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Zelus renardii (Kolenati, 1856), a newly established alien species in Italy (Hemiptera: Reduviidae, Harpactorinae)

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Abstract
This note adds new occurrence records of the hemipteran alien species *Zelus renardii* (Kolenati, 1856) in Italy by citizens, entomologists and photographers. This species was recorded for first time in Rome in 2013.

Key words: *Zelus renardii*, Hemiptera, Heteroptera, alien species, faunistic, new records, Italy.

Introduction

Zelus Fabricius, 1803 is one of the most diverse genus of the family Reduviidae (Hemiptera: Heteroptera). It is endemic of the New World, with a distribution that ranges from Canada to Argentina, Chile, Caribbean and Pacific Islands. It is represented by more than 70 species widely distributed in the American continent, even if the majority of the species shows a restricted distribution (Maldonado 1990).

Apparently, some species have been accidentally introduced in the Caribbean and some Pacific islands as Dominican Republic, Puerto Rico, Cuba, Haiti, Trinidad and Tobago, and Guadeloupe (Hart 1972; 1986; 1987). There are also four species in Argentina (Morrone & Coscarón 1998). No taxa of *Zelus* had been recorded from Chile until 2004, when two species, apparently of recent introduction, *Z. renardii* (Kolenati, 1856) and *Z. cervicalis* Stål, 1872 were found (Curkovic et al. 2004; Elgueta & Carpintero 2004). *Z. renardii* was also recently reported from French Polynesia (Zhang et al. 2016).

The only species of the genus that has been so far recorded in Europe, is *Z. renardii* that has been found in Greece (Davranoglou 2011; Petrakis & Moulet 2011; Simov et al. 2017) including the island of Crete (van der Heyden 2015), Spain (Vivas 2012), Italy (Dioli 2013b), Turkey (Çerçi & Koçak 2016) and recently Albania (van der Heyden 2017). In Italy, *Z. renardii* was recorded only twice in the towns of Rome (Dioli 2013b) and Bari (Cornara et al. 2016), and never reported anymore. In this note, we add new records for this species in Italy.

Material and methods

The material was collected and/or photographed from few Italian localities from 2013 to 2017. Specimens were mostly detected by nature photographers on plants or collected with light trapping system. Examination of the male genitalia was necessary to confirm the species identification; the revision by Zhang et al. (2016) was used for this purpose. The collected specimens are preserved in the private collection of P. Dioli (Sondrio) as pinned dry specimens. Geographical coordinates are reported in decimal degrees (datum WGS84); number of decimals varies according to the accuracy of original source.

Results

Material examined. **LATIUM:** Roma (41.90° N 12.49° E), 5 Jul 2015, 1 nymph, photo by Angelo Vannozzi (www.naturamediterraneo.com); Roma, Monteverde quarter, Via M.L. Longo (41.868° N 12.451° E), 19 Jul 2015, photo by Angelo Vannozzi (www.naturamediterraneo.com); Roma, at the crossroad between Via Gianicolense and Via Ramazzini (41.8701° N 12.4530° E), 19 Jul 2016, 1 ♂, Angelo Vannozzi leg. (Coll. P. Dioli, Sondrio); Roma, Villa

Gordiani (41.892° N 12.553° E), summer 2016, 1 nymph, photo and pers.com. by Domenico Camelio (www.facebook.com); Roma, Piazza Euclide (41.9268° N 12.4812° E), 10 Jan 2017, 1 ex., photo by Elena Regina (www.formicarium.it); Roma (41.90° N 12.49° E), 15 Jan 2017, 1 ♀, Angelo Vannozzi leg. (Coll. P. Dioli, Sondrio); Roma, Via Giovanni Giolitti (41.896° N 12.507° E), 18 Apr 2017, 1 ex., photo by Massimo Valdastri (www.csmon-life.eu); Roma, Pinciano quarter (41.919° N 12.484° E), 20 Jun 2017, 1 ex., photo by Flavio Rocchi (www.inaturalist.org); Malagrotta (RM), 41.883° N 12.333° E, 14 Feb 2017, 1 ex., photo by Luigi Lenzini (Figs 1-2) (www.entomologiitaliani.net); Roma, Parco della Riserva Grande (41.94° N 12.36° E), 11 Jul 2017, 1 ex., on *Chenopodium nepeta* (L.) Kuntze, photo and pers.com. by Lory Rossi (www.facebook.com); Roma, Riserva Naturale Valle dell'Aniene (41.92° N 12.55° E), 7 Sep 2017, photo by Chiara Curto (www.facebook.com); Roma, Ponte Galeria (41.812° N 12.326° E), 4 Sep 2017, 1 ex.; ibidem, 10 Sep 2017, 1 ex.; ibidem, 9 Dec 2017, 1 ex., all photos and pers.com. by Michele Sessa (www.facebook.com). **APULIA:** Bari, Parco 2 Giugno (41.1023° N 16.8747° E), Feb 2014, 1 ex., on *Lantana camara* L., photo and pers.com. by Antonio Tinella (www.facebook.com); Bari, University Campus (Università di Bari) (41.109° N 16.879° E), Feb 2014, 1 ex., photo and pers.com. by Antonio Tinella (www.facebook.com); Monopoli (BA) (40.94° N 17.29° E), at the terrace in front of the sea, Oct 2014, 1 ex., on *Plectranthus* L'Hér., spurflower, photo and pers.com. by Vito Bini (www.facebook.com); Molfetta (BA) (41.19° N 16.59° E), 23 Nov 2015, 1 ex., photo and pers.com. by Vincenzo Bisceglie (www.facebook.com); Foggia (41.45° N 15.55° E), 5 Nov 2017, 1 ex., on *Capsicum chinense* Jacq., parasitized by *Frankinella occidentalis* (Pergande, 1895), photo and pers.com. by Fabrizio Palmieri; Gallipoli (LE), Camping "La Masseria" (40.073° N 18.008° E), 8 Nov 2017, 1 ex., photo and pers.com. by Sandro Francesco Prian (www.facebook.com).

Diagnosis. Males can be recognized by the paramere apically greatly enlarged, slightly curved dorsally; the medial process laterally compressed; apex strongly curved ventrally, clearly hook-like (cf. Zhang et al. 2016). This species is recognized by the following characters: medial process laterally compressed; apex strongly curved ventrally, clearly hook-like; paramere apically expanded, slightly curved dorsally; humeral angle of pronotum widened; body length 5.5× or less of width through humeral angles. Corium is reddish; the remaining parts of the body surface are greenish; the humeral angle with small subtuberculate projection. Body more robust than in *Z. cervicalis*, the only species that may be confused with *Z. renardii*.

Distribution. Native of Central and North America, from USA to Honduras. In USA, where it is known as "*leafhopper assassin bug*", is common in the western and southwestern areas (Hart 1986; Maldonado 1990). Introduced in several countries across the world (Mexico, Guatemala, the Polynesian islands (Samoa, Hawaii), Jamaica, Philippines and Chile (Hart 1986; Zhang et al. 2016). In Europe has been to date recorded in Spain, Italy, Albania, Greece (including Crete) and Turkey.

Biology. Zelus renardii is a zoophagous and generalist predator found on several wild and crop plants where it preys on a wide range of insects. In Europe, this species was recorded by Davranoglou (2011) in Athens on tall ornamental plants, such as bushes and young trees: e.g. *Brachychiton populneus* (Schott & Endl.) R. Br., Sterculiaceae; *Duranta repens* L., Verbenaceae, although some specimens, in particular nymphs, have been collected on low vegetation and nymphal exuviae have been recorded at the base of trees of the genus *Eucalyptus* spp., Myrtaceae. In Turkey the bug was found on *Ficus* sp., Moraceae, and *Paulownia* sp., Paulowniaceae. Specimens collected in Istanbul were gathered by sweeping branches of *Vitis* sp., Vitaceae, and flowers of *Daucus* sp., Apiaceae (Çerçi & Koçak 2016).

Hagen et al. (1999) mention that nymphs of *Z. renardii* usually feed on aphids, weevils and thrips, while adults feed on almost any arthropod they can catch. As widely documented, *Z. renardii* preys on all types of insects belonging to different orders (Hemiptera, Lepidoptera, Coleoptera, Hymenoptera, Neuroptera, Blattaria or Orthoptera) (Nielson & Henderson 1959; Ables 1978; Ali & Watson, 1978; Rosenheim et al. 1993; Cisneros & Rosenheim 1997; Heimpel et al. 1997; Hodge 1999; Rosenheim 2001; Sanchez-González & Arredondo-Bernal 2009; Vivas 2012; Ewing & Ivy 1943; Clancy 1946; Nielson & Henderson 1959; Rakickas & Watson 1974; Stoner et al. 1975; Ables 1978; Sterling 1982; Cisneros & Rosenheim 1997; Costello & Daane 1999; Naranjo et al. 2002; Ponsard et al. 2002; Davranoglou 2011), even on intermediate predators (Rosenheim et al. 1999; Hemptinne et al. 2012; Law & Rosenheim 2011) for the effect of intraguild predation (IGP). As generalist predator, *Z. renardii* can affect populations of natural enemies and biological control agents too. For example, the populations of chrysopids and aphelinids, used as biological control agents of agricultural pests, can significantly decrease in the presence of *Z. renardii* (Cisneros et al. 1997).

Predatory behaviour has been widely documented: as soon as it detects a prey, the assassin bug does not move, it lifts its forelegs and projects the antennae forward, almost simultaneously the sticky substance, secreted by glands located in the tibia, ensures that the prey does not escape. Smaller, more mobile prey is 'ambushed', while larger, less mobile prey is 'stalked'. Generally it is paralyzed in less than a minute. The entire feeding process on a medium to large sized meal takes between 60 to 80 minutes (Ables 1978; Law & Sediqi 2010). Except the use of sticky substances, the indigenous species of the family Reduviidae

Figs 1-2 – Specimens of *Zelus renardii* (Kolenati, 1856) from Rome. Photos by Luigi Lenzini.

show predatory behaviour similar to that reported for *Z. renardii*; however, they use thorny appendages or surfaces blockers. Another reduviid, *Nagusta goedelii* (Kolenati, 1857), for example plays the same ecological predatory role, against leafhoppers (Flatidae) on trees in Northern Italy (Dioli 2013a).

Discussion

The presence of this species in Italy is currently limited to Latium (Rome) and Apulia (Foggia, Molfetta, Bari, Monopoli, and Gallipoli). So far, in Latium *Z. renardii* has been always recorded as single specimen (nymph or adult). Different is the case of Apulia, where the species has been reported in higher densities from eggs to adults (Cornara et al. 2016). Records of further specimens from Rome and other cities in Apulia are included in the present work. In a few years the species has spread in the Mediterranean region to Turkey: this fact poses an urgent question about its permanence and progressive adaptation to the natural and agricultural ecosystem. In this regard, Weirauch et al. (2012) discussed a possible link between biological attributes and a potential invasion. European diffusion may be derived from Mediterranean climate adapted populations, which is similar to California. This hypothesis could be tested in the future using molecular markers and phylogeographic models. In fact, temperature has a significant effect on the development of *Z. renardii* nymphs with the optimum for temperature ranging from 25 °C to 30 °C. Higher and lower temperatures, like in Tropical or Arctic Areas, significantly decrease the development of each preimaginal stage, increasing the mortality at nymphal stage. Other factors, such as photoperiod, might play an important role in the development of this species (Ali & Watson 1978; Davranoglou 2011).

Zelus renardii seems more likely to be dispersed by human activities than other species, given the abundance in human-disturbed environments. In fact, this species was observed inhabiting agricultural settings and even urban and suburban environments, such as parks or other public spaces (Weirauch et al. 2012). Since *Z. renardii* females readily glue their egg batches on plants (usually on the ventral surface of the leaves) or other objects (i.e., tissue paper in the lab), egg batches may have been passively introduced through commerce, e.g. in nursery plant stock, a to Europe (Weirauch et al. 2012) .

Weirauch et al. (2012) suggest that *Z. renardii* could be considered as a pioneer species, and it might also be more tolerant to adverse conditions, such as high temperatures and scarce food supply, compared with its congeners. Wild-caught *Z. renardii* specimens can survive to the transfer into the laboratory even under hot conditions, can establish colonies easily, and even irregular food supply usually does not impact their reproductive success. Shorter predation and feeding time in *Z. renardii* might represent ecological advantages that reduce the risk of being preyed upon; and thus may contribute to the high abundance of this species in many areas. *Zelus renardii* is likely dispersed by humans, given the abundance in human-disturbed environments. The association with humans observed in *Z. renardii* may be is the reason for the dispersal of this species; biological parameters including predation efficiency and higher rate of offspring per mating may further facilitate the establishment of this species outside its native range (Weirauch et al. 2012). A clear confirmation of this attitude is documented by Cornara et al. (2016), which showed *Zelus renardii* as a predator of *Macrohomotoma gladiata* (Kuwayama, 1908) (Psylloidea Homotomidae), a new insect pest originating from Asia of *Ficus microcarpa* Hort. Berol. ex Walp. (Moraceae), an ornamental of urban greenery in Bari (Italy). Recent studies suggest *Z. renardii* as a candidate agent for the biological control of *Philaenus spumarius* (L.). This leafhopper is a vector of *Xylella fastidiosa* (Wells et al., 1987), a bacterial disease on *Olea europea* L. (Porcelli 2017). The hypothesis, however, requires careful checks due to the intra-guild predation (IGP) against other arthropods used for biological control (mainly, Coccinellidae and Crysopidae) that could affect their performance (Cisneros et al. 1997). Finally, the particular morphological conformation of the forelegs (Ables 1978; Weirauch et al. 2012) of this assassin bug is so far unknown among the European species of the same family: so it could create direct competition with other indigenous reduviids of the Palaeartic region. Thus, its use as biocontrol agent should be strongly discouraged because of its status of alien species and generalist predator.

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