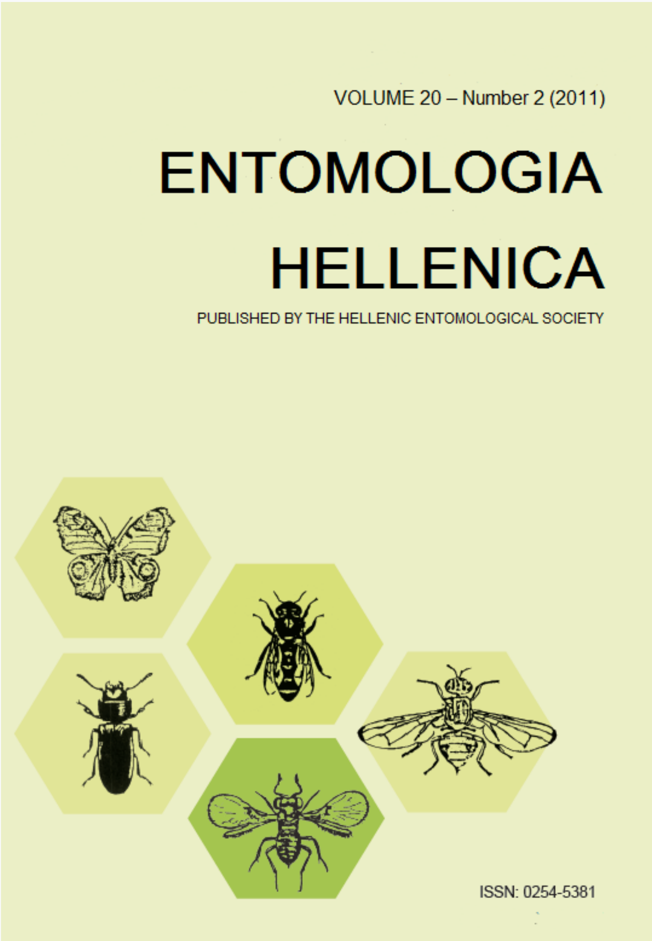
ENTOMOLOGIA HELLENICA

Vol 20, No 2 (2011)



First record of the Nearctic Zelus renardii (Heteroptera, Reduviidae, Harpactocorinae) in Europe

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doi: [10.12681/eh.11511](https://doi.org/10.12681/eh.11511)

ENTOMOLOGIA HELLENICA **20** (2011): 75-81

First record of the Nearctic *Zelus renardii* (Heteroptera, Reduviidae, Harpactocorinae) in Europe

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ABSTRACT

The Nearctic assasin bug species *Zelus reinardii* was found for the first time in Attica, Greece, Europe. This species is a generalist predator which can contribute to the control of insect pests. This is also a known predator of several biological control agents of pests. Therefore, its naturalization in Greece is potentially problematic in economic settings since the insect may act as both an intraguild and a beneficial predator. The risky nature of importation in other areas (e.g. Hawaii) showed the possibility of these ecological roles.

KEYWORDS: *Zelus renardii,* distribution, invasive species.

Introduction

The leafhopper assassin bug *Zelus renardii* Kolenati, 1857 (Hemiptera, Reduviidae, Harpactocorinae) was found in three localities in Attica, Greece for the first time in Europe. It is native of the Nearctic region (continental USA, Mexico, Guatemala) and has been putatively introduced into Hawaii, the Philippines and Jamaica (Maldonado 1990) and recently reported from Chile (Curkovic et al. 2004). This species has been considered as a generalist predator with restricted ability to suppress pests (Frank and Slosser 1996, Rosenheim et al. 2004).

It was recently discovered that *Z. renardii* disrupts classical biological control programs by exhibiting strong intraguild predation (IGP) on other intermediate predators that cause population reduction of crop pests (Ables 1978, Cohen and Tang 1997, Cisneros and Rosenheim 1998, Rosenheim et al. 1999, Howarth and Preston 2002, Ponsard et al. 2002, *contra* Law and Rosenheim 2011).

Invasion of assassin bugs in non-native regions usually triggers interception measures because of their commonly broad diet. Such predatory heteropterans are known to also switch to plant feeding increasing their survivorship (Stoner et al. 1975, Cohen 1990, Torres and Boyd 2009).

Amongst the *c.* 6900 species of assassin bugs known worldwide, including about 110 species in Europe and 40 species in Greece, only 3 species (two cryptogenic and one alien) are adventitious to Europe (Putshkov and Putshkov 1996, Rabitsch 2008, 2010, Aukema 2011). This work reports on the introduction of the Nearctic species, *Z. renardii*, to Greece.

The records

Zelus renardii was found in three locations in the Attica prefecture in Greece. The first finding was a recently captured dead male insect within the glass housing of a road light in the area Thracomacedones – Olympiako

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Chorio (38^{o} 7' 46''N, 23^{o} 46' 25''E) on 15th August 2010. We also found this species eating a *Synophropsis lauri* (Horváth, 1897) (Hemiptera: Auchenorrhyncha: Cicadellidae) captured in an insect net in the district Alsoupolis – Olympiako Stadio (38^{o} 2' 10''N, 23^{o} 46' 25''E), between August 2nd, 2011 and September 2nd, 2011 (Moulet collection); the prey was immobilized by the sticky raptorial forelegs of the assassin bug. This assassin bug was also found in the pinewood outside the Forest Entomology laboratory in the Institute of Mediterranean Forest Ecosystem (37^{o} 58' 30'', 23^{o} 46' 40''; August 29th, 2011).

It is assumed that a single generation of *Z. renardii* occurs in Greece because of the extensive sampling effort in Attica (i.e. approximately100 fortnightly inspected traps all over the year).

Identification

Zelus Fabricius, 1803 (Fig. 1) belongs to the most diverse genus of the family Reduviidae. It is represented by 60 species widely distributed in the American continent but with the majority of species having restricted distribution (Maldonado 1990). Seven species are widespread and found both in North and South America [i.e. *cervicalis* Stål, 1872; *longipes* (Linnaeus, 1767); *minutus* Hart, 1987; *nugax* Stal, 1872; *renardii* Kolenati, 1857; *tetracanthus* Stal, 1862; *vespiformis* Hart, 1987] (Maldonado 1990).

Some species are known to invade southern biotopes where they can become harmful to local insects (Funasaki et al. 1988, Rosenheim et al. 2004).

This species is recognized by the following characters: body length 12 – 16 mm; cryptozoic coloration; body gracile (thin and slender) with thin and long legs; the head is elongate and eyes not prominent; rostrum thin and elongate; pronotum, elongate trapezoidal, lateral angles obtuse. The coloration varies greatly but is generally cryptic.

Zelus renardii is closely related to *Z. luridus* and *Z. cervicalis* but can be distinguished from them by the reddish pronotum, hemielytra and legs (cf. green in *Z. luridus*), apex of femora without a large and dark ring (cf. present in Z. *luridus*); and humeral angles of pronotum obtuse (cf, elongate and acute tooth in Z. *luridus*, at most with minute subtuberculate process in *Z. cervicalis*) and (length) $\geq 5.8 \times$ (width) in males [for an identification key see Hart 1986; a taxonomic description of the genus is urgently needed and is undertaken by G. Zhang under the supervision of C. Weirauch].

Biology and Distribution

Zelus renardii is a commonly encountered species of Reduviidae throughout its geographic range (Hart 1986) and is usually found in alfalfa, sweetpotato, potato and cotton crops where it preys on all types of insects, even on intermediate predators (Rosenheim et al. (1999) for the effect of intraguild predation (IGP) on the introduced predator *Chrysoperla carnea* (Stephens) for classical biological control; Müller and Brodeur (2002) for the effect on biological control in conservation; Law and Rosenheim (2011) when the intermediate predator is *Geocoris pallens* Stål and the herbivore is *Lygus hesperus* Knight; Hemptinne et al. (2011) when the intermediate predator is a ladybird beetle) and it frequents the catches of sweep nettings. In the source region the insect is a sit-and-wait predator and has a population peak in late summer but smaller populations exist in mid-summer (Ali and Watson 1978). The same authors conducted

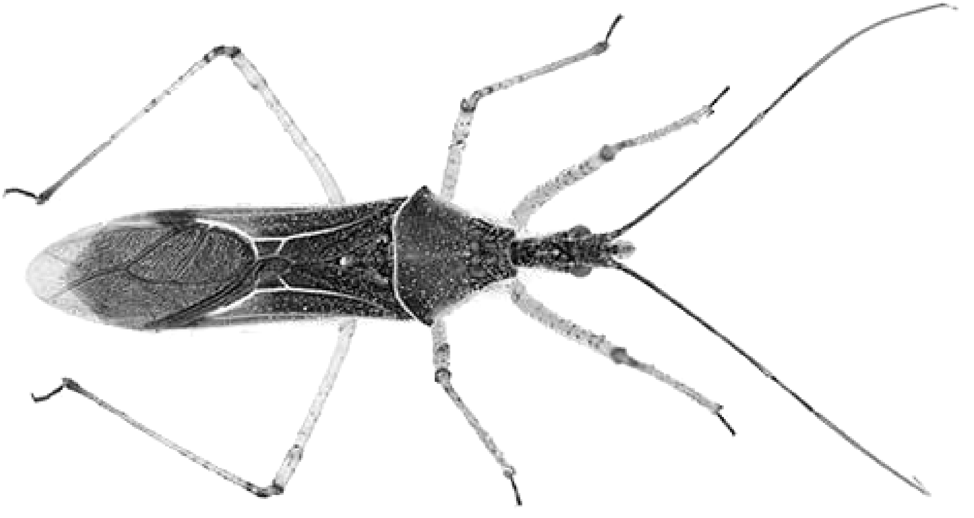

FIG. 1. The insect *Zelus reinardii*, dorsal view.

laboratory experiments for the determination of optimal temperature conditions for the development and survival of *Z. renardii*. The greatest longevity occurs at 25°C but at 20°C the survival was substantially high except for the first instar for which the survival is 46%. *Zelus renardii* is able to vary many life cycle parameters and morphometric values such as the survival in various temperature regimes and the duration of each instar.

In the invaded region the voltinism of *Z. renardii* has not yet been studied. However, since the insect was trapped in late August – early September it can be speculated that the insect has an additional spring generation (Ali and Watson 1978). The low population levels are shown by the very low captures of the insect in the set of more than one hundred fortnightly inspected traps.

Discussion

Mediterranean species of true bugs are repeatedly introduced in northern and mid-latitude European countries but are usually go unnoticed, rarely reported in the literature, and do not often become established (Rabitsch 2008). In contrast, the Nearctic species *Z. renardii* originated in climatic conditions very similar to the northern Mediterranean. As a result it is an invasion risk for European countries.

With regard to the classical biological control Reduviidae being polyphagous may not be useful as controlling agents of specific pest species. However, they are useful in situations where a variety of pest insect species exist. In all these situations reduviids in general and *Z. renardii* in particular are suitable because they can kill significantly more prey than they can consume (Ambrose 2001).

A problem that may arise when invading *Z. renardii* become abundant is phytophagy.

When the prey is not enough or it cannot be easily captured the insect switches from zoophagy to phytophagy to obtain the necessary nutrients (Stoner et al. 1975, Cohen 1990, Rosenheim et al. 1999, Torres and Boyd 2009). Field observations in French Guiana and lab experiments have shown that *Zelus araneiformis* Haviland, 1931 is able to complete its whole larval development only feeding on *Cecropia* trees (Bérenger and Pluot Sigwalt 1997). Blatchley (1926) wrote that "our species … usually have the front legs thickly covered with pollen grains, bits of petals, small seeds and other minute parts of plants …" However, this phytophagy does not decrease longevity when the insect is a predator of pests of transgenic *Bt*-cotton (Ponsard et al. 2002).

The ability of the insect for an extra-oral digestion make it an efficient predator of many prey sizes (Cohen 1993, Cohen and Tang 1997) from the very early developmental stages after hatching from the egg because of the sticky substance in the front legs which immobilizes prey (Law and Sediqi 2010). However, when exists an intermediate predator, which is more prey specific then *Z. renardii* exhibits IGP which disrupts prey suppression. A supporting paradigm is the intermediate not cannibalistic predator *Chrysoperla carnea* (Stephens, 1836) (Chrysopidae) (Cohen and Tang 1997) for the disruption of the suppression; contra for the annibalistic predator *Geocoris pallens* (Stål, 1854) (Law and Rosenheim 2011) for the enhancement of pest suppression. Nevertheless the situation is not easily decided and the dust from the quarrel of pest suppression has not yet settled in IGP.

Zelus renardii belongs in the subfamily Harpactocorinae that is the most rich in species. This subfamily differs from the Triatominae one that contains the haematophagous insects which are capable in hosting protozoa species of genus *Trypanosoma* and are associated with Chagas disease. However, the research in these groups is scarce and a review is urgently needed. In addition haematophagy evolved independently in different groups of Triatominae together with the fact that a switch to this feeding mode is not uncommon in reduviid bugs (Schaefer 2000, Baena 2011). Diet shift to haematophagy cannot be excluded for *Z. renardii* since research on digestive enzymes of *Z. renardii* showed that there are many orderly modifications of proteolytic enzymes that make this predatory insect more efficient consumer of proteins than haematophagous insects (Cohen 1993). As a result many insects constitute a risk factor as they are hosts of an unknown number of pathogens and the bites in birds, domestic animals and humans from newly imported assassin bugs should be carefully examined.

The measures taken for the interception of the insect are the ones already applied for the quarantine insects in Europe. However, the ecological role of the insect is not exactly known and for this it is premature to include this in the list of quarantine insects of the European Plant Protection Organization (EPPO Reporting Service 2010). In the meanwhile the examination of planted material and commercial plants has to be practiced at the points of introductions (harbors, airports, and railway stations) in lack of more specific tests. It is amazing that in many countries there are no common tests that must be done on introduced bio-control parasitic agents despite the fact that many cases of local extinctions have been reported (Petrakis 2007).

Acknowledgements

We are deeply indebted to Nicoletta Souliotis, Theodoros Kritikos and Panaghiotis Tsopelas for providing biological material and Leonidas Davranoglou for providing important literature. Emily Lahlou is thanked for helping in servicing and the sorting of the content of light traps. George Karetsos and Sylvia Papika are especially thanked for the information they gave on the planted species in Attica for the occasion of the 2004 Olympic games.

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Πρώτη αναφορά του *Zelus renardii* (Heteroptera, Reduviidae, Harpactocorinae) στην Ευρώπη

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ΠΕΡΙΛΗΨΗ

Το νεαρκτικό είδος εντόμου *Zelus reinardii* βρέθηκε για πρώτη φορά στην Αττική, Ελλάδα, Ευρώπη. Ο εγκλιματισμός και η φυσική ενσωμάτωση αυτού του εντόμου στην Ελλάδα μπορεί να έχουν ωφέλιμη επίδραση στον έλεγχο επιζήμιων εντόμων σε καλλιέργειες καθώς το έντομο αυτό συμπεριφέρεται ως ωφέλιμο αρπακτικό. Ωστόσο, η εγκατάσταση και εξάπλωσή του μπορεί δυνητικά να έχουν και αρνητικά αποτελέσματα καθώς πρόκειται για πολυφάγο αρπακτικό που μπορεί να τρέφεται με άλλα αρπακτικά έντομα που υπάρχουν στα οικοσυστήματα ή χρησιμοποιούνται σε προγράμματα βιολογικής αντιμετώπισης εχθρών των καλλιεργειών στη χώρα μας. Η εισαγωγή του εντόμου σε άλλες περιοχές (π.χ. Χαβάη) έδειξε τη δυνατότητά του να έχει όλους αυτούς τους οικολογικούς ρόλους.