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INVASIVE INSECT SPECIES RECENTLY IDENTIFIED IN BIHOR COUNTY

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SPECII INVAZIVE DE INSECTE RECENT IDENTIFICATE ÎN JUDEȚUL BIHOR

Rezumat

Patru specii invazive de insecte (Harmonia axyridis, Sceliphron cementarium, Rhynocoris punctiventris și Eurycantha calcarata) *au fost identificate în anii recenți în județul Bihor. Unele dintre ele au format populații stabile în zonă, iar potențialul lor impact asupra biodiversității locale este discutat pe scurt.*

Cuvinte cheie: *specii invazive, insecte, Bihor.*

Introduction.

Insects are generally more prone to invasiveness than other groups due to their shorter-lived individuals and accordingly more generations in a certain interval of time, which may make then more adaptable to environmental changes. In addition, their smaller size allows transport to non-native areals, colonizing or through human intervention, whether this was intentional or not.

***Harmonia axyridis* (Pallas 1773) (Coleoptera, Coccinellidae)**

H. axyridis has spread rapidly across Europe particularly since 2002, so that it may become one of the most widely distributed coccinellids on the continent[1], and it has a reproductive advantage over native ladybugs. It feeds also on plant materials when insect prey is scarce, thus becoming a pest for wine and fruit, and its overwintering aggregates in urban areas are a nuisance to humans[2]. The species is native to temperate and subtropical regions in Asia and it occupies many habitats. First it has been released

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as a biological control agent in North America in 1916 and in Europe in 1927 (in Georgia, then in Western Europe in 1982 in France and in Greece in 1994). This was based on its polyphagous nature, as it preys mainly upon various tree-dwelling homopterans: aphids, coccids, adelgids, and psyllids[3]. Yet it also attacks the eggs of many other insects, including coccinellids and lepidopterans[4].

While efficient in aphids control, its polyphagous nature suggests a negative impact on non-target species through its intra-guild predation potential, due to its larger size throughout its life cycle, higher developmental rate, continuous breeding, with evidence of bi-voltinism in Great Britain and Belgium, and a more plastic phenotype (a guild is a community of specialist and generalist predator, parasitoid and pathogen species sharing the same prey/host resource). It has replaced the European species *Coccinella septempunctata* as top aphidophagous predator, causing the decline of all the European coccinellids[5], with the exception of the coniferous tree specialist *Anatis ocellata* (L. 1758). The latter might act as a threat for *H. axyridis*[6], a fact wich could be useful for the biological control of the invasive ladybug.

***Sceliphron caementarium* (Drury 1770) (Hymenoptera, Sphecidae)**

The solitary wasp *S. caementarium* is native to North America and it was accidentally introduced into Europe on several occasions: supposedly „during the 19th century"[7], in 1942 in the Czech Republic, not established[8], in 1945 in Versailles, France, not established[9], in

[3] Koch, R. L. 2003. – The multicolored Asian lady beetle, *Harmonia axyridis*: a review of its biology, uses in biological control, and non-target impacts. *Journal of Insect Science* 3: 32, 16 pp. Available online: insectscience.org/3.32; Poutsma, J., Loomans, A. J. M., Aukema, B., Heijerman, T. 2008. - Predicting the potential geographical distribution of the harlequin ladybird, *Harmonia axyridis*, using the CLIMEX model. In: Roy, H. E., Wajnberg, E. (eds.): From Biological Control to Invasion: the Ladybird *Harmonia axyridis* as a Model Species. (Springer), 287 pp.

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[9] Rasplus 2010.

1974 in southern France, then it established in France, Portugal and Madeira[10], and its European range expanded gradually in most countries. *Sceliphron* species are known as mud-daubers, preying on spiders and often confectioning their nests in or aroung buildings.

***Rhynocoris punctiventris* (Herrich-Schäffer 1846) (Hemiptera, Reduviidae)**

R. punctiventris is an eastern Mediterranean species and its known range includes the Balkan and Crimea Peninsulas, Russia, Cyprus, Syria, and Turkey, up to central Asia[11]. Little is known on the biology of the species, while many aspects may be inferred by analogy with other *Rhynocoris* species, which are generalist predators. In Turkey, *R. punctiventris* occurs often on the ground, under low vegetation, on grasses, trees or shrubs, similarly to the two present occurrences, and it preys on various insects (Hymenoptera, Hemiptera, Coleoptera)[12].

***Eurycantha calcarata* (Lucas, 1869) (Phasmatodea, Lonchodidae)**

E. calcarata is endemic to the Australasian region, being native to Papua New Guinea, New Caledonia, and the Solomon Islands, where it lives in the foliage and ground litter of rainforests[13], but not in Australia. It is a nocturnal feeder; during the day it gathers in groups under tree bark and in other hiding places for protection from predators, and its cryptic and cataleptic abilities are also used to evade predators[14]. Defensive display behavior and grasping of the disturber with the last femora and tibiae was noted in males, behaviors which are rare in Phasmatodea[15].

In its natural habitat, *E. calcarata* feeds on rainforest leaves and is known as a pest of oil palm[16], while in captivity it accepts rose, ivy, raspberry and oak leaves. It is sometimes kept as pet in terraria at an optimum temperature of 20-35 °C and it lives for

[10] Bitsch, J., Barbier, Y. 2006. – Répartition de l'éspèce invasive *Sceliphron curvatum* (F. Smith) en Europe et plus particulièrement en France (Hymenoptera, Sphecidae). *Bulletin de la Societé entomologique de France* 111 (2): 227-237; Rasplus 2010.

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[15] Bedford 1976a; Burrows, M., Morris, O. 2002 – Jumping in a winged stick insect. *The Journal of Experimental Biology* 205: 2399–2412.

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12 to 18 months. Typically, it reproduces sexually, deposits eggs subterraneously or on the ground, and hatching occurs in 3-6 months[17], but in the absence of males parthenogenesis is manifested as reproductive strategy. Metamorphosis takes 4-6 months to complete and includes 5-6 instars.

Material and methods

The Asian harlequin ladybug *Harmonia axyridis* was first observed and collected in the Pârâul Peţea natural reserve, 9 km southeast from Oradea, NW Romania, in May-June 2011, with several color forms: an imago (f. *succinea*) on *Rosa canina* flowers, which took flight and could not be retrieved, and a larva on a shrub by the lake shore. Then two imagos (f. *succinea* and f. *conspicua*) were collected manually on shrubs near the end limit of thereserve. Another *f. succinea* imago was found in October, 2011, entering the Ţării Crişurilor Museum (MTC) building in Oradea in search for a shelter for overwintering[18]. The specimens were identified according to published keys[19] and deposited in the entomological collection of MTC. Since then it has become the dominant Coccinellid in the area.

An imago of the Nearctic mud dauber *Sceliphron caementarium* was captured in July, 2012, during a very hot summer, in Oradea[20]. This represents the first record of this species in the country, while the establishing of the species remains possible because other individuals were observed occasionally in that region in the following years. The first individual was observed trying to enter the building of the MTC, by our colleague Iacinta Chiriac. The specimen was captured, prepared, mounted and included in the museum's collection. No nests or other individuals were found then. The specimen was identified using the published keys[21].

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Imagos and nymphs of the eastern Mediterranean Reduviid *Rhynocoris punctiventris*, apparently established, were observed and collected for the first time in Romania in June 2013 in two protected areas in the country's northwest[22]. In June, 2013, while monitoring the fauna in the Pârâul Peţea natural reserve, dozens of imagos and nymphs of *R. punctiventris* were observed on *Urtica* and various shrubs on the stream shore, close to groups of Aphididae (Fig. 1). A week later, during the monitoring in the Natura 2000 site ROSCI0008 Betfia, 5 km southeast from the first reserve, four *R. punctiventris* imagos (two males and two females) were captured on grass at the foot of Şomleu Hill, then they were prepared and included in the museum's collection. The specimens were identified using the published keys[23].

Fig. 1. A newly moulted *Rhynocoris punctiventris* imago in the Pârâul Peţea natural reserve (photo: Ovidiu Pascu).

An Australasian giant spiny stick insect *Eurycantha calcarata* individual was found alive in Oradea for the first time in Romania[24]. This is the first occurrence of this tropical species in Europe, and while it is presumably accidental, the invasive potential of the species is briefly discussed below. In April, 2017, a large, dark brown, wingless, spiny, long-legged insect with long antennae was observed and photographed by our colleague Dr. Sabina Horvath walking on a small street in Oradea (Crizantemelor St.,

[22] Gagiu, A., 2013. – The possible first record of *Rhynocoris punctiventris* (Herrich-Schäffer 1846) (Hemiptera, Heteroptera, Reduviidae) in Romania. *"Nymphaea", Folia naturae Bihariae* 40: 77-82.
[23] Dioli, P., 1990. - *Rhinocoris iracundus* (Poda, 1761) e *Rhinocoris rubricus* (Germar, 1816). (Insecta, Heteroptera, Reduviidae). *Il Naturalista Valtellinese - Atti del Museo civico di Storia Naturale di Morbegno* 1: 55-60; Putshkov, P. V. 2002. - *Rhynocoris persicus* (Heteroptera, Reduviidae): three species or one? *Vestnik zoologii,* 36(5): 27-34.
[24] Gagiu, A., 2017. – *Eurycantha calcarata* (Lucas, 1869) (Phasmatodea, Phasmatidae), an Australasian stick-insect found for the first time in Romania. *"Nymphaea", Folia naturae Bihariae* 44: 57-62.

near the Environmental Protection Agency of Bihor County). The peculiar insect was crossing an alley close to a wire fence which delimits an abandoned yard full of *Rosa sp.* shrubs, ruderal vegetation and cut branches. Collecting efforts produced no result, while in the mean time weather conditions have turned to chilly, windy and heavy rain. Two days later, however, during better weather, Dr. Horvath and the author found the insect dead in the midst of the molting process, in the bushes in the abandoned yard, at about 1 m from the spot where it has been first observed two days before. All its soft parts have been scavenged upon by ants and mites, thus only its remaining complete exoskeleton and exuvia were found intact. The exoskeleton had a body length of 90 mm and the exuvia, light brown and lacking the head part, was 85 mm long. The insect and its exuvia were collected and prepared for inclusion in the entomological collection of MTC. The specimen was identified as a newly molted male, according to published keys[25].

Results and discussion

Only one previous record of the presence of *H. axyridis* in Bihor County is available, mentioning two collectings from Oradea (10 April 2009) and Gurani (2 Aug. 2009), with no other details and erroneously considered as the first records from Romania[26]. The real first record in the wild in Romania was in the summer of 2008 (in the „Calcarele din Dealul Măgura", a mountaineous area in Băița, Hunedoara county, central Romania)[27]. There is no information that *H. axyridis* was ever released for biological control purposes in Romania. As it invaded Hungary from western and possibly northern directions and within one year (2009) it became one of the most common coccinellids (with f. *succinea* predominating, 91.3 %)[28], it is likely that the individuals in the Pârâul Pețea reserve originated from Hungary or the Baia Mare region, since no major natural barrier could prevent their spread.

Selection of human houses as overwintering sites may constitute a cold-free space, which could explain its great invasive success in northern regions[29]. The larvae favor temperatures of 18-30 ºC, while larvae and pupae are capable of developing at temperatures between 0 and 35 °C, although very slowly below 15 °C, with an optimum for development in adults from 5 to 25 °C and for larvae and pupae from 5 to 15 °C[30].

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[25] Bedford 1976a; Brock, P. D. 1987 – Brief notes on *Eurycantha horrida* Boisduval and *Eurycantha calcarata* Lucas. *The Phasmid Study Group Newsletter* 30: 7-8; Brock, P. D. 2017 - Phasmida Species File. Version 10.7. Species File Group. Checklist Dataset https://doi.org/10.15468/8nv8vf accessed via GBIF.org on 2017-10-13; Buckley & al. 2008.

[26] Markó, V., Pozsgai, G. 2009. – A harlekinkatica (*Harmonia axyridis* Pallas, 1773) (Coleoptera, Coccinellidae) elterjedése Magyarországon és megjelenése Romániában, Ukrainában. *Növényvédelem* 45 (9): 481-492.

[27] Ruicănescu & Alexandru 2009.

[28] Markó & Pozsgai 2009.

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[30] Acar, E. B., Mill, D. D., Smith, B. N., Hansen, L. D., Booth, G. M. 2004. – Calorespirometric determination of the effects of temperature on metabolism of *Harmonia axyridis* (Col.: Coccinellidae) from second instars to adults. *Environmental Entomology* 33 (4): 832-838.

Being a colonizing species in new habitats, climates, resources and selection pressures, *H. axyridis* displays great phenotypic plasticity on a genetic basis, including the ability to enter into quiescence during periods of low resource availability and the ability to forage for a variety of different food sources, even through cannibalism[31].

Various techniques and trapping methods to prevent ladybugs from entering and aggregating in buildings or on grapes in autumn or to remove aggregates inside buildings have been proposed, as well as several natural enemies, but the latter showed very limited potential as biological control agents[32], thus it is unlikely that any highly specific predator or parasitoid would be effective against *H. axyridis* in the field in the colonized regions. The data about the presence of *H. axyridis* in Romania indicate a fast spreading and numerous populations in southern, central and western regions, this ladybug being already distributed in the whole country. The presence of both imagos and larvae indicates that the ladybugs were already reproducing in the Pârâul Peţea reserve in 2011.

The first known occurrence of *S. caementarium* in Romania in 2012 may have been a vagrant individual and did not represent a proof for the establishment of the species in the Romanian fauna, but other individuals and nests were observed in the following years in the area. The species was not recorded then in the neighbouring countries, but only in the Crimea peninsula. Nevertheless, the distribution data for *S. caementarium* in the European countries, especially in the east, look rather incomplete, and its expansion in Hungary and Serbia from the populations in their respective neighbouring countries seems likely, suggesting a possible eastward way of colonization in Romania, without major natural obstacles. Another hypothetical modality is an accidental, human introduction of nests or imagos, like in the first European colonization instances, due to the increasing human transportation and travelling activities.

The impact of invasive mud-daubers has received little attention so far, though issues concerning competition and hybridization with local species have been noticed[33]. The alien mud-daubers may also have an impact on the local populations of Araneae. In France, *S. caementarium* established itself mainly in the Mediterranean bioregion[34] and it supersedes the native *S. spirifex*[35]. There is a clear trend towards range expansion, especially in southern Europe[36]. The thermophilic character of *S. caementarium*, in

[31] Grill, C. P., Moore, A. J., Brodie, E. D. 1997. – The genetics of phenotypic plasticity in a colonizing population of the ladybird beetle, *Harmonia axyridis*. *Heredity* 78: 261- 269; Lombaert, E., Malausa, T., Devred, R., Estoup, A. 2008. – Phenotypic variation in invasive and biocontrol populations of the harlequin ladybird, *Harmonia axyridis*. *BioControl* 53: 89-102.

[32] Kenis, M., Roy, H. E., Zindel, R., Majerus, M. E. N. 2008. - Current and potential management strategies against Harmonia axyridis. In: Roy, H. E., Wajnberg, E. (eds.): From Biological Control to Invasion: the Ladybird *Harmonia axyridis* as a Model Species. (Springer), 287 pp.

[33] Rasplus 2010; Rasplus, J.-Y., Villemant, C., Paiva, M. R., Delvare, G., Roques, A. 2010. - Hymenoptera. Chapter 12. In: Roques, A. et al. (eds.) Arthropod invasions in Europe. *BioRisk* 4 (2): 669–776.

[34] Bitsch & Barbier 2006.

[35] Piek, T. 1986. - *Sceliphron caementarium* (Drury) supersedes *S. spirifex* Linnaeus in the Provence, France (Hymenoptera, Sphecidae). *Entomologische Berichten* 46: 77-79.

[36] Bogusch, P., Liška, P., Lukáš, J., Dudich, A. 2005. - Spreading and summary of the knowledge of the invasive sphecid wasp *Sceliphron curvatum* (SMITH 1870) in the Czech Republic and Slovakia (Hymenoptera: Apocrita, Sphecidae). *Linzer biologische Beiträge* 37 (1): 215-221.

connection with its expansion in Europe even at higher latitudes, as in the occurrence in Oradea, may possibly suggest a tendency towards climate warming in Europe.

The total lengths of the collected *Rhynocoris punctiventris* specimens are 9.5, 10 (males) and 11, 10.5 mm (females), indicating suboptimal developmental conditions. The presence of many nymphs indicates reproduction of the species in the Pârâul Peței and Betfia reserves. Further studies on the biology of *R. punctiventris* are needed to assess about its overwintering strategy, voltinism, possible impact on local insects, and other aspects. Its establishment in the Pârâul Peței natural reserve and in its surroundings seems likely, while it is still unclear if these occurrences represented a northward range expansion due to climate warming or just a case of incomplete distribution data in central and Eastern Europe.

The exuvia of the *Eurycantha calcarata* individual was found stuck on its first pair of legs, indicating that the insect has died while molting. Thus it appears that the observed living individual was a last instar nymph, because of its remarkable size. Contacted pet shops in Oradea denied their involvement with the trade of this species as pet. This first and surprising find of a living Australasian insect in a street of Oradea may be accidental for the moment, as European climate and environmental conditions appear as unsuitable for a tropical, rainforest animal. There are no publications of similar finds in Europe or of *E. calcarata* as invasive species in temperate regions. That particular individual may have been previously kept as pet and probably escaped or was irresponsibly released from captivity, as the find occurred in an urban area.

In its native range, no diapauses in eggs were observed[37], but in the eggs of non-tropical phasmids, such as the spur legged phasmid *Didymuria violescens* Leach, 1815, common in temperate regions of Australia, or *Ramulus irregulariterdentatus* (Brunner von Wattenwyl, 1907) from Japan, one or two obligatory diapauses occur, enabling them to overwinter once or twice before hatching[38]. A common characteristic of Phasmidae, including diapauses species, is long and variable egg periods, from several to 30 months[39].

Therefore, the invasive potential of *E. calcarata* deserves further attention. Although the insect is flightless, its distribution indicates capabilities of dispersion across both land and water[40]. Despite its remarkable size and threatening appearance, its cryptic abilities, adaptable diet (in captivity including several European plants), parthenogenesis as reproductive strategy, and the hypothetical possibility of adaptation to overwintering as eggs in man-made shelters pose its invasive threat to a certain degree of probability, possibly low, yet not negligeable.

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[37] Bedford 1976b.

[38] Bedford 1976b; Yamaguchi, H., Nakamura, K. 2015 - Effects of environmental factors on the regulation of egg diapause in the walking-stick insect, *Ramulus irregulariterdentatus* (Phasmatodea: Phasmatidae). *European Journal of Entomology* 112 (1): 35-40.

[39] Kobayashi, S., Usui, R., Nomoto, K., Ushirokita, M., Denda, T., Izawa, M. 2016 - Population Dynamics and the Effects of Temperature on the Eggs of the Seawater-dispersed Stick Insect *Megacrania tsudai* (Phasmida: Phasmatidae). *Zoological Studies* 55 (20): 1-10. doi:10.6620/ZS.2016.55-20.

[40] Gibson et al. 2012.

A future established population of this large insect in Europe may have considerable impact on local ecosystems, first and especially on vegetation. Thus, irresponsible keeping of pets (including *E. calcarata*) should be strongly discouraged by law[41], first of all in the case of dangerous or invasive species, since it has led previously to biological invasions.

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