HETeroptera POLONIAE
ACTA FAUNISTICA 16

Heteroptera Poloniae – Acta Faunistica
vol. 16: 7–14. Opole, 29 III 2022
ISSN 2083-201X
http://doi.org/10.5281/zenodo.6373854

Zelus renardii (Hemiptera: Heteroptera: Reduviidae): first records from Croatia, Montenegro, and an accidental introduction to the Czech Republic

Petr Kment[1], Torsten van der Heyden[2]

[1] *Department of Entomology, National Museum, Cirkusová 1740, CZ-193 00 Praha 9 – Horní Počernice, Czech Republic;* e-mail*:* sigara@post.cz

[2] *Immenweide 83, D-22523 Hamburg, Germany*; e-mail: tmvdh@web.de

Abstract. Based on the collected specimen and available photographs, we provide first records of the invasive assassin bug species *Zelus* (*Diplodacus*) *renardii* Kolenati, 1857 from Croatia and Montenegro. We also report a case of accidental introduction of a larva of *Z. renardii* to the Czech Republic. These records document further spreading of this species native in America in Mediterranean Europe and possible ways of its spreading to the new areas.

Key words: Hemiptera, Heteroptera, Reduviidae, Harpactorinae, alien species, Croatia, Czech Republic, Montenegro, Palaearctic Region

Introduction

The assassin bug genus *Zelus* Fabricius, 1803, member of the family Reduviidae, the subfamily Harpactorinae, and the tribe Harpactorini, includes 71 species distributed in the New World, from southern Canada to central Argentina (Froeschner 1988; Maldonado-Capriles 1990; Zhang et al. 2016). Only two species of *Zelus* have been recorded in the Old World: *Z.* (*Zelus*) *longipes* (Linnaeus, 1767) with doubtful records from Iran (Sakenin et al. 2008, as *Z. biblobus* [sic!, instead of *Z. bilobus* (Say, 1832)]; Ghahari et al. 2013), and *Z.* (*Diplodacus*) *renardii* Kolenati, 1857[1)], recently introduced to the Mediterranean (see below).

Zelus renardii is native to the Western and Southwestern United States of America (USA) and northern Central America. Zhang et al. (2016) provided confirmed records from USA: Arizona, Arkansas, California, Colorado, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, most of Mexico, Guatemala, Honduras, and El Salvador. It was listed also from Louisiana and Jamaica (Froeschner 1988; Maldonado-Capriles 1990) though not confirmed by Hart (1987) and Zhang et al. (2016). Within its native range, *Z. renardii* inhabits areas of tropical, arid and semi-arid, as well as Mediterranean climate (Weirauch et al. 2012).

The species has been introduced to Hawaiian Islands already in 19th century, being first found at Honolulu in 1897 and described as a new species, *Z. peregrinus* Kirkaldy, 1902 (Kirkaldy 1902, 1908, 1910; Zimmerman 1948).

Later, it was discovered also in Johnston Atoll (1320 km SW of Honolulu, 1932 – Hart 1986; Zhang et al. 2016: Appendix; probably misinterpreted as Midway Atoll in Froeschner 1988), Samoa (no details – Hart 1986; Froeschner 1988; Maldonado-Capriles 1990; not confirmed by Zhang et al. 2016), French Polynesia (Tuamotu, 1971 – Zhang et al. 2016), Chile (2000 – Curkovic et al. 2004; Elgueta & Carpintero 2004, misidentified as *Z. cervicalis*; Faúndez 2015; Melo & Faúndez 2015), Argentina (2012 – D'Hervé et al. 2018; Carpintero et al. 2019), Philippines (no details – Hart 1986; Froeschner 1988; Maldonado-Capriles 1990; not confirmed by Zhang et al. 2016), and the Mediterranean (Fig. 1).

First European records came from 2010, when it was found nearly simultaneously in Athens agglomeration, Greece (Davranoglou 2011; Petrakis & Moulet 2011) and Monteagudo in Murcia, Spain (Baena & Torres 2012; Vivas 2012). Further records of the species in northern and eastern Mediterranean followed soon, documenting its rapid spread in mainland Italy (2013 – Dioli 2013), Crete (2014 – van der Heyden 2015), Asian and European Turkey (2015 and 2016, respectively – Çerçi & Koçak 2016), Albania (2016 – van der Heyden 2017), Israel (2018 – van der Heyden 2018), France (2019 – Garrouste 2019), Portugal (2020 – van der Heyden & Grosso-Silva 2020), Sardinia (2020 – Rattu & Dioli 2020), and Sicily (2020 – Bella 2020). Finally, in 2021 the species was found in Tenerife, Canary Islands (Baena & Santos 2021a; van der Heyden 2022) and Black Sea coast of Romania (Preda in prep.) (for details see Table 1).

1) In some papers, the year of publication of *Zelus renardii* Kolenati is given as 1856 (e.g., Froeschner 1988; Zhang et al. 2016, partim). However, the censor's note permitting print of the volume 29 of the *Bulletin de la Société Impériale des Naturalistes de Moscou* gives the date February 28, 1857 [= March 12, 1857 of Gregorian calendar]. 1857 was accepted as the correct year of publication for example by Hart (1986), Maldonado Capriles (1990), Aukema et al. (2013), Zhang et al. (2016, partim) and Baena & Santos (2021a,b). Aukema et al. (2013) listed the authorship of the species as *Z. renardii* (Kolenatii [sic!], 1857), however, as the original combination was *Zelus renardii* (see Kolenati 1857), the author's name should not be given in parentheses: *Zelus renardii* Kolenati, 1857.

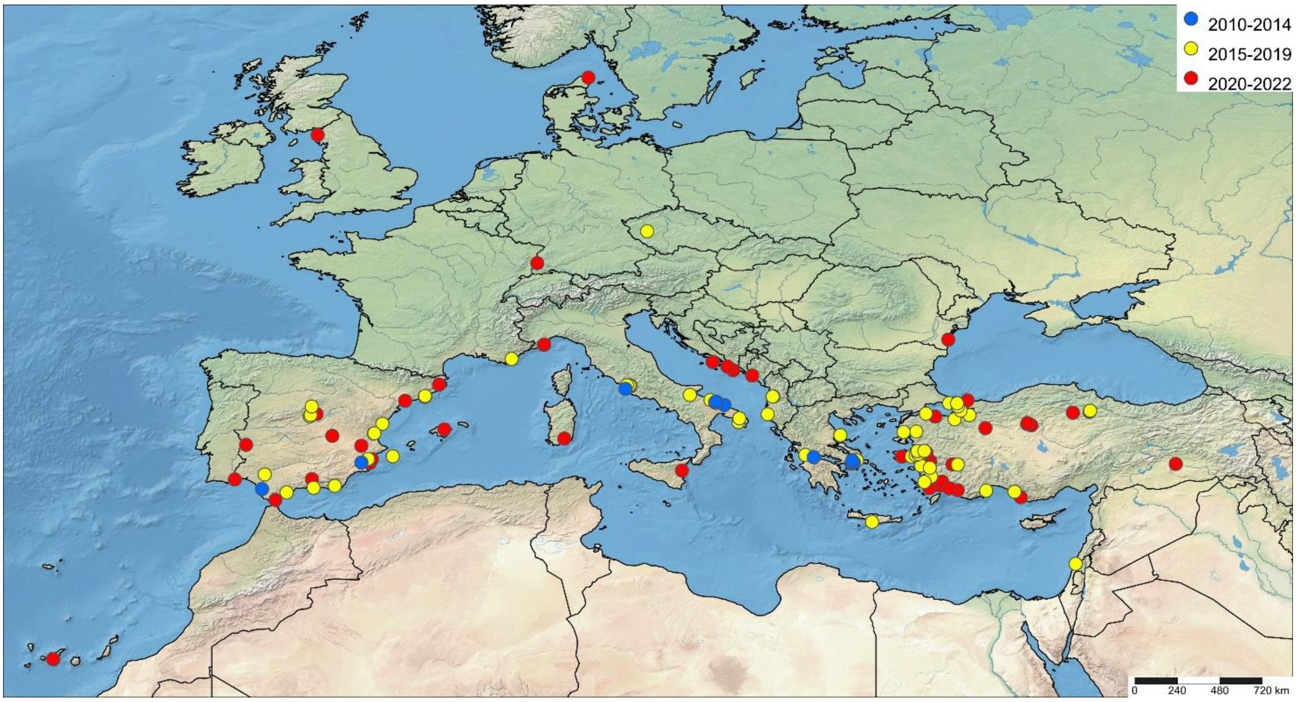

Fig. 1. Distribution of *Zelus renardii* Kolenati, 1857 in the Mediterranean. (Map created using: https://www.simplemappr.net/).

There are also isolated indoor records from Germany, Denmark, and England (van der Heyden 2021a,b) which illustrate the human mediated passways of its spreading. The citations of its occurrence in Algeria and Lybia by Bella (2020) seems to be erroneous (see Baena & Santos 2021a).

As a newcomer in Euro-Mediterranean, the genus *Zelus* is missing from the identification monograph of Putshkov & Moulet (2009). Within the fauna of this region, *Z. renardii* resembles most the species of the genus *Nagusta* Stål, 1859 (see Putshkov & Moulet 2009: 286). However, those are usually either smaller (7.0–11.5 mm in *N. nigerensis* Villiers, 1948, *N. simonis* Puton, 1890, *N. tuberosa* Stål, 1874 – Putshkov & Moulet 2009) or larger (12.5–16.2 mm in *N. goedelii* (Kolenati, 1857) – Putshkov & Moulet 2009) than *Z. renardii* (10.57–12.98 mm according to Zhang et al. 2016) and further differ by presence of spines on antenniferous tubercles, spinose humeral angles of pronotum, laterally produced connexival segments, as well as usually uniform brown colouration of entire body and its appendices (see Putshkov & Moulet 2009). In *Z. renardii* the antenniferous tubercles are devoid of spines, humeral angles of pronotum are acutangulate but not spinose, connexival segments are not expanded laterally, and body ventrally and femora are greenish (in dead specimens yellowish).

In California, *Z. renardii* is common in suburban and disturbed habitats in addition to certain natural areas (ranging from 8 to 2000 meter above see level). In suburban environments it was frequently found on native and non-native herbaceous and woody plants, as well as on vegetable (tomatoes, pepper).

Fig. 2. Habitus photo of male *Zelus renardii* Kolenati, 1857 collected in Žuljana, Croatia (body length 11.85 mm).

It often occurs on flowering vegetation that attracts a diversity of potential prey (Weirauch et al. 2012, van der Heyden 2015). It was also collected in alfalfa fields in Arizona (Rakickas & Watson 1974, Cohen & Tang 1997) and cotton fields in California and Texas (Ables 1978; Cisneros & Rosenheim 1997, 1998). Ables (1978) reported unusually high population densities (50,000–75,000 specimens per hectar) of *Z. renardii* in some untreated cotton fields.

Zelus renardii is a generalist predator known to prey on adults, larvae as well as eggs of various groups of insects (thrips, aphids, psyllids, leafhoppers, true bugs, lacewings, hymenopterans, beetles, mosquitoes, flies), spiders and spider mites (Kirkaldy 1910; Zimmerman 1948; Ables 1978; Mbata et al. 1987; Cohen & Tang 1997; Cisneros & Rosenheim 1997, 1998; Law & Sediqi 2010; Petrakis & Moulet 2011; Weirauch et al. 2012; van der Heyden 2017; D'Hervé et al. 2018; Rodríguez Lozano et al. 2018; Garrouste 2019; Goula et al. 2019; Bella 2020; Çelik et al. 2021; Özgen et al. 2021, Lahbib et al. 2022).

According to Lahbib et al. (2022), it prefers comparatively large, highly mobile, and readily available prey. *Zelus renardii* seems to prefer hemipteran prey (namely leafhoppers, aphids and psyllids). It often seeks honeydew-contaminated plants because they may host potential prey, however it shows no interest in immotile instars of whiteflies and scale insects (Lahbib et al. 2022).

With its congeners it shares a unique predation technique of 'sticky trap predation' involving use of sticky substances coated on its fore and middle legs; while adults and older larval instars secret these substances from their dermal glands, the first instars instead obtain them from empty egg shells (Law & Sediqi 2010, Weirauch et al. 2012, Zhang & Weirauch 2013). These sticky substances increase predation success and also enhance the bug's adherence to the substrate (Law & Sediqi 2010). The females glue their egg batches on plants (usually on the under surface of the leaves) or other objects (e.g. tissue paper in the lab) (Weirauch et al. 2012). Stoner et al. (1975) studied the ability of plant-feeding in first instars, however, though it prolonged their survival compared to feeding on only water, it did not allow their development on such a diet. Additional details on feeding biology, mating and development of *Z. renardii* could be found in Ables (1978), Mbata et al. (1987), Cohen (1993), Cohen & Tang (1997), Cisneros & Rosenheim (1997, 1998), Law & Sediqi (2010), and Lahbib et al. (2022). This species may cause a bite to humans (Rodríguez Lozano et al. 2018, Pérez-Gómez et al. 2020, Baena & Santos 2021a, Miralles-Núñez et al. 2021, Lahbib et al. 2022).

Material examined

CROATIA: Splitsko-Dalmatinska County: Jelsa, approx. 43.117168°N 16.699025°E, viii.2021, 1 adult, photographic record (fot. „albertcardona", available at: https://www.inaturalist.org/observations/92134125). Dubrovacko-Neretvanska County: Općina Mljet, 42.699968°N 17.739982°E, 8.ix.2021, 1 adult, photographic record (fot. „skejo", available at: https://www.inaturalist.org/observations/94919700); Pelješac Peninsula, Žuljana, Vučine bay, 42.887271°N 17.449646°E, campsite, 24.ix.2021, 1 male (Fig. 2), J. Balážová lgt., P. Kment det. (coll. National Museum, Prague, Czech Republic).

CZECH REPUBLIC: Bohemia: Plzeň, approx. 49.7413889°N, 13.3825000°E, 7.xii.2019, 1 larva, probably arrived in crate of tangerines, photographed by M. Opielová, L.-R. Davranoglou det.

MONTENEGRO: Tivat, 42.430503°N 18.704392°E, 28.ix.2020, 1 larva, photographic record (fot. „kishmysh", available at: https://www.inaturalist.org/observations/61765746).

Discussion

Since 2010, *Z. renardii* is spreading quickly in northern and eastern Mediterranean. In this non-native area, this species is found usually in urban, suburban and rural areas on native as well as non-native trees and shrubs (e.g., *Ailanthus altissima*, *Aloysia citriodora*, *Brachychiton populneus*, *Buxus sempervirens*, *Chamaerops humilis*, *Citrus* spp., *Corylus avellana*, *Cupressus*, *Eucalyptus*, *Ficus* spp., *Hedera helix*, *Laurus nobilis*, *Malus*, *Nerium oleander*, *Olea europaea*, *Paulownia*, *Pinus*, *Pittosporum tobira*, *Pyracantha coccinea*, *Pyrus communis*, *Quercus ilex*, *Salix*, *Spartium junceum*, *Vitis*), as well as herbs (e.g. *Capsicum* spp., *Chenopodium nepeta*, *Daucus carota*, *Mentha*, *Lantana camara*, *Ocimum basilicum*, *Plectranthus, Teucrium*), often on ruderal vegetation (Davranoglou 2010; Petrakis & Moulet 2011; van der Heyden 2015, 2017; Çerçi & Koçak 2016; Simov et al. 2017; D'Hervé et al. 2018; Pinzari et al. 2018; Rodríguez Lozano et al. 2018; Goula et al. 2019; Bella 2020; Kıyak 2020; Pérez-Gómez et al. 2020; Baena & Santos 2021a; Lahbib et al. 2022).

This is in agreement with its habitat requirements in California as described by Weirauch et al. (2012). Moreover, the species is frequently encountered in houses (Faúndez 2015, D'Hervé et al. 2018, Rodríguez Lozano et al. 2018, Dursun & Fent 2020, Baena & Santos 2021a) where it may hibernate (Dioli 2013); it was also found in car parking (Pérez-Gómez et al. 2020) or camping site (this paper).

All the four records from non-Mediterranean Europe were made indoor, the Czech one suggests the import of the specimen with exotic fruits (van der Heyden 2021a,b; this paper). Considering the dispersal pathways, Davranoglou (2011) and Weirauch et al. (2012) suggested that egg batches may be easily shipped with nursery stock but despite this pathway seems likely, we lack evidence to support it. On the other hand, the above mentioned records document hitchhiking of adults and larvae which is not surprising in species frequently occurring in synanthropic conditions, being moreover attracted to light (Faúndez 2015, Simov et al. 2017).

Table 1. Chronological review of the spread of *Zelus renardii* Kolenati, 1857 in Europe and the Mediterranean.

Country	Region	Year of first record	Reference
Greece	Attica	2010	Davranoglou (2011), Petrakis & Moulet (2011)
	Achaea	2014	Simov et al. (2017)
	Crete	2014	van der Heyden (2015)
	Aetolia-Acarnania	2015	Simov et al. (2017)
	Thessaly	2015	Simov et al. (2017)
Spain	Murcia	2010	Baena & Torres (2012), Vivas (2012)
	Cádiz	2013	Pérez-Gómez et al. (2020)
	Granada	2016	Pérez-Gómez et al. (2020)
	Málaga	2016	Pérez-Gómez et al. (2020)
	Almería	2017	Rodríguez-Lozano et al. (2018)
	Alicante	2018	Rodríguez-Lozano et al. (2018), Miralles-Núñez et al. (2021), Lahbib et al. (2022)
	Barcelona	2018	Goula et al. (2019)
	Castellon	2018	Goula et al. (2019)
	Sevilla	2018	Goula et al. (2019)
	Madrid	2019	Goula et al. (2019)
	Valencia	2019	Goula et al. (2019)
	Albacete	2020	Baena & Santos (2021a)
	Cuenca	2020	Baena & Santos (2021a)
	Gerona	2020	Baena & Santos (2021a)
	Islas Baleares: Mallorca	2020	Baena & Santos (2021a)
	Tarragona	2020	Baena & Santos (2021a)
	Badajoz	2021	Baena & Santos (2021a)
Italy	Lazio	2013	Dioli (2013)
	Apulia	2014	Cornara et al. (2016), Pinzari et al. (2018), Lahbib et al. (2022)
	Campania	2020	Bella (2020)
	Liguria	2020	Bella (2020)
	Sardinia	2020	Rattu & Dioli (2020)
	Sicily	2020	Bella (2020)
Turkey: Asian part	İzmir	2015	Çerçi & Koçak (2016)
	Aydın	2016	Çerçi et al. (2021)
	Muğla	2016	Çerçi et al. (2021)
	Amasya	2018	Dursun & Fent (2020), Dursun (2021)
	Balıkesir	2018	Çerçi et al. (2021)
	Bursa	2018	Çerçi et al. (2021)
	Yalova	2018	Çerçi et al. (2021)
	Antalya	2019	Çerçi et al. (2021)
	Çanakkale	2019	Çerçi et al. (2021)
	Denizli	2019	Çerçi et al. (2021)
	Manisa	2019	Çerçi et al. (2021)
	Ankara	2020	Kıyak (2020)
	Çorum	2020	Dursun (2021)
	Diyarbakır	2020	Çelik et al. (2021)
	Eskişehir	2021	Çerçi et al. (2021)
Turkey: European part	İstanbul	2016	Çerçi & Koçak (2016)
Albania	Vlorë	2016	van der Heyden (2017)
	Tirana	2019	Lahbib et al. (2022)
Israel	North District	2018	van der Heyden (2018)
Czech Republic	Bohemia	2019	this paper
France	Var	2019	Garrouste (2019)
Denmark	North Jutlandic Island	2020	van der Heyden (2021b) (accidental introduction)
Germany	Baden-Württemberg	2020	van der Heyden (2021a,b) (accidental introduction)
Montenegro	Tivat	2020	this paper
Portugal	Algarve	2020	van der Heyden & Grosso-Silva (2020)
United Kingdom: England	Cumbria	2020	van der Heyden (2021b) (accidental introduction)
Canary Islands	Tenerife	2021	Baena & Santos (2021a), van der Heyden (2022)
Croatia	Splitsko-Dalmatinska County, Dubrovacko-Neretvanska County	2021	this paper
Romania	Constanța County	2021	Preda (in prep.)

It should be mentioned that frequent synanthropic occurrence and seeking indoor hibernation sites is characteristic also for other very successful heteropteran invaders, *Leptoglossus occidentalis* Heidemann, 1910 (e.g., Blatt 1994, Fent & Kment 2011) and *Halyomorpha halys* (Stål, 1855) (Pentatomidae) (e.g., Inkley 2012; Hamilton et al. 2018; Nixon et al. 2021). Further predisposition for successful spreading may be the ability of *Z. renardii* to survive well in adverse circumstances such as hot conditions and irregular food supply (Butler 1966; Ali & Watson 1978; Weirauch et al. 2012). Weirauch et al. (2012) also ascertained high percentage (67%) of hatching viable first instars, however, results of Mbata et al. (1987) do not confirm this, so its influence on possible spreading success remains a question.

Acknowledgements

The first author is obliged to Miss Julie Balážová (Letonice, Czech Republic) for donation of the collected specimen from Croatia. We also thank M. Opielová (Plzeň, Czech Republic) for sending us her photograph of *Z. renardii* larva, and Leonidas-Romanos Davranoglou (Department of Zoology, University of Oxford, United Kingdom) for its identification, and Cristina Preda (Constanța, Romania) for information about the first record in Romania. This work received support from the Ministry of the Culture of the Czech Republic (DKRVO 2019–2023/5.I.d, National Museum, 00023272).

References

Ables J.R. 1978. Feeding behavior of an assassin bug, *Zelus renardii*. *Annals of the Entomological Society of America* **71**: 476–478.

Ali A.S.A., Watson T.F. 1978. Effect of temperature on development and survival of *Zelus renardii*. *Environmental Entomology* **7**: 889–890.

Aukema B., Rieger C., Rabitsch W. 2013. *Catalogue of the Heteroptera of the Palaearctic Region. VI*. Supplement. The Netherlands Entomological Society, Amsterdam, xxiii + 629 pp.

Baena M., Santos S. 2021a. *Zelus renardii* Kolenati, 1857, primera cita en las Islas Canarias (Hemiptera, Reduviidae). *Revista Gaditana de Entomología* **12**: 131–135.

Baena M., Santos S. 2021b. Corrigenda. *Zelus renardii* Kolenati, 1857, primera cita en las Islas Canarias (Hemiptera, Reduviidae). *Revista Gaditana de Entomología* **12**: 145–146.

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). *Boletín de la Asociación Española de Entomología* **36**: 351–360.

Bella S. 2020. The Nearctic bug *Zelus renardii* (Kolenati) (Hemiptera Reduviidae) in northern Italy and Sicily. *Redia* **103**: 87–88.

Blatt S.E. 1994. An unusually large aggregation of the western conifer seed bug, *Leptoglossus occidentalis* (Hemiptera: Coreidae), in a man-made structure. *Journal of the Entomological Society of British Columbia* **91**: 71–72.

Butler G.D. Jr. 1966. Development of several predaceous Hemiptera in relation to temperature. *Journal of Economic Entomology* **59 (5)**: 1306–1307.

Carpintero D.L., Farina J.L., De Biase S. 2019. Report for Buenos Aires Province of three species of Heteroptera (Hemiptera) introduced in Argentina. *Historia Natural, Tercera Serie* **9 (1)**: 63–70.

Çelik H., Dioli P., Bolu H. 2021. First record in Southeastern Anatolia of *Zelus* (*Diplodacus*) *renardii* (Kolenati, 1856) (Hemiptera: Reduviidae) and his new prey *Allantus* (s.str.) *viennensis* (Schrank, 1781) (Hymenoptera: Tenthredinidae: Allantinae). *Journal of the Heteroptera of Turkey* **3 (1)**: 31–39.

Çerçi B., Karataş A., Karataş A. 2021. Insecta non gratae: New distribution records of eight alien bug (Hemiptera) species in Turkey with contributions of citizen science. *Zootaxa* **5057 (1)**: 1–28.

Çerçi B., Koçak Ö. 2016. Contribution to the knowledge of Heteroptera (Hemiptera) fauna of Turkey. *Journal of Insect Biodiversity* **4 (15)**: 1–18.

Cisneros J.J., Rosenheim J.A. 1997. Ontogenetic change of prey preference in the generalist predator *Zelus renardii* and its influence on predator–predator interactions. *Ecological Entomology* **22**: 399–407.

Cisneros J.J., Rosenheim J.A. 1998. Changes in the foraging behavior, within-plant vertical distribution, and microhabitat selection of a generalist insect predator: an age analysis. *Environmental Entomology* **27**: 949–957.

Cohen A.C. 1993. Organization of digestion and preliminary characterization of salivary trypsin-like enzymes in a predaceous heteropteran, *Zelus renardii*. *Journal of Insect Physiology* **39**: 823–829.

Cohen A.C., Tang R. 1997. Relative prey weight influences handling time and biomass extraction in *Sinea confusa* and *Zelus renardii* (Heteroptera: Reduviidae). *Environmental Entomology* **26**: 559–565.

Cornara D., Nocera A., Corrado I., Verrastro V., Lamaj F., El Kenawy A., Russo V., Porcelli F. 2016. Lo *Zelus renardii* (Kolenati, 1857) (Heteroptera Reduviidae): un promettente predatore della *Macrohomotoma gladiata* (Kuwayana, 1908) (Psylloidea Homotomidae) sui *Ficus microcarpa* Hort. Berol. ex Walp. (Moraceae) ornamentali del verde urbano a Bari. [in:] *Atti di XXV Congresso Nazionale Italiano di Entomologia, Padova, 20–24 Giugno 2016.* [Not seen, *fide* Pinzari et al. (2018)].

Curkovic T., Araya J.E., Baena M., Guerrero M.A. 2004. Presencia de *Zelus renardii* Kolenati (Heteroptera:

Reduviidae) en Chile. *Boletín de la Sociedad Entomológica Aragonesa* **34**: 163–165.

Davranoglou L.R. 2011. *Zelus renardii* (Kolenati, 1856), a New World Reduviid discovered in Europe (Hemiptera: Reduviidae: Harpactorinae). *Entomologist's Monthly Magazine* **147**: 157–162.

D'Hervé F.E., Olave A., Dapoto G.L. 2018. *Zelus renardii* (Hemiptera: Reduviidae: Harpactorinae: Harpactorini): first record from Argentina. *Revista de la Sociedad Entomológica Argentina* **77 (1)**: 32–35.

Dioli P. 2013. *Zelus renardii* (Kolenati, 1856) (Insecta Heteroptera Reduviidae). *Quaderno di Studi e Notizie di Storia Naturale della Romagna* **38**: 232–233.

Dursun A. 2021. Türkiye'de dağılım gösteren yabanci Heteroptera (Insecta: Hemiptera) türleri. [Foreign species of Heteroptera distributed in Turkey (Insecta: Hemiptera)], pp. 145–171. [in:] Kaçar, G. (ed). *Bitki Korumada Son Gelişmeler.* [*Recent Advances in Plant Protection*]. Paradigma Akademi, Çanakkale, 171 pp (in Turkish).

Dursun A., Fent M. 2020. First record of the alien species *Zelus renardii* (Kolenati, 1856) (Hemiptera: Heteroptera: Reduviidae) from Black Sea Region of Turkey. *Journal of the Heteroptera of Turkey* **2 (2)**: 144–147.

Elgueta M., Carpintero D.L. 2004. *Zelus cervicalis* Stål (Hemiptera: Reduviidae: Harpactorinae), aporte neártico a la entomofauna introducida de Chile. *Gayana* (Concepción) **68 (1)**: 133–136.

Faúndez E.I. 2015. The assassin bug *Zelus renardii* (Kolenati, 1856) (Heteroptera: Reduviidae) in Chile: comments after 15 years of its arrival in the country. *Boletín de la Sociedad Entomológica Aragonesa* **57**: 421–423.

Fent M., Kment P. 2011. First record of the invasive western conifer seed bug *Leptoglossus occidentalis* (Heteroptera: Coreidae) in Turkey. *North-Western Journal of Zoology* **7 (1)**: 72–80.

Froeschner R.C. 1988. Family Reduviidae Latreille, 1807. The Assassin Bugs, pp. 616–651. [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, New York, København, Köln, xix + 958 pp.

Garrouste R. 2019. *Zelus renardii* (Kolenati, 1856): une réduve nouvelle pour la France (Hemiptera, Reduviidae, Harpactorinae). *Bulletin de la Société Entomologique de France* **124 (3)**: 335–336.

Ghahari H., Moulet P., Cai W.-Zh., Karimi J. 2013. An annotated catalog of the Iranian Reduvioidea (Hemiptera: Heteroptera: Cimicomorpha). *Zootaxa* **3718 (3)**: 201–238.

Goula M., Lizana F., Miralles-Núñez A. 2019. New records of the Nearctic leafhopper assassin bug, *Zelus renardii* Kolenati, 1857 in the Iberian Peninsula (Hemiptera: Heteroptera: Reduviidae). *Butlletí de la Institució Catalana d'Història Natural* **83**: 219–222.

Hamilton G.C., Ahn J.J., Bu W.-J., Leskey T.C., Nielsen A.L., Park Y.-L., Rabitsch W., Hoelmer K.A. 2018. *Halyomorpha halys* (Stal), pp. 243–292. [in:] McPherson J.E. (ed.). *Invasive stink bugs and related species (Pentatomoidea): Biology, higher systematics, semiochemistry, and management*. CRC Press, Taylor & Francis Group, Boca Raton, London, New York, xix + 819 pp.

Hart E.R. 1986. Genus *Zelus* Fabricius in the United States, Canada, and Northern Mexico (Hemiptera: Reduviidae). *Annals of the Entomological Society of America* **79**: 535–548.

Hart E.R. 1987. The genus *Zelus* Fabricius in the West Indies (Hemiptera: Reduviidae). *Annals of the Entomological Society of America* **80**: 293–305.

Inkley D.B. 2012. Characteristics of home invasion by the brown marmorated stink bug (Hemiptera: Pentatomidae). *Journal of Entomological Science* **47**: 125–130.

Kirkaldy G.W. 1902. Hemiptera, pp. 93–174, pls. IV–V. [in:] Sharp, D. (ed.). *Fauna Hawaiiensis. Vol. III. Part II*. Cambridge University Press, London, 174 pp. + pls. I–V.

Kirkaldy G.W. 1908. A list of the described Hemiptera (excluding Aleyrodidae and Coccidae) of the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society* **1**: 186–208 + pl. IV.

Kirkaldy G.W. 1910. Supplement to Hemiptera, pp. 531–599. [in:] Sharp D. (ed.). *Fauna Hawaiiensis. Vol. II. Part IV*. Cambridge University Press, Cambridge, pp. 531–700.

Kıyak S. 2020. The new record invasive alien species (IAS) *Zelus renardii* (Kolenati, 1857) (Hemiptera: Heteroptera: Reduviidae) in central Anatolia (Turkey). *Journal of the Heteroptera of Turkey* **2 (1)**: 47–52.

Kolenati F.A. 1857. Meletemata entomologica. Fasc. VI. Hemipterorum Heteropterorum Caucasi. Harpagocorisiae, monographice dispositae. *Bulletin de la Société Impériale des Naturalistes de Moscou* **29** [1856]: 419–502.

Lahbib N., Picciotti U., Sefa V., Boukhris-Bouhachem S., Porcelli F., Garganese F. 2022. *Zelus renardii* roaming in Southern Italy. *Insects* **13 (158)**: 1–30.

Law Y.-H. & Sediqi A. 2010. Sticky substance on eggs improves predation success and substrate adhesion in newly hatched *Zelus renardii* (Hemiptera: Reduviidae) instars. *Annals of the Entomological Society of America* **103 (5)**: 771–774.

Maldonado-Capriles J. 1990. *Systematic catalogue of the Reduviidae of the World*. Caribbean Journal of

Science, Special Publication No. 1. University of Puerto Rico, Mayagüez, Puerto Rico, 694 pp.

Mbata K.J., Hart E.R., Lewis R.E. 1987. Reproductive behaviour in *Zelus renardii* Kolenati 1857 (Hemiptera: Reduviidae). *Iowa State Journal of Research* **62 (2)**: 261–265.

Melo M.C., Faúndez E. 2015. Synopsis of the family Reduviidae (Heteroptera: Cimicomorpha) from Chile. *Revista de la Sociedad Entomológica Argentina* **74 (3)**: 153–172.

Miralles-Núñez A., Pradera C., Pujol Fructuoso J.A. 2021. La problemática de las especies exóticas: el caso de las picaduras producidas por *Zelus renardii* Kolenati, 1857 (Hemiptera: Reduviidae) en España. *Arquivos Entomolóxicos* **24**: 133–138.

Nixon L., Morrison W.R. III, Rice K.B., Goldson S., Brockerhoff E.G., Khrimian A., Rostás M., Leskey T.C. 2021. Behavioural responses of diapausing *Halyomorpha halys* (Hemiptera: Pentatomidae) to conspecific volatile organic compounds. *Journal of Applied Entomology*, **146 (3)**: 319–327.

Özgen I., Dioli P., Koç İ., Topdemir A. 2021. Some Heteroptera (Hemiptera) species that are potential natural enemies of *Cimbex quadrimaculata* (Müller, 1766) (Hymenoptera: Cimbicidae). *Journal of the Heteroptera of Turkey* **3 (2)**: 151–156

Pérez-Gómez Á., Sánchez Í., Baena M. 2020. Nuevos registros de hemípteros (Insecta: Hemiptera) alóctonos en Andalucía (sur de España). *Revista de la Sociedad Gaditana de Historia Natural* **14**: 9–19.

Petrakis P.V., Moulet P. 2011. First record of the Nearctic *Zelus renardii* (Heteroptera, Reduviidae, Harpactocorinae) in Europe. *Entomologia Hellenica* **20**: 75–81.

Pinzari M., Cianferoni F., Martellos S., Dioli P. 2018. *Zelus renardii* (Kolenati, 1856), a newly established alien species in Italy (Hemiptera: Reduviidae, Harpactorinae). *Fragmenta Entomologica* **50 (1)**: 31–35.

Preda C. in prep. Is *Zelus renardii* (Kolenati, 1856) expanding its range north on the Black Sea Coast?

Putshkov P.V., Moulet P. 2009. *Hémipteres Reduviidae d'Europe occidentale. Faune de France, Vol. 92*. Fédération Française des Sociétés de Sciences Naturelles, Paris, 668 pp. + 24 pls.

Rakickas R.J., Watson, T.F. 1974. Population trends of *Lygus* spp. and selected predators in strip cut alfalfa. *Environmental Entomology* **3**: 781–784.

Rattu A., Dioli P. 2020. Prima segnalazione di *Zelus renardii* (Kolenati, 1856) in Sardegna (Hemiptera, Reduviidae). *Revista Gaditana de Entomología* **11**: 119–125.

Rodríguez Lozano B., Baena Ruiz M , Gómez de Dios M.Á. 2018. The invasive species *Zelus renardii* (Kolenati, 1857) (Hemiptera, Reduviidae) in Spain and comments about its global expansion. *Transactions of the American Entomological Society* **144**: 551–558.

Sakenin H., Ghahari H., Kerkhner [sic!] I.M. 2008. Bugs (Insecta: Heteroptera) from rice fields and surrounding grasslands of northern Iran, with special study on predator species, p. 559. [in:] Mason P.G., Gillespi D.R., Vincent Ch. (eds). *Proceedings of the Third International Symposium on Biological Control of Arthropods. February 8–13, 2009, Christchurch, New Zealand*. Christchurch, New Zealand.

Simov N., Gradinarov D., Davranoglou L.-R. 2017. Three new assassin bug records (Hemiptera: Heteroptera: Reduviidae) for the Balkan Peninsula. *Ecologica Montenegrina* **13**: 25–29.

Stoner A., Metcalf A.M., Weeks R.E. 1975. Plant feeding by Reduviidae, a predaceous family (Hemiptera). *Journal of the Kansas Entomological Society* **48**: 185–188.

van der Heyden T. 2015. Ein aktueller Nachweis von *Zelus renardii* (Kolenati, 1856) auf Kreta/ Griechenland (Hemiptera: Heteroptera: Reduviidae: Harpactorinae). *BV news Publicaciones Científicas* **4 (52)**: 55–59.

van der Heyden T. 2017. First records of *Zelus renardii* (Kolenati, 1856) (Hemiptera: Heteroptera: Reduviidae: Harpactorinae) for Albania. *Arquivos Entomolóxicos* **18**: 49–50.

van der Heyden T. 2018. First record of *Zelus renardii* Kolenati (Heteroptera: Reduviidae: Harpactorinae) in Israel. *Revista Chilena de Entomología* **44 (4)**: 463–465.

van der Heyden T. 2021a. Erstfund von *Zelus renardii* Kolenati, 1856 in Deutschland (Heteroptera: Reduviidae). *Heteropteron* **61**: 31–32.

van der Heyden T. 2021b. On the recent Northern European dispersion of *Zelus renardii* Kolenati (Hemiptera: Heteroptera: Reduviidae) via human activity. *Israel Journal of Entomology* **51**: 43–46.

van der Heyden T. 2022. Confirmation of the presence of *Zelus renardii* Kolenati, 1857 (Hemiptera: Reduviidae) on the Canary Islands (Spain). *Arquivos Entomolóxicos* **25**: 51.

van der Heyden T., Grosso-Silva J.M. 2020. First record of *Zelus renardii* Kolenati, 1856 in Portugal (Heteroptera: Reduviidae: Harpactorinae). *Arquivos Entomolóxicos* **22**: 347–349.

Vivas L. 2012. Primera cita en España de la especie *Zelus renardii* (Kolenati, 1857) (Heteroptera: Reduviidae) que representa la segunda cita en Europa. *BV news Publicaciones Científicas* **1 (6)**: 34–40.

Weirauch Ch., Alvarez C., Zhang G.-Y. 2012. *Zelus renardii* and *Z. tetracanthus* (Hemiptera: Reduviidae): biological atributes and the potential for dispersal in two assassin bug species. *Florida Entomologist* **95 (3)**: 641–649.

Zhang G.-Y., Hart E.R., Weirauch Ch. 2016. A taxonomic monograph of the assassin bug genus *Zelus* Fabricius (Hemiptera: Reduviidae): 71 species based on 10,000 specimens. *Biodiversity Data Journal* **4 (e8150)**: 1–356 + 2 on-line appendices.

Zhang G.-Y., Weirauch Ch. 2013. Sticky predators: a comparative study of sticky glands in harpactorine assassin bugs (Insecta: Hemiptera: Reduviidae). *Acta Zoologica* (Stockholm) **94**: 1–10.

Zimmerman E.C. 1948. *Insects of Hawaii. Vol. 3. Heteroptera*. University of Hawaii Press, Honolulu, 255 pp.

Received: 3 January 2022
Accepted: 14 March 2022