

ATTILIO CARAPEZZA & CAMILLO CUSIMANO

HETEROPTERA IN THE AEROPLANCTON OF PALERMO TOWN,
WITH TWO NEW RECORDS FOR ITALY
(Hemiptera Heteroptera)

SUMMARY

Details are given of the Heteroptera intercepted in a Johnson-Taylor suction trap at the campus of the University of Palermo in the period May-September 2011. A total number of 21 species of Heteroptera, belonging to seven different families were sampled. *Pinalitus conspurcatus* (Reuter, 1875) and *Orthotylus (Parapachylops) junipericola regularis* Linnavuori, 1965 are new Italian records; the alien sycamore seed bug *Belonochilus numenius* (Say, 1832) is reported for the first time from Sicily.

Key words: Johnson-Taylor suction trap, aeroplancton, Heteroptera, alien species

RIASSUNTO

Eterotteri nell'aeroplancton della città di Palermo, con due specie nuove per l'Italia. Si presentano i risultati dello studio degli Eterotteri raccolti tramite una trappola a suzione rimasta in funzione dal 17 maggio al 19 settembre 2011 all'interno del giardino del Parco d'Orléans dell'Università degli studi di Palermo, nella zona meridionale della città. Sono state raccolte complessivamente 21 specie di Heteroptera appartenenti a sette differenti famiglie; la grande maggioranza degli esemplari appartiene a specie di piccole e piccolissime dimensioni. Tra le specie raccolte *Pinalitus conspurcatus* (Reuter, 1875) e *Orthotylus (Parapachylops) junipericola regularis* Linnavuori, 1965 sono nuove per la fauna italiana; viene inoltre segnalata per la prima volta la presenza in Sicilia di *Belonochilus numenius* (Say, 1832), Lygaeidae alloctono di origine neartica, parassita dei platani.

Parole chiave: Trappola a suzione, aeroplancton, Heteroptera, insetti alloctoni

INTRODUCTION

This paper presents the results relating to Heteroptera of a field investigation aimed to survey the entomological composition of the aeroplankton in Palermo town. Almost half a century after the classic works of SOUTHWOOD (1960) and JOHNSON (1969) on the dispersal of airborne insects, the study of aerial insects, either flying or wind-born, is nowadays particularly relevant due to the increasing number of alien species invading European countries. One of the problems with insects introduced outside their native range is that their early introduction phase is often unobserved, and as a consequence they become visible only after their stabilization and spread, often when the damages they cause are evident (INGHILESI *et al.*, 2013). A continuous monitoring of aerial dispersal of insects through suction traps would help understand the dynamics of migrating insects and allow an early detection of the arrival of new alien species.

MATERIALS AND METHODS

A Johnson-Taylor suction trap was set up in the area of “Parco d’Orléans” inside the University campus of Viale delle Scienze, where it was operated by Bruno Massa and Camillo Cusimano; in particular the position chosen for sampling (38° 6’26.58”N 13°21’2.81”E) was at a height of 10 m above the ground over the roof of the Entomology building in the gardens of the Department of Agricultural and Forest Sciences of the University of Palermo. The surrounding area is rich in citrus fruit orchards and ornamental trees and is close to the urban park “Fossa della Garofala”. The aeroplankton monitoring lasted four months, from 17th May to 19th September 2011; the trap worked continuously for the whole period with the exception of about 20 days, due to unfavourable meteorological conditions or power failures.

For some species, in addition to the specimens of Heteroptera intercepted by the suction trap, other specimens were taken into consideration as belonging too to the aeroplankton of Palermo; these were either found in the faecal sacs of Pallid swifts *Apus pallidus* at Parco d’Orléans or attracted to a light trap at the eighth floor of a building in the SW part of the town.

RESULTS

As a whole the insects collected in the sampling period totalled 11.739 specimens, with Heteroptera (194 exx) representing only a small percentage (1.65%) of the total catchings, Hymenoptera being 7332 (62.5%), Diptera

2177 (18.5%), Homoptera 1417 (12.0%), Thysanoptera 231 (1.81%), Lepidoptera 146 (1.24%) and Coleoptera 144 (1.22%). The fortnightly period when Heteroptera were most abundant was the second half of June (61 exx), followed by first half of July (30 exx), first half of June (24 exx), second halves of July and August (17 exx each), second half of May and first half of September (16 exx each), second half of August (11 exx). The four-hours period of the day when Heteroptera were most abundant was 16.00-20.00 (51 exx), followed by 12.00-16.00 (35 exx), 20.00-24.00 (32 exx), 08-12.00 (31 exx), 04.00-08.00 (25 exx) and 00.00-04.00 (20 exx).

After specific identifications, the Heteroptera proved to belong to 21 different species, subdivided in the following seven families: Tingidae 2, Anthocoridae 6, Miridae 8, Lygaeidae 2, Oxycarenidae 1, Rhyparochromidae 1, Rhopalidae 1.

With the single exceptions of the very few specimens of *Liorhyssus hyalinus* (Fabricius, 1794) and *Belonochilus numenius* (Say, 1832), whose body length is in the range of 6-7 mm, the vast majority of intercepted specimens belongs to species minute to small in body size (2.0-5.0 mm), suggesting that they are more wind-borne than active flying insects. The appreciable presence of alien invasive species among them could mean that the wind plays a major role in their dispersal.

Two of the species, *Pinalitus conspurcatus* (Reuter, 1875) and *Orthotylus (Parapachylops) junipericola regularis* Linnavuori, 1965 are new Italian records; the alien sycamore seed bug *Belonochilus numenius* (Say, 1832) is reported for the first time from Sicily.

SYSTEMATIC ACCOUNT

In the list of examined material the number of specimens for each species is indicated by the abbreviation x/y, where x is the number of ♂♂, y that of ♀♀. All the examined specimens, unless otherwise specified, are preserved in the collection of Attilio Carapezza.

FAMILY TINGIDAE LAPORTE, 1832

Corythuca ciliata (Say, 1832)

Mat.: Sicily, Palermo, Parco d'Orléans, 15-31.VII.2011: 0/2, 16-31.VIII.2011: 5/0, 1-19.IX.2011: 2/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

C. ciliata is a well known pest of *Platanus*; the species, of Nearctic origin, was first detected outside its primary range in Italy in 1964 and since then has

dispersed in most European countries and in Palaearctic eastern Asia (China, Japan and Korea); it has also been reported in Chile and Australia (AUKEMA *et al.*, 2013).

Monosteira unicostata (Mulsant and Rey)

Mat.: Sicily, Palermo, Parco d'Orléans, 16-31.VIII.2011: 1/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

M. unicostata is a common pest of fruit trees, mainly Rosaceae, widely distributed in the southern Palaearctic region (PÉRICART, 1983; NEAL & SCHAEFER, 2000).

FAMILY ANTHOCORIDAE FIEBER, 1836

Anthocoris nemoralis (Fabricius, 1794)

Mat.: Sicily, Palermo, Parco d'Orléans, 1-15.VII.2011: 0/1, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

Euromediterranean species, introduced in North America where it was imported to control the pear psylla; it lives on a great variety of plants where it feeds upon several small insects (Psyllidae, Aphidoidea, eggs and caterpillars of Lepidoptera, etc.) and mites (PÉRICART, 1972, 1996; LATTIN, 2000).

Orius (Orius) laevigatus laevigatus (Fieber, 1860)

Mat.: Sicily, Palermo, Parco d'Orléans, 1-15.VI.2011: 1/5, 1-15.VII.2011: 2/3, 16-31.VIII.2011: 1/1, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

O. laevigatus lives on many different herbs and shrubs feeding on a wide variety of prey, such as aphids, mites, thrips and whiteflies. It is an Euromediterranean-Central Asian species whose distribution extends to Arabian peninsula and Pakistan; a separate subspecies, *O. l. maderensis* (Reuter, 1884), is found in Macaronesia (PÉRICART, 1972; CARAPEZZA *et al.*, 2014).

Orius (Orius) niger (Wolff, 1811)

Mat.: Sicily, Palermo, Parco d'Orléans, 15-31.VII.2011: 2/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

O. niger lives on low vegetation, mainly Asteraceae, where it is a predator of aphids, thrips and insect eggs (PÉRICART, 1972). It is widely distributed in the Palaearctic region (PÉRICART, 1996).

Orius (Heterorius) horvathi Reuter, 1884

Mat.: Sicily, Palermo, Parco d'Orléans, 15-31.VII.2011: 1/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

O. horvathi is found on a variety of different plants, apparently preying on aphids (PÉRICART, 1972). It is widely distributed in the Palaearctic region (PÉRICART, 1996; AUKEMA *et al.*, 2013).

Xylocoris (Proxylocoris) galactinus (Fieber, 1836)

Mat.: Sicily, Palermo, Parco d'Orléans, 1-15.VI.2011: 0/1, 1-15.VII.2011: 0/1, 15-31.VII.2011: 0/1, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

X. galactinus is associated with vegetable matter heated by fermentation and is frequently found in the litter of barns, manure heaps, haystacks and other plant debris; outside these preferential habitats, it is occasionally collected in prairies and swamps. It is a predacious species, feeding on beetle and fly larvae, mites, and other small arthropods; it plays an important role as predator of pests of stored grains (PÉRICART, 1972). It is widely distributed in the Palaearctic and Nearctic Regions (PÉRICART, 1996; AUKEMA *et al.*, 2013).

Cardiastethus nazarenus Reuter, 1884

Mat.: Sicily, Palermo, Parco d'Orléans, 15-30.VI.2011: 0/1, 1-15.VII.2011: 0/1, 15-31.VII.2011: 2/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

C. nazarenus lives on both wild and cultivated trees on which it preys on small insects and mites. It is a Mediterranean-macaronesian species whose distribution extends to Transcaucasia and Iran (PÉRICART, 1996; AUKEMA *et al.*, 2013).

FAMILY MIRIDAE HAHN, 1833

Campyloneura virgula (Herrich-Schaeffer, 1835)

Mat.: Sicily, Palermo, Parco d'Orléans, 15-30.V.2011: 0/2, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

C. virgula is a zoophytophagous species living on a variety of different bushes and trees where it feeds on small arthropods and their eggs (WHEELER, 2000). It is a geographically parthenogenetic species with sexual reproduction occurring only in Sicily and North Africa, the single area of its geographical range where males occur. It is a Euromediterranean species, introduced to North America where it is known from British Columbia in Canada to California (LATTIN & STONEDAHL, 1984; KERZHNER & JOSIFOV 1999; AUKEMA *et al.*, 2013).

Dicyphus (Dicyphus) tamaninii Wagner, 1951

Mat.: Sicily, Palermo, Parco d'Orléans, 15-30.VI.2011: 1/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

D. tamaninii is a zoophytophagous species occurring on several wild and cultivated plants with glandular trichomes, mainly Solanaceae, used to control aphids and whiteflies on greenhouse-grown tomatoes (GOULA & ALOMAR 1994; WHEELER, 2000). It is a Mediterranean species known from Spain, France, Italy, Croatia, Bosnia Herzegovina, Crete, Tunisia and Israel (KERZHNER & JOSIFOV, 1999; AUKEMA *et al.*, 2013).

Macrolophus pygmaeus Rambur, 1839

Mat.: Sicily, Palermo, Parco d'Orléans, 1-15.VI.2011: 0/2, 15-30.VI.2011: 1/1, 1-15.VII.2011: 0/1, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

M. pygmaeus is a polyphagous zoophytophagous species living generally on plants provided with glandular hairs (Asteraceae, Fabaceae, Hydrophyllaceae, Lamiaceae, Solanaceae and Urticaceae) (MARTINEZ-CASCALES *et al.*, 2006); it is a W-Palaeartic species extending eastwards to Central Asia (Tadzhikistan and Tukmenistan), introduced in New Zealand (KERZHNER & JOSIFOV, 1999; AUKEMA *et al.*, 2013).

Pinalitus conspurcatus (Reuter, 1875)

Mat.: Sicily, Palermo, Parco d'Orléans, 15-30.VI.2011: 0/1, 1-15.VII.2011: 0/2, 16-31.VIII.2011: 0/1, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

The species is highly polyphagous and has a S-Mediterranean distribution including Canary islands, Madeira, Portugal, South Spain, North Africa, Middle East (Turkey, Cyprus, Israel and Yemen) extending to Sudan (CARAPEZZA, 1997; AUKEMA *et al.*, 2013). Recently it was reported from the Principality of Monaco (PONEL *et al.*, 2013), which suggests that *P. conspurcatus* too is one of the many species of Mediterranean Heteroptera which are spreading northwards their ranges in the European continent.

This is the first record of the species for Italy.

Orthotylus (Parapachylops) caprai Wagner, 1955

Mat.: Sicily, Palermo, Parco d'Orléans, 1-15.VI.2011: 1/0, 1-15.VII.2011: 2/2, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.; Palermo, via Botticelli, 7-16.VI.1999: 2/9 at lamp, A. Carapezza leg.; Sicily, Madonie, Mandarini, m 1000, 18.VIII.2004: 3/17 on *Cupressus sempervirens*, A. Carapezza leg.; Sicily, Menfi (AG), loc. Cinquanta, 13.VI.2010: 6/2, at lamp, A. Carapezza leg.

As all the other species of the subgenus *Parapachylops*, *O. caprai* feeds on both wild and cultivated Cupressaceae; it has been reported on *Junipe-*

rus, *Chamaecyparis*, *Cupressus*, *Sequoiadendron giganteum* (Lindley) Buchholz and *Thuja* (CARAPEZZA, 1984, 1997; NAU, 2007a, 2007b; SIMON, 2007; HODGE, 2008; RYAN, 2008; GOULA & MATA, 2011), but also, doubtfully, on *Pinus sylvestris* L. (Pinaceae) (SIMON, 2007). The species was described in 1955 from Sardinia and, as noted by GOULA & MATA (2011), it was regarded as a Sardinian endemic for longer than 40 years, until it was found in Sicily (CARAPEZZA, 1997). In recent years it has spread its range in Europe north of the Alps where it is considered an alien species (RABITSCH, 2010): Croatia, Germany and Switzerland (SIMON, 2007), Great Britain (NAU, 2007a, 2007b; HODGE, 2008; RYAN, 2008), Spain (GOULA & MATA, 2011) and Principality of Monaco (PONEL *et al.*, 2013). In addition to the published records listed above, some years ago I was informed of the presence of the species in northern Italy, in the city of Milan, where it was attracted to lights (M. Rizzotti Vlach, *pers. comm.*).

Orthotylus (Parapachylops) junipericola regularis Linnavuori, 1965

Mat.: Sicily, Palermo, Parco d'Orléans, 1-15.VI.2011: 3/2, 15-30.VI.2011: 8/6, 1-15.VII.2011: 1/2, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.; Sicily, Palermo, SW part of town, 7-16.VI.1999: 6/0, 5-7.VI.2000: 10/1, light trap at 8th floor of a building, A. Carapezza leg.; Sicily, Messina, Torre Faro, Granatari, 16-26. VI.2002: 1/0, C. Baviera leg. and coll.

O. junipericola has been collected on various Cupressaceae such as *Cupressus*, *Juniperus* spp., *Thuja* and *Tetraclinis articulata* (CARAPEZZA, 1997; RIBES & BORGES, 2001; RIEGER, 2007).

The species has a Macaronesian-Mediterranean distribution and is presently split into eight subspecies: *O. j. attilioi* Ribes et Borges, 2001 (Azores is.); *O. j. castellanus* Ribes, 1978 (North and Northwest Spain); *O. j. armoricanus* Éhanno et Matocq, 1990 (West France and North Spain); *O. j. balcanicus* Josifov, 1974 (Bulgaria, Greece and Turkey); *O. j. terminalis* Linnavuori, 1965 (Turkey and Rhodes Is.); *O. j. contractulus* Linnavuori, 1965 (Libya); *O. j. junipericola* Linnavuori, 1965 (Central Tunisia); *O. j. regularis* Linnavuori, 1965 (Northern Tunisia and Principality of Monaco) (CARAPEZZA, 1997; RIBES & BORGES, 2001; RIEGER, 2007; MATOCQ & ÖZGEN, 2010; PONEL *et al.*, 2013; MATOCQ *et al.*, 2014).

It is rather likely that also *O. j. regularis* is spreading northwards its distribution and should be regarded as a taxon "alien in Europe" according to the definition of RABITSCH (2010) reserved for those species which originate in the Mediterranean and move northwards in Europe. This is shown by the fact that in Sicily it has been found only in the last fifteen years and that all the findings have taken place in habitats under strong human influence, particularly towns, as it is typical for such species. This hypothesis is confirmed

by its recent sampling in the Principality of Monaco, which is the first record for the French-Monegasque fauna; there too it was collected in an urban environment, i.e. the escarpments of the Princely Palace (“Glacis du Palais Princier”), and its condition of invasive alien can explain the reason why it was found together with another subspecies of the same species (PONEL *et al.*, 2013).

This is the first record of the species for Italy.

Campylomma verbasci (Meyer-Dür, 1843)

Mat.: Sicily, Palermo, Parco d’Orléans, 15-31.V.2011: 1/0, 1-15.VI.2011: 0/2, 15-30.VI.2011: 0/1, 15-31.VII.2011: 0/2, 1-19.IX.2011: 0/2, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

C. verbasci is an omnivorous zoophytophagous mirid which plays an important role as predator of small-sized pests of cultivated fruit trees such as aphids, psyllids and thrips (WHEELER, 2000); it is a widely distributed Central Asian-Euromediterranean species which was accidentally introduced into North America (KERZHNER & JOSIFOV, 1999).

Atractotomus marcoi Carapezza, 1982

Mat.: Sicily, Palermo, Parco d’Orléans, 1-15.VI.2011: 0/1, 15-30.VI.2011: 3/0, 15-31.VII.2011: 0/2, 1-19.IX.2011: 0/2, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

A. marcoi was originally described from Sicily (Mt. Etna) and later found in Andorra, Northern Italy, Bulgaria, Germany, and Russia (KERZHNER & JOSIFOV, 1999; AUKEMA *et al.*, 2013), but its distribution is probably still imperfectly known. It lives on several species of *Pinus* (CARAPEZZA, 1982; RIZZOTTI VLACH, 1998; SIMOV & JOSIFOV, 2004).

FAMILY LYGAEIDAE SCHILLING, 1829

Nysius cymoides (Spinola, 1837)

Mat.: Sicily, Palermo, Parco d’Orléans, 1-15.VI.2011: 1/1, 15-30.VI.2011: 1/0, 1-15.VII.2011: 1/0, 1-19.IX.2011: 1/1, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

Highly polyphagous species found in warmer regions of Palaearctic Region and northern parts of tropical Africa (PÉRICART, 1999a, 2001; LINNAVUORI *et al.*, 2014).

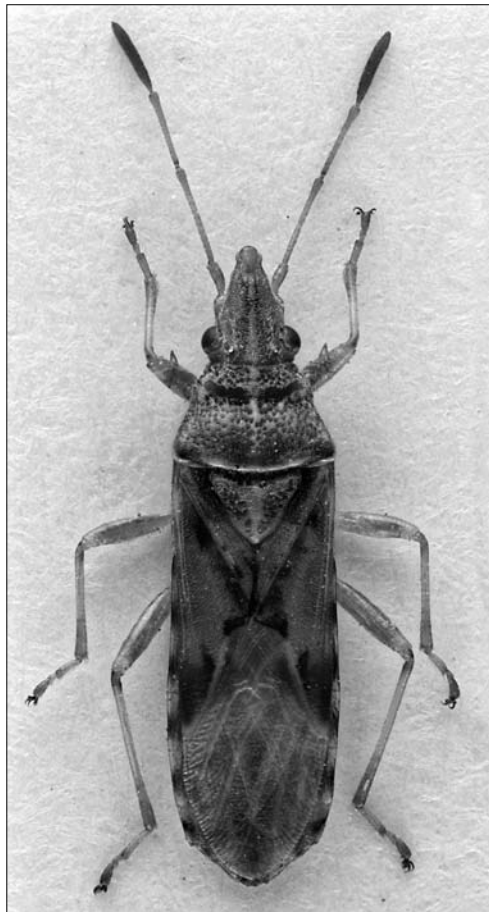
Belonochilus numenius (Say, 1832)

Mat.: Sicily, Palermo, Parco d'Orléans, 15-30.VI.2011: 1/0, 1-15.VII.2011: 1/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

In addition to the specimens listed above, several remnants of *B. numenius* were found examining the content of faecal sacs of Pallid swifts (*Apus pallidus* Shelley, fam. Apodidae) collected in the same area of Palermo town in August 2013 by Bruno Massa. Considering that Pallid swifts live catching insects high in the air, this is a further confirmation that *B. numenius* is a regular component of the aeroplanton hovering over Palermo town.

B. numenius, the sycamore seed bug, completes its biological cycle upon the seed balls of several species of *Platanus*, both hanging from the tree or fallen to the ground. Only occasionally the species can develop on other plants such as *Ambrosia trifida* L., *Celtis occidentalis* and *Salix* sp. In southcentral Pennsylvania it overwinters in the egg stage and has 3-4 generations per year, between April and September (WHEELER, 1984; SWEET, 2000).

The species is native to the Nearctic Region where it is distributed in an area extending from southern Canada to Mexico (ASHLOCK, 1967; ASHLOCK & SLATER, 1988). Outside its native range it was first found in South France and Corsica (MATOCQ, 2008; DUSOULIER *et al.*, 2013) and since then its rate of propagation in Europe has been very fast: South Spain (GESSÉ *et al.*, 2009; BAENA & TORRES, 2012), Italy (Tuscany) (KÜCHLER & STRAUSS, 2010), Austria (RABITSCH *et al.*, 2011), Czech Republic (HRADIL, 2011), Hungary (TORMA, 2012), Bulgaria (Carapezza in AUKEMA *et al.*,



Adult female of *Belonochilus numenius* (Say, 1832)

2013), Germany (Küchler in AUKEMA *et al.*, 2013; WERNER *et al.*, 2013), Slovakia (KMENT & KUNEV, 2013).

After its first finding in Italy in May 2010, when a reproducing population was found at Cecina in province of Livorno in Tuscany (KÜCHLER & STRAUSS, 2010), the species was recorded in 2012 and 2013 in photosharing websites from other Italian regions: Lombardy, Veneto, Marche and Campania.

This is the first record of the species for Sicily.

FAMILY OXYCARENIDAE STÅL, 1862

Oxycarenum (Oxycarenum) hyalinipennis (A. Costa, 1845)

Mat.: Sicily, Palermo, Parco d'Orléans, 15-30.VI.2011: 1/1, 1-15.VII.2011: 3/4, 15-31.VII.2011: 1/1, 16-31.VIII.2011: 2/1, 1-19.IX.2011: 3/2, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

O. hyalinipennis lives on wild and cultivated Malvaceae; it is widely distributed in southern parts of Palaearctic Region, Afrotropical and Oriental Regions, introduced to South America (PÉRICART, 1999b, 2001; SWEET, 2000; AUKEMA *et al.*, 2013).

FAMILY RHYPAROCHROMIDAE AMYOT ET SERVILLE, 1843

Camptocera glaberrima (Walker, 1872)

Mat.: Sicily, Palermo, Parco d'Orléans, 1-15.VII.2011: 1/0, 15-30.VI.2011: 1/0, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

The species lives on the ground and is likely to have a myrmecophilous association (PÉRICART, 1999b; LINNAVUORI *et al.*, 2014). It is widely distributed in Afrotropical and Mediterranean regions, Macaronesia, southern Europe, Transcaucasia, Near East, Arabian Peninsula, Iran, Afghanistan, Central Asia, Mongolia and Oriental Region (PÉRICART, 2001; AUKEMA *et al.*, 2013).

FAMILY RHOPALIDAE AMYOT ET SERVILLE, 1843

Liorhyssus hyalinus (Fabricius, 1794)

Mat.: Sicily, Palermo, Parco d'Orléans, 1-19.IX.2011: 0/1, Johnson-Taylor suction trap, C. Cusimano & B. Massa leg.

The hyaline grass bug is a highly polyphagous species recorded in association with a variety of plants belonging to several different families, mostly

Asteraceae. It is a cosmopolitan species distributed in tropical, subtropical and warmer areas of temperate regions. HRADIL *et al.* (2007) reviewed its worldwide distribution and biology commenting its recent northward expansion in western and central Europe in connection with possible global warming.

Acknowledgements — A particular gratitude is due to Bruno Massa for managing the suction trap and for the critical revision of the manuscript.

REFERENCES

- ASHLOCK P.D., 1967. A generic classification of the Orsillinae of the World (Hemiptera: Heteroptera: Lygaeidae). *Univ. California Publ. Entomol.*, 48: 1-82.
- ASHLOCK P.D. & SLATER A., 1988. The seed bugs and chinch bugs. Pp. 167-245 in Henry T.J. & Froeschner R.C. (Eds), *Catalog of the Heteroptera, or true bugs, of Canada and the continental United States*. E.J. Brill, Leiden, 958 pp.
- AUKEMA B., RIEGER CH. & RABITSCH W., 2013. Catalogue of the Heteroptera of the Palaearctic Region. VI. Supplement. *Netherlands Entomol. Soc.*, Amsterdam, xxiii + 629 pp.
- BAENA M. & TORRES J. L., 2012. Nuevos datos sobre heterópteros exóticos en España y Francia: *Tempyra biguttula* Stål, 1874, *Belonochilus numenius* (Say, 1832) y *Zelus renardii* (Kolenati, 1856) (Heteroptera, Rhyparochromidae, Orsillidae, Reduviidae). *Bol. Asoc. esp. Entomol.*, 36: 351–360.
- CARAPEZZA A., 1997. Heteroptera of Tunisia. *Naturalista sicil.*, Palermo, 21 (Suppl. A): 1-312.
- CARAPEZZA A., LINNAVUORI R.E. & KMENT P., 2014. Order Hemiptera, suborder Heteroptera. Infraorder Cimicomorpha, families Tingidae, Nabidae and Anthocoridae. *Artthropod fauna of the UAE*, 5: 148–186.
- DUSOULIER F., MAILLOT R. & DERREUMAUX V., 2013. *Belonochilus numenius* (Say, 1832): état de la progression de l'espèce et nouvelles localités dans le Sud de la France (Hemiptera Lygaeidae). *Entomologiste*, 69 (3): 185-190.
- GESSÉ F., RIBES J. & GOULA M., 2009. *Belonochilus numenius*, the sycamore seed bug, new record for the Iberian fauna. *Bull. Insectol.*, 62(1): 121-123.
- GOULA M. & MATA L., 2011. *Orthotylus (Parapachylops) caprai* Wagner, 1955, new record for Iberian Peninsula (Heteroptera, Miridae). *Bull. Soc. entomol. Fr.*, 116 (2): 177-179.
- HODGE P., 2008. A second British site for the mirid *Orthotylus caprai*. *Heteroptera News*, 12: 16.
- HRADIL K., KMENT P. & ROHÁĚOVÁ M., 2007. New records of *Liorbyssus hyalinus* (Heteroptera: Rhopalidae) in the Czech Republic, with a review of its worldwide distribution and biology. *Acta Mus. Moraviae, Scientiae biol.*, Brno, 92: 53-107.
- HRADIL K., 2011. Faunistic records from the Czech Republic. 315. Heteroptera: Lygaeidae. *Belonochilus numenius* (Say, 1831). *Klapalekiana*, 47: 261-262.
- INGHILESI A.F., MAZZA G., CERVO R., GHERARDI F., SPOSIMO P., TRICARICO E. & ZAPPAROLI M., 2013. Alien insects in Italy: Comparing patterns from the regional to European level. *J. Insect Sciences*, 13, art. 73: 1-13.
- JOHNSON C.G., 1969. Migration and Dispersal of Insects by Flight. *Metheun and Co*, London, pp. xxii+763.
- KMENT P. & CUNEV J., 2013. First record of the alien seed bug *Belonochilus numenius* (Hemiptera: Heteroptera: Lygaeidae) in Slovakia. *Entomofauna Carpathica*, 25(2): 15-20 [in Czech].
- KERZHNER I. M. & JOSIFOV M., 1999. Cimicomorpha II: Miridae. In: Aukema B. & Rieger C. (eds), *Catalogue of the Heteroptera of the Palaearctic Region*, Vol. 3. *Netherlands entomol. Soc.*, Amsterdam, 577 pp.

- KÜCHLER S. & STRAUSS G., 2010. *Belonochilus numenius* (Say, 1832) (Heteroptera: Lygaeidae) – bald auch in Mitteleuropa? *Beitr. Entomof.*, 11: 27-33.
- LATTIN J.D., 2014. Minute Pirate Bugs (Anthocoridae). Pp. 607–637 in: Schaefer C.W & Panizzi A.R. (eds), Heteroptera of Economic Importance. *CRC Press*, Boca Raton, Florida, xxii + 828 pp.
- LATTIN J.D. & STONEDAHL G.M., 1984. *Campyloneura virgula*, a predaceous Miridae not previously recorded from the United States (Hemiptera). *Pan-Pac. Entomol.*, 60: 4–7.
- LINNAVUORI R. E., 1999. Studies on the Miridae fauna of Greece (Hemiptera, Heteroptera). *Biologia Gallo-hellenica*, 25 (1): 25–68.
- LINNAVUORI R., KMENT P. & CARAPEZZA A., 2014. Order Hemiptera, suborder Heteroptera. Infraorder Pentatomomorpha, superfamily Lygaeoidea. *Arthropod fauna of the UAE*, 5: 192–246.
- MARTINEZ-CASCALES J. I., CENIS J. L., CASSIS G. & SANCHEZ J. A., 2006. Species identity of *Macrolophus melanotoma* (Costa 1853) and *Macrolophus pygmaeus* (Rambur 1839) (Insecta: Heteroptera: Miridae) based on morphological and molecular data and bionomic implications. *Insect Syst. Evol.*, Copenhagen, 37: 385-404.
- MATOCQ A., 2008. Présence en France et en Corse d'un Hétéroptère néarctique, *Belonochilus numenius* (Say, 1832) (Hemiptera, Lygaeidae, Orsillinae). *Bull. Soc. entomol. Fr.*, 113(4): 533-534.
- MATOCQ A., PLUOT-SIGWALT D. & ÖZGEN ., 2014. Terrestrial Hemiptera (Heteroptera) collected in South-East Anatolia (Diyarbakir, Mardin and Elazi Provinces) (Turkey): Second list. *Mun. Ent. Zool.*, 9 (2): 884-930.
- MATOCQ A. & ÖZGEN ., 2010. A preliminary list of Heteroptera collected in Mardin and Siirt provinces from South-Eastern Anatolia of Turkey (Hemiptera). *Munis Entomology & Zoology*, 5 (suppl.): 1011-1019.
- NAU B.S., 2007a. "Unknown" orthotyline on Wellingtonia in Oxford. *Heteroptera News*, 9: 9.
- NAU B.S., 2007b. *Orthotylus caprai* Wagner, 1955 (Miridae). *Heteroptera News*, 10: 10.
- NEAL J.V. & SCHAEFER C.W., 2000. Lace bugs (Tingidae). Pp. 85–137 in: C.W. Schaefer & Panizzi A.R. (eds), Heteroptera of Economic Importance. *CRC Press*, Boca Raton, Florida, xxii + 828 pp.
- PÉRICART J., 1972. Hémiptères Anthocoridae, Cimicidae et Microphysidae de l'Ouest paléarctique. Faune de l'Europe et du Bassin Méditerranéen. Vol. 7. *Masson et Cie*, Paris, 402 pp.
- PÉRICART J., 1983. Hémiptères Tingidae euro-méditerranéens. Faune de France et régions limitrophes. Vol. 69. *Fédération Française des Sociétés de Sciences Naturelles*, Paris, x + 620 pp.
- PÉRICART J., 1996. Family Anthocoridae Fieber, 1836 – flower bugs, minute pirate bugs. Pp. 108–140 in: B. Aukema & Rieger Ch. (eds), Catalogue of the Heteroptera of the Palaearctic Region. Vol. 2. *Netherlands entomol. Soc.*, Amsterdam, xiv + 361 pp.
- PÉRICART J., 1999a. Hémiptères Lygaeidae Euro-Méditerranéens. Faune de France et régions limitrophes. Vol. 84A. *Fédération Française des Sociétés de Sciences Naturelles*, Paris, xx + 468 pp + 6 pls.
- PÉRICART J., 1999b. Hémiptères Lygaeidae Euro-Méditerranéens. Faune de France et régions limitrophes. Vol. 84B. *Fédération Française des Sociétés de Sciences Naturelles*, Paris, iii + 453 pp + 9 pls.
- PÉRICART J., 2001. Superfamily Lygaeoidea Schilling, 1829. Family Lygaeidae Schilling, 1829. – Seed Bugs. Pp. 35–220 in: B. Aukema & Rieger Ch. (eds). Catalogue of the Heteroptera of the Palaearctic Region. Vol. 4. *Netherlands entomol. Soc.*, Amsterdam, xiv + 346 pp.
- PÉRICART J. & GOLUB V.B., 1996. Superfamily Tingioidea Laporte, 1832. Family Tingidae Laporte, 1832 – lacebugs. Pp. 3–78 in: B. Aukema & Rieger Ch. (eds), Catalogue of the Het-

- eroptera of the Palaearctic Region. Vol. 2. *Netherlands entomol. Soc.*, Amsterdam, xiv + 361 pp.
- PONEL P., MATOCQ A. & LEMAIRE J.-M., 2013. Hétéroptères de la Principauté de Monaco: premier inventaire comprenant six taxons de Miridae nouveaux pour la faune franco-monégasque (Hemiptera). *Bull. Soc. Entomol. Fr.*, 118 (2): 223-234.
- RABITSCH W., 2010. True Bugs (Hemiptera, Heteroptera), Chapter 9.1. in: Roques A., Kenis M., Lees D., Lopez-Vaamonde C., Rabitsch W., Rasplus J.Y. & Roy D.B. (eds), Alien terrestrial arthropods of Europe. *BioRisk*, 4 (special issue): 407-433.
- RABITSCH W., BRÄU M. & FRIESS T., 2011. *Belonochilus numenius* (Say, 1832) (Heteroptera, Lygaeidae) has reached Austria! *Beitr. Entomof.*, 12: 148-149.
- RIBES J. & BORGES P., 2001. A new subspecies of *Orthotylus junipericola* Linnavuori, 1965 (Insecta, Heteroptera) from the Azores Arquipélago. *Life and Marine Sciences*, 18A: 1-4.
- RIEGER C., 2007. Neunachweise und Ergänzungen zur Wanzen-Fauna Griechenlands (Insecta: Heteroptera). *Mainzer naturwiss. Archiv, Beiheft*, 31: 199-207.
- RIZZOTTI VLACH M., 1998. Due interessanti miridi in Alto Adige: *Lygus adspersus* (Schilling) e *Atractotomus marcoi* Carapezza (Insecta Heteroptera). *Atti Accad. roveret. Agiati*, 8 B: 105-114.
- RYAN R.P., 2008. *Orthotylus caprai* Wagner (Hemiptera, Miridae) new to Britain. *Entomologist's Monthly Magazine*, 144: 129-130.
- SIMON H., 2007. Nachtrag zum Verzeichnis der Wanzen in Rheinland-Pfalz (Insecta: Heteroptera). *Fauna Flora Rheinland-Pfalz*, 11: 109-135.
- SIMOV N. & JOSIFOV M., 2004. Contribution to the Bulgarian fauna of Heteroptera. *Hist. naturalis bulg.*, 16: 89-94.
- SOUTHWOOD T.R.E., 1960. The flight activity of Heteroptera. *Trans R. Ent. Soc. London*, 113 (8): 173-220.
- SWEET M. H. JR., 2000. Seed and Chinch Bugs (Lygaeoidea). Pp. 143-263 in: Schaefer C.W & Panizzi A.R. (eds), Heteroptera of Economic Importance. *CRC Press*, Boca Raton, Florida, xxii + 828 pp.
- TORMA A., 2012. First record of the alien sycamore seed bug *Belonochilus numenius* (Heteroptera: Lygaeidae) in Hungary. *Növényvédelem*, 48 (10): 467-468 [in Hungarian].
- WERNER D.J., BRANDNER J., MULLER A. & ZAPF M., 2013. Ein Fund von *Belonochilus numenius* (Say, 1831) in Deutschland (Heteroptera: Lygaeidae) mit Diskussion zum Jahr der Erstbeschreibung der Art. *Heteropteron*, 39: 37-39.
- WHEELER A.G. JR., 1984. Seasonal history, habits and immature stages of *Belonochilus numenius* (Hemiptera: Lygaeidae). *Proc. Entomol. Soc. Washington*, 86: 790-796.
- WHEELER A.G. JR., 2000. Predacious Plant Bugs (Miridae). Pp. 657-694 in: Schaefer C.W & Panizzi A.R. (eds), Heteroptera of Economic Importance. *CRC Press*, Boca Raton, Florida, xxii + 828 pp.
- WHEELER A.G. JR., 2001. Biology of the Plant Bugs (Hemiptera: Miridae). Pests, Predators, Opportunists. *Cornell University Press*, Ithaca and London, 507 pp.

Authors' addresses — A. CARAPEZZA, via Sandro Botticelli, 15 - 90144 Palermo (I); e-mail: attilio.carapezza@unipa.it; C. CUSIMANO, Dipartimento di Scienze agrarie e forestali, Viale delle Scienze, 13 - 90128 Palermo (I); email: c.cusimano@inwind.it.

