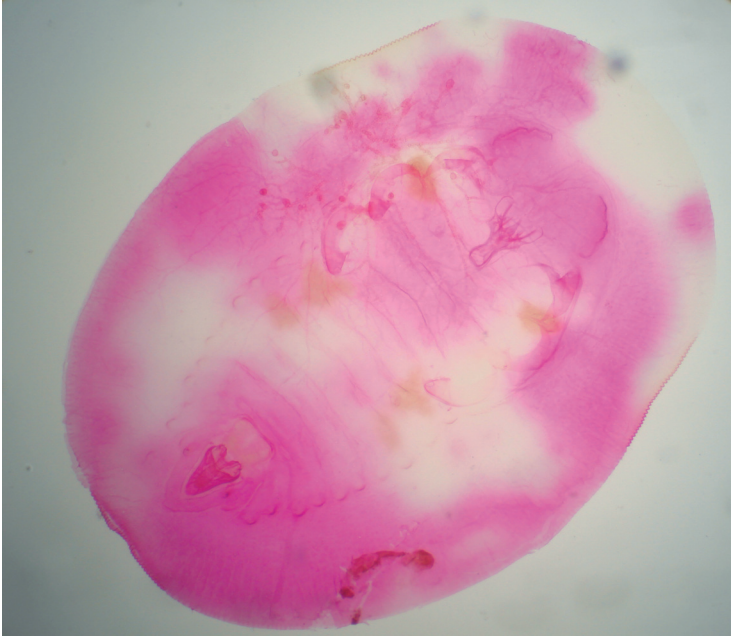


Fig. 2. *Aleyrodes lonicerae* Walker, 1852, permanent microscopic slide (photo: M. Šimala)



**Fig. 3.** *Asterobemisia carpini* Koch, 1857, permanent microscopic slide (photo: M. Šimala)



**Fig. 4.** *Massilieuroides setiger* Goux, 1939, permanent microscopic slide (photo: M. Šimala)



Fig. 5. *Tetralicia ericae* Harrison, 1917, permanent microscopic slide (photo: M. Šimala)

## Order Hemiptera

### Suborder Sternorrhyncha

#### Superfamily Aleyrodoidea

#### Family Aleyrodidae

##### ■ Gen. *Aleurochiton* Tullgren, 1907

- *Aleurochiton acerinus* Haupt, 1934 (ŠIMALA, 2008)
- *Aleurochiton aceris* Modeer, 1778 (MATOŠEVIĆ, 2004 as *Aleurochiton complanatus* Baerensprung, 1918; MATOŠEVIĆ *et al.*, 2006 as *Aleurochiton complanatus* Baerensprung, 1918; ŠIMALA, 2008)
- *Aleurochiton pseudoplatani* Visnya, 1936 (ŠIMALA, 2008)

##### ■ Gen. *Aleuroclava* Singh, 1931

- *Aleuroclava hikosanensis* Takahashi, 1938 (ŠIMALA, 2008)
- *Aleuroclava jasmini* Takahashi, 1932 (ŠIMALA, 2008)

##### ■ Gen. *Aleurolobus* Quaintance & Baker, 1914

- *Aleurolobus olivinus* Silvestri, 1911 (NOVAK, 1940 as *Aleurodes olivinus* SILVESTRI, 1911; KOVAČEVIĆ, 1961; ŽANIĆ, 2006a; ŠIMALA, 2008)
- *Aleurolobus wunni* Ryberg, 1938 (ŠIMALA, 2008)

- **Gen. *Aleurothrixus* Quaintance & Baker, 1914**
  - *Aleurothrixus floccosus* Maskell, 1896 (ŽANIĆ, 2007c; ŠIMALA, 2008)
- **Gen. *Aleurotrachelus* Quaintance & Baker, 1914**
  - *Aleurotrachelus rhamnocola* Goux, 1940 (ŽANIĆ, 2004; ŠIMALA, 2008)
- **Gen. *Aleurotuba* Tremblay & Iaccarino, 1982**
  - *Aleurotuba jelinekii* Frauenfeld, 1867 (ŠIMALA, 2008)
- **Gen. *Aleuroviggianus* Iaccarino, 1982**
  - *Aleuroviggianus adrianae* Iaccarino, 1982 (ŠIMALA, 2008)
- **Gen. *Aleyrodes* Latreille, 1796**
  - *Aleyrodes asari* Schrank, 1801 (ŠIMALA, 2008)
  - *Aleyrodes elevatus* Silvestri, 1934 (ŠIMALA, 2008)
  - *Aleyrodes lonicerae* Walker, 1852 (ŠIMALA, 2008)
  - *Aleyrodes proletella* Linnaeus, 1758 (KOVAČEVIĆ, 1961 as *Aleyrodes brassicae* WALKER, 1852; MACELJSKI, 1999; ŠIMALA, 2008)
- **Gen. *Asterobemisia* Trehan, 1940**
  - *Asterobemisia carpini* Koch, 1857 (ŠIMALA, 2008)
  - *Asterobemisia obenbergeri* Zahradnik, 1961 (ŠIMALA, 2008)
  - *Asterobemisia paveli* Zahradnik, 1961 (ŠIMALA, 2008)
- **Gen. *Bemisia* Quaintance & Baker, 1914**
  - *Bemisia afer* Priesner & Hosny, 1934 (ŠIMALA, 2008)
  - *Bemisia tabaci* Gennadius, 1889 (ŽANIĆ *et al.*, 2001a; ŽANIĆ *et al.*, 2001b; ŠIMALA *et al.*, 2002; ŠIMALA & MASTEN, 2003; ŽANIĆ *et al.*, 2003; ŽANIĆ, 2004; MASTEN *et al.*, 2004; ŽANIĆ *et al.*, 2005; ŠIMALA, 2008)
- **Gen. *Dialeurodes* Cockerell, 1902**
  - *Dialeurodes citri* Ashmead, 1885 (BAKARIĆ, 1983; MACELJSKI, 1999; ŽANIĆ, 1999; ŽANIĆ *et al.*, 2000; ŠIMALA, 2008)
- **Gen. *Massilieuodes* Goux, 1939**
  - *Massilieuodes chittendeni* Laing, 1928 (ŠIMALA, 2008)
  - *Massilieuodes setiger* Goux, 1939 (ŠIMALA, 2008)
- **Gen. *Neopealius* Takahashi, 1954**
  - *Neopealius rubi* Takahashi, 1954 (ŠIMALA, 2008)
- **Gen. *Simplaleurodes* Goux, 1945**
  - *Simplaleurodes hemisphaerica* Goux, 1945 (ŠIMALA, 2008)
- **Gen. *Siphoninus* Silvestri, 1915**
  - *Siphoninus immaculatus* Heeger, 1856
  - *Siphoninus phillyreae* Haliday, 1835 (ŽANIĆ, 2004; ŽANIĆ *et al.*, 2007a; ŽANIĆ *et al.*, 2007b; ŠIMALA, 2008)
- **Gen. *Tetraleurodes* Cockerell, 1902**
  - *Tetraleurodes hederiae* Goux, 1939 (ŠIMALA, 2008)



■ **Gen. *Tetralicia* Harrison, 1917**

- *Tetralicia ericae* Harrison, 1917 (ŠIMALA, 2008)

■ **Gen. *Trialeurodes* Cockerell, 1902**

- *Trialeurodes lauri* Signoret, 1882 (TAKAHASHI, 1940 as *Trialeurodes klemmi* TAKAHASHI, 1940; ZAHRADNIK, 1963; ŠIMALA, 2008)
- *Trialeurodes vaporariorum* Westwood, 1856 (KOVAČEVIĆ, 1961; PAGLIARINI, 1979; 1983; 1985; 1988; PAGLIARINI & JASEK, 1989; PAGLIARINI & PEROVIĆ, 1992; MACELJSKI, 1999; MACELJSKI *et al.*, 2004; PARADIKOVIĆ *et al.*, 2004; ŽANIĆ 2006b; ŠIMALA, 2008)

Because there are few published data on whitefly fauna in Croatia and taking account of the number of species recorded in Europe and the Mediterranean Basin, further studies are necessary and other new records are expected. Since this is the first check list of whiteflies in Croatia, it will have to be amended and complemented.

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## SAŽETAK

### Popis vrsta štitastih moljaca (Insecta: Hemiptera: Aleyrodidae) u Hrvatskoj

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Fauna štitastih moljaca Hrvatske nedovoljno je istražena. Ovu skupinu kukaca dosad ni jedan entomolog nije na klasičan način, temeljito i sustavno istražio na području čitave Republike Hrvatske. Faunistička istraživanja bila su ograničena na proučavanje manjeg broja vrsta na području srednje Dalmacije. Pojedinačni nalazi vrsta u Hrvatskoj rezultat su istraživanja faune štitastih moljaca nekolicine stranih autora na području bivše Jugoslavije ili istraživanja domaćih autora u okviru primjenjene entomologije.

Cilj ovog rada bio je na temelju literaturnih podataka (1940–2007) i rezultata faunističkih istraživanja autora, provedenih na području čitave Hrvatske (2005–2007), izraditi po prvi puta popis vrsta štitastih moljaca Republike Hrvatske.

Pregledom literature utvrđena je prisutnost 10 vrsta. Tijekom vlastitih faunističkih istraživanja, vizualnim pregledom biljaka domaćina štitastih moljaca i identifikacijom vrsta klasičnom metodom na temelju morfoloških obilježja puparija i/ili egzuvija pripremljenih u obliku trajnih mikroskopskih preparata, prema relevantnim ključevima utvrđena je 31 različita vrsta, od čega je 21 nova u fauni Hrvatske. To su slijedeće vrste: *Aleurochiton acerinus* Haupt, 1934; *Aleurochiton pseudoplatani* Visnya, 1936; *Aleuroclava hikosanensis* Takahashi, 1938; *Aleuroclava jasmini* Takahashi, 1932; *Aleurolobus wunni* Ryberg, 1938; *Aleurotuba jelinekii* Frauenfeld, 1867; *Aleuro-*

*viggianus adrianae* Iaccarino, 1982; *Aleyrodes asari* Schrank, 1801; *Aleyrodes elevatus* Silvestri, 1934; *Aleyrodes lonicerae* Walker, 1852; *Asterobemisia carpini* Koch, 1857; *Asterobemisia obenbergeri* Zahradnik, 1961; *Asterobemisia paveli* Zahradnik, 1961; *Bemisia afer* Priesner & Hosny, 1934; *Massilieuodes chittendeni* Laing, 1928; *Massilieuodes setiger* Goux, 1939; *Neopealius rubi* Takahashi, 1954; *Simplaleurodes hemisphaerica* Goux, 1945; *Siphoninus immaculatus* Heeger, 1856; *Tetraleurodes hederæ* Goux, 1939 i *Tetraticia ericae* Harrison, 1917.

Popis štitastih moljaca Hrvatske sadrži 31 vrstu iz 1 potporodice, Aleyrodinae svrstane u 18 rodova.