

## ARTIGO / ARTÍCULO / ARTICLE

Exponential outspread of *Halyomorpha halys* (Stål, 1855)  
(Hemiptera: Pentatomidae) in PortugalHugo Gaspar<sup>1</sup>, Sílvia Castro<sup>1</sup>, José Manuel Grosso-Silva<sup>2</sup>, Torsten van der Heyden<sup>3</sup>  
& João Loureiro<sup>1</sup>

<sup>1</sup> Centre for Functional Ecology, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal. e-mails: hgaspar@uc.pt; scastro@bot.uc.pt; jloureiro@uc.pt

<sup>2</sup> Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP) / PRISC, Praça Gomes Teixeira, 4099-002 Porto, Portugal. e-mail: jmgrossosilva@mhnc.up.pt

<sup>3</sup> Immenweide 83, 22523 Hamburg, Germany. e-mail: tmvdh@web.de

**Abstract:** The presence of the invasive species *Halyomorpha halys* (Stål, 1855) (Hemiptera: Pentatomidae), the brown marmorated stink bug (BMSB), was first confirmed in Portugal in late 2018. In this note, an update to the known distribution in the Portuguese territories, including the first record in the Madeiran Archipelago, is presented. In Portugal, the BMSB has now been detected 51 times more, including six new districts, with increasing records registered in the last two years that envisage an exponential outspread in this territory. Also, the re-occurrence of individuals in the same localities in past years and the detection of a high number of individuals in some of them suggest that small stable populations may already exist, at least in some regions.

**Key words:** Hemiptera, Pentatomidae, *Halyomorpha halys*, brown marmorated stink bug, invasive species, Portugal, outspread.

**Resumen:** **Expansión exponencial de *Halyomorpha halys* (Stål, 1855) (Hemiptera: Pentatomidae) en Portugal.** La presencia de la especie invasora *Halyomorpha halys* (Stål, 1855) (Hemiptera: Pentatomidae), el chinche apestoso marrón (BMSB, en las siglas inglesas), fue confirmada por primera vez en Portugal a finales de 2018. En esta nota, se presenta una actualización de la distribución conocida en los territorios portugueses, incluyendo el primer registro en el archipiélago de Madeira. En Portugal, el BMSB ya se ha detectado 51 veces más, incluyendo seis nuevos distritos, con registros crecientes registrados en los últimos dos años, previéndose una expansión exponencial en este territorio. Además, la reaparición de individuos en las mismas localidades en los últimos años y la detección de un alto número de individuos en algunas de ellas sugiere la existencia de pequeñas poblaciones estables, al menos en algunas regiones.

**Palabras clave:** Hemiptera, Pentatomidae, *Halyomorpha halys*, chinche apestoso marrón, especie invasora, Portugal, expansion.

**Recibido:** 14 de enero de 2023

**Aceptado:** 17 de enero de 2023

**Publicado on-line:** 22 de enero de 2023

## Introduction

Since the first records of the invasive brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål, 1855) (Hemiptera: Pentatomidae), in Europe, from 2004 in Liechtenstein (ARNOLD, 2009) and Switzerland (cf. HAYE et al., 2014), very few European countries are still aside from the rapid spread of the BMSB. This increase is evident also by the exponential increase in the number of occurrences registered in online platforms such as iNaturalist (Fig. 1). Armenia is one of the more recent countries where the BMSB was introduced or has spread into (KALASHIAN et al., 2022). After it arrived in

Europe, this southeastern Asian species took 14 years to be detected for the first time in Portugal (in 2018; CIANFERONI *et al.*, 2018; GROSSO-SILVA *et al.*, 2020). Its presence was confirmed two years later, in 2020, in three distant locations in mainland Portugal's central and northern coastal side (GROSSO-SILVA *et al.*, 2020). This highly problematic invasive species poses a serious threat to agricultural production in most of the existing crops, and effective control is still being investigated (KRITICOS *et al.*, 2017). Furthermore, this species tends to move to humanized structures to obtain refuge during winter, making it particularly susceptible to human detection (HAYE *et al.*, 2014).

The confirmation of its presence in the country in 2020 has not resulted in any national monitoring protocol. However, efforts done by academia and producers associations (e.g., APK - Associação Portuguesa de Kiwicultores, the Portuguese Kiwifruit Producers Association) resulted in an ongoing public awareness campaign comprised of numerous seminars and digital content production, with the final goal of informing and stimulating the general public's ability to provide new records. This has resulted in multiple reports submitted by e-mail, and in the Facebook group created for that purpose despite that, fortunately, it was not always confirmed to be the BMSB, but other Hemiptera from the Portuguese fauna. Also, online biodiversity platforms such as iNaturalist represent valuable tools for monitoring the presence of *H. halys* (MAISTRELLO *et al.*, 2016) as this bug is easily identifiable using a good photograph, and specialists worldwide can easily contribute to validating the identification of each specimen.

In this paper, we provide a summary of all the new records of *H. halys* from Portugal since the first confirmation of the species in the country, combining new records from the public awareness campaign and the iNaturalist platform.

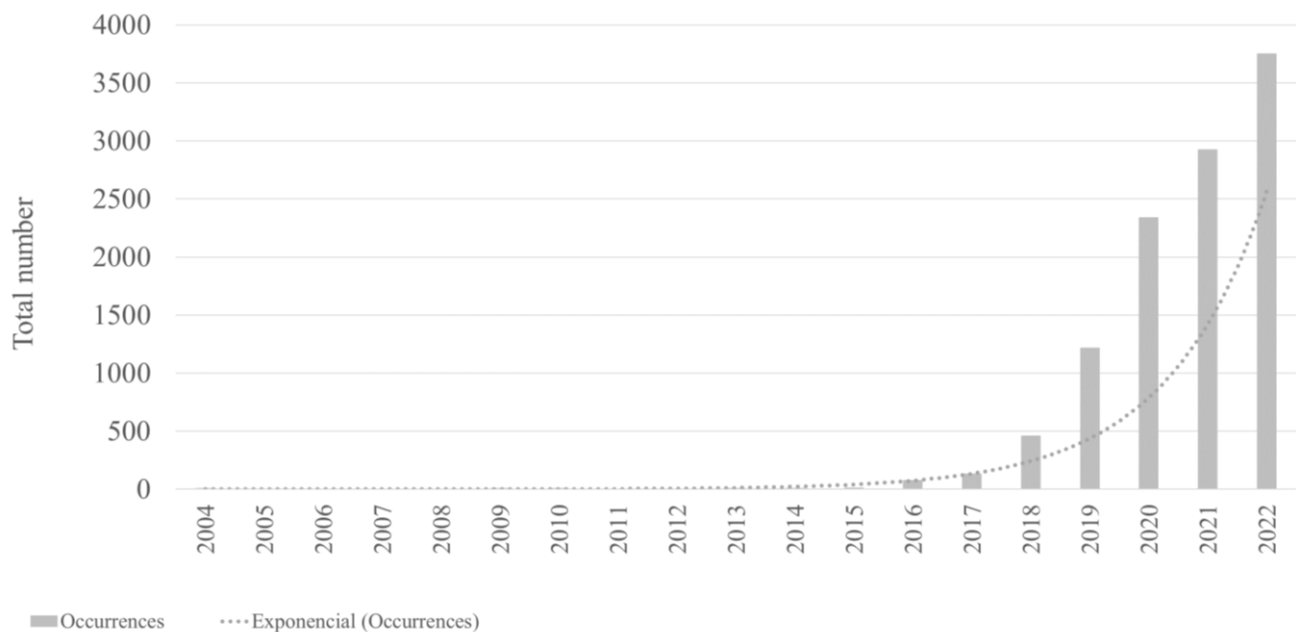


Fig. 1.- Total number of occurrences (and exponential line) in Europe exclusively provided by iNaturalist records.

## Results and discussion

Our results have shown evidence of the alarming growth in distribution range and individual counts of *H. halys* in Portugal, with six new districts, including for the first time its presence in regions in the coastal south and the interior north of Portugal mainland, and in the Madeiran Archipelago (Fig. 2; Table 1). In total, since the record of *H. halys* in four localities from 2018 to 2020 (GROSSO-SILVA *et al.*,

2020), 51 new occurrences and 117 individuals (including eight nymphs) were obtained from the awareness campaign (21 occurrences) and the iNaturalist online platform [under the project "Percevejo asiático (*Halyomorpha halys*) PT", see [here](#)] (30 occurrences until 31-12-2022) (Table 1).

These new records were reported mainly between September and March (82%) (Table 1), the expected period with higher interaction with humans as this species is looking for shelter in anthropogenic structures. Indeed, most interceptions were made in urban areas inside houses or shelters near the windows and doors or in the vicinity of the house in private gardens. In one location (Ganfei, Viana do Castelo), the interception resulted from a pheromone trap installed by a kiwi producer. Interestingly, using this method, it was possible to capture up to 30 individuals, constituting the record with the most observations.

As already highlighted before by MAISTRELLO *et al.* (2016), the relevance of citizen science for the early monitoring of pests with morphological traits easily distinguishable with a good photograph is also evident here, as the public produced all the records either by using online biodiversity platforms (e.g., iNaturalist) or other communication channels (e.g., e-mails or social media) made available in the awareness campaign launched in Portugal.

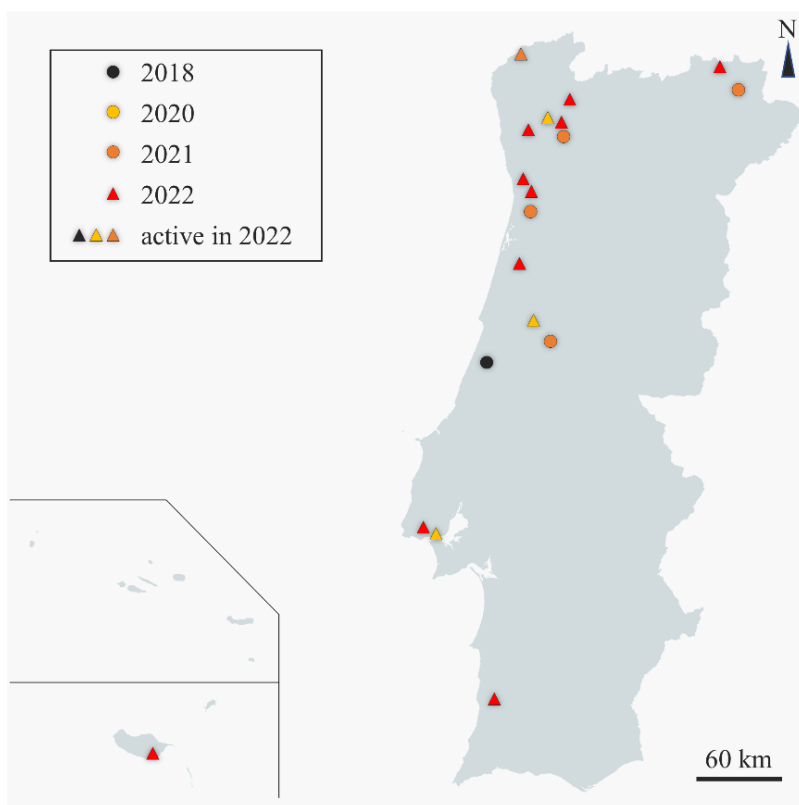
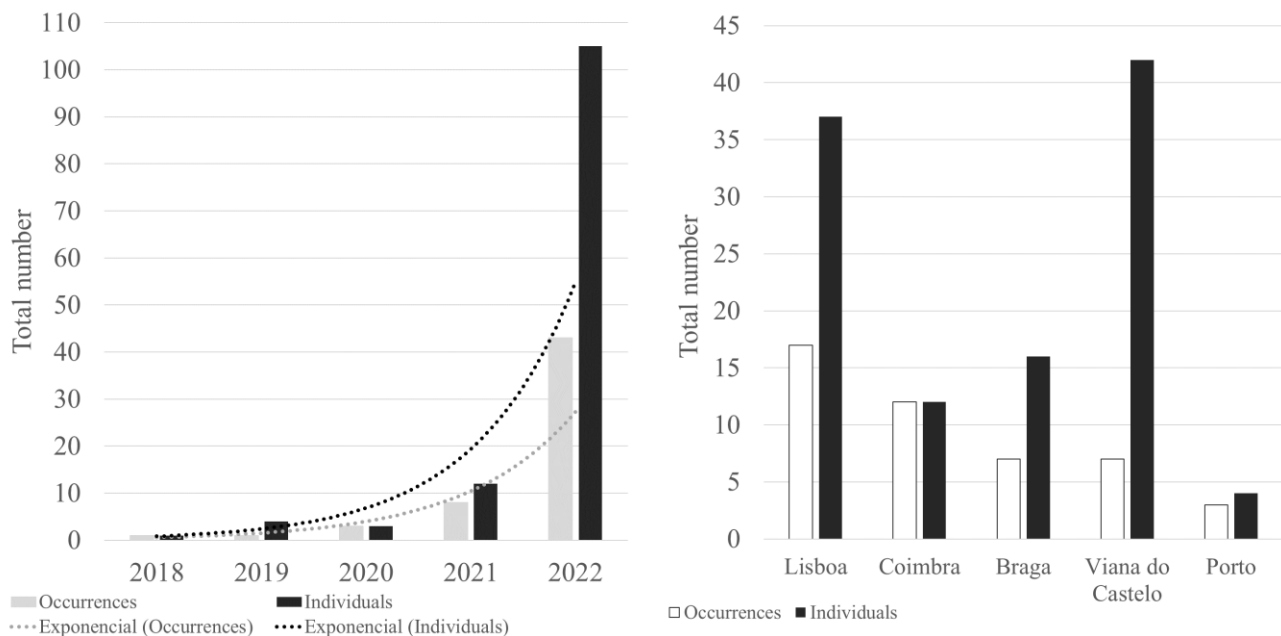


Fig. 2.- Distribution map of *Halyomorpha halys* locations in mainland and insular Portugal from GROSSO-SILVA *et al.* (2020), 2018 and 2020, and this study, 2021 and 2022. Each colour represents the year of introduction, and the triangle shape means that the insect was recorded in a particular location in 2022. Records of the same locality were compiled in the same symbol.

The increase in the number of occurrences and individuals in Portugal from 2018 to 2022 is alarming and well adjusted to an exponential growth of the species in this territory (Fig. 3). If the rise was slow from 2018 to 2021, in 2022, a 4.4-fold increase in the number of occurrences and a 7.8-fold increase in the number of individuals is a great concern. Despite the value of the citizen science tools that contributed to such records, this pest is likely even more widespread in Portugal, and the silent spread of these problematic organisms cannot be underestimated.

Overall, the information published here represents a clear sign of the development and spread of this problematic invasive species that might achieve population levels and distribution ranges soon capable of creating damage at regional and national levels, with particular importance in the loss of crop productivity, in the near future. Again, as highlighted in GROSSO-SILVA *et al.* (2020), besides the efforts done by

academia to raise awareness for this invasive pest, it is urgent that the Portuguese national phytosanitary authorities develop monitoring plans directed at detecting its occurrence and abundance, and understanding local population dynamics, while developing management strategies to prevent its damage to agricultural productions.



**Fig. 3.** - The total number of occurrences and individuals of *Halyomorpha halys* in Portugal by year - with exponential lines (left) and in the top five districts of Portugal according to the number of occurrences (right).

## Acknowledgements

The authors want to thank all the record providers who contributed through the various available channels, and the Portuguese Kiwifruit Producers Association (APK) for supporting the campaign.

This work was partially supported by Operational group i9Kiwi - "Developing strategies for the sustainability of kiwifruit production through the creation of an added value product", funded by PDR2020. SC and HG were funded by the Integrated Program of Scientific Research and Technological Development CULTIVAR (CENTRO-01-0145-FEDER-000020), co-financed by the Regional Operational Programme Centro 2020, Portugal 2020 and European Union, through European Fund for Regional Development (ERDF).

## References

- CIANFERONI, F., GRAZIANI, F., DIOLI, P. & CECCOLINI, F. 2018. Review of the occurrence of *Halyomorpha halys* (Hemiptera: Heteroptera: Pentatomidae) in Italy, with an update of its European and World distribution. *Biologia*, **73**(6): 599-607.
- GROSSO-SILVA, J.M., GASPAR, H., CASTRO, S., LOUREIRO, J., AMORIM, F. & VAN DER HEYDEN, T. 2020. Confirmation of the presence of *Halyomorpha halys* (Stål, 1855) (Hemiptera: Pentatomidae) in mainland Portugal. *Arquivos Entomológicos*, **22**: 373-376.
- HAYE, T., ABDALLAH, S., GARIEPY, T. & WYNIGER, D. 2014. Phenology, life table analysis and temperature requirements of the invasive brown marmorated stink bug, *Halyomorpha halys*, in Europe. *Journal of Pest Science*, **87**(3): 407-418.
- KALASHIANA, M.Y., GHREJYANA, T.L. & KARAGYANA, G.H. 2022. Brown Marmorated Stink Bug *Halyomorpha halys* (Stål, 1855) (Heteroptera: Pentatomidae) Penetrated into Armenia. *Russian Journal of Biological Invasions*, **13**(3): 305-308.

KRITICOS, D.J., KEAN, J.M., PHILLIPS, C.B., SENAY, S.D., ACOSTA, H. & HAYE, T. 2017. The potential global distribution of the brown marmorated stink bug, *Halyomorpha halys*, a critical threat to plant biosecurity. *Journal of Pest Science*, **90**(4): 1033-1043.

MAISTRELLO, L., DIOLI, P., BARISELLI, M., MAZZOLI, G.L. & GIACALONE-FORINI, I. 2016. Citizen science and early detection of invasive species: phenology of first occurrences of *Halyomorpha halys* in Southern Europe. *Biological Invasions*, **18**(11): 3109-3116.

**Table 1.** - Records of *Halyomorpha halys* in Portugal. Information about record date, number of adults (NA), number of nymphs (NN), geographical coordinates (when available), location (district and locality) and source (iNaturalist or HJS - H. Gaspar, J. Loureiro and S. Castro) are provided for each record. JB-JS-PV-C in locality represents the vicinity of Jardim Botânico, Jardim da Sereia, Parque Verde and Choupal and TA-M the vicinity of Tapada da Ajuda and Parque Florestal de Monsanto. Districts marked with an \* represent first district records. New records are from 2021 and 2022.

Year	Month	Day	NA	NN	Coordinates	District	Locality	Source
2018	11	-	1	0	39.943218, -8.825231	Leiria	Guia	INIAV
2019	2	-	4	0	39.943218, -8.825231	Leiria	Guia	HJS
2020	9	13	1	0	-	Braga	Braga	HJS
	9	28	1	0	40.206956, -8.422999	Coimbra	JB-JS-PV-C	HJS
	10	12	1	0	38.707628, -9.182306	Lisboa	TA-M	iNaturalist
2021	3	14	1	0	41.003143, -8.562899	*Aveiro	Mozelos	iNaturalist
	5	4	1	0	40.209693, -8.418863	Coimbra	JB-JS-PV-C	iNaturalist
	9	1	1	3	42.045148, -8.632968	*Viana do Castelo	Ganfei	HJS
	9	7	0	1	40.102398, -8.249389	Coimbra	Lousã	iNaturalist
	10	5	1	1	41.805191, -6.750374	*Bragança	Bragança	iNaturalist
	10	7	1	0	40.206928, -8.423038	Coimbra	JB-JS-PV-C	HJS
	10	25	1	0	-	Braga	Guimarães	HJS
	11	10	1	0	38.697437, -9.198990	Lisboa	TA-M	HJS
2022	1	12	1	0	38.771943, -9.299492	Lisboa	Sintra	iNaturalist
	1	19	1	0	40.206916, -8.422726	Coimbra	JB-JS-PV-C	iNaturalist
	1	26	1	0	40.206928, -8.423038	Coimbra	JB-JS-PV-C	HJS
	3	1	1	0	38.70497, -9.19473	Lisboa	TA-M	HJS
	3	5	1	0	-	Braga	Braga	HJS
	4	6	1	0	42.045148, -8.632968	Viana do Castelo	Ganfei	HJS
	4	29	1	0	42.045148, -8.632968	Viana do Castelo	Ganfei	HJS
	4	30	1	0	42.045148, -8.632968	Viana do Castelo	Ganfei	HJS
	5	12	1	0	42.045148, -8.632968	Viana do Castelo	Ganfei	HJS
	7	6	1	0	38.706368, -9.155557	Lisboa	TA-M	iNaturalist
	7	10	1	0	38.74798, -9.192229	Lisboa	TA-M	iNaturalist
	7	12	1	0	40.208531, -8.421366	Coimbra	JB-JS-PV-C	HJS
	8	13	1	0	38.745158, -9.185337	Lisboa	TA-M	iNaturalist

Year	Month	Day	NA	NN	Coordinates	District	Locality	Source
2022	9	2	0	2	38.6975, -9.223056	Lisboa	TA-M	iNaturalist
	9	9	1	0	40.197116, -8.430088	Coimbra	JB-JS-PV-C	HJS
	9	17	1	0	41.518244, -8.310436	Braga	Santo Estêvão	iNaturalist
	9	19	1	0	40.210022, -8.424531	Coimbra	JB-JS-PV-C	iNaturalist
	9	21	1	0	38.698611, -9.224722	Lisboa	TA-M	iNaturalist
	9	21	1	0	41.55515, -8.417001	Braga	Braga	iNaturalist
	9	-	1	0	-	Lisboa	TA-M	iNaturalist
	9	-	0	1	-	Lisboa	TA-M	iNaturalist
	10	2	1	0	41.092676, -8.537518	*Porto	Vila Nova de Gaia	iNaturalist
	10	2	1	0	37.598942, -8.644925	*Beja	Odemira	iNaturalist
	10	3	1	0	38.743551, -9.135963	Lisboa	TA-M	iNaturalist
	10	6	2	0	38.74343, -9.134527	Lisboa	TA-M	iNaturalist
	10	6	19	0	38.674942, -9.157859	Lisboa	TA-M	HJS
	10	7	1	0	41.691185, -8.204209	Braga	Terras do Bouro	iNaturalist
	10	8	1	0	41.160149, -8.60954	Porto	Porto	iNaturalist
	10	12	1	0	38.681519, -9.157292	Lisboa	TA-M	iNaturalist
	10	12	4	0	42.045148, -8.632968	Viana do Castelo	Ganfei	HJS
	10	12	1	0	40.557556, -8.550487	Aveiro	Oiã	iNaturalist
	10	14	1	0	38.747226, -9.193309	Lisboa	TA-M	iNaturalist
	10	15	30	0	42.045148, -8.632968	Viana do Castelo	Ganfei	HJS
	10	16	10	0	41.545669, -8.395413	Braga	Braga	HJS
	10	19	1	0	38.711886, -9.168909	Lisboa	TA-M	HJS
	10	19	1	0	40.206928, -8.423038	Coimbra	JB-JS-PV-C	HJS
	10	28	1	0	41.914263, -6.915486	Bragança	Vinhais	iNaturalist
	11	9	1	0	40.222261, -8.443895	Coimbra	JB-JS-PV-C	iNaturalist
	11	9	1	0	41.546895, -8.402305	Braga	Braga	iNaturalist
	11	24	1	0	40.206928, -8.423038	Coimbra	JB-JS-PV-C	HJS
	12	18	1	0	41.448086, -8.28126	Braga	Guimarães	iNaturalist
	12	18	1	0	32.648027, -16.910898	*Madeira	Funchal	iNaturalist
	12	31	2	0	-	Porto	Santo Tirso	HJS