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SHORT COMMUNICATION

The Oriental latrine fly *Chrysomya megacephala* (Diptera: Calliphoridae) has arrived in Eastern Europe

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Abstract. The Oriental latrine fly, *Chrysomya megacephala* (Fabricius) (Diptera: Calliphoridae), is a rapidly expanding species, likely to become one of the most widely used species in forensic entomology in the near future, as it is currently recorded on every continent except Antarctica. In Europe, it has been confirmed only from a few Mediterranean countries (Portugal, Spain and Malta), together with the closely related and also expanding *Chrysomya albiceps.* Our study confirms that *Chrysomya megacephala* has arrived in Eastern Europe, with adult individuals of both sexes recorded during surveys and trapping in a nature reserve along the Black Sea coast in Romania. We present initial data on the overall complex assemblage of native and non-native sarcosaprophagous Diptera at this site and highlight important knowledge gaps. Given its forensic relevance and potential health risks, further investigations into its distribution, ecology, and invasion pathways in Europe are required, particularly as climate change may support its continued expansion into Central Europe.

INTRODUCTION

Chrysomya megacephala (Fabricius, 1794) (Diptera: Calliphoridae), known as the Oriental latrine fly, is a synanthropic species, usually associated with human settlements. It plays an increasingly important role in forensic entomology, aiding researchers in estimating the time of death during criminal investigations due to its rapid rates of colonizing decaying organic matter (Badenhorst & Villet, 2018), and has already been utilised extensively for this purpose in various countries across Africa, Asia, and South America (Martínez-Sánchez et al., 2025). Additionally, the species poses public health risks, as it can serve as a vector for various pathogens, spreading diseases through contact with contaminated substances, such as human excrement or carrion (Boonchu et al., 2003; Ramaraj et al., 2014; Badenhorst & Villet, 2018; Martínez-Sánchez et al., 2025) and causes significant economic losses due to its salt tolerance and high capacity to contaminate with larvae specific food items such as sun-dried fish (Wall et al., 2001; Badenhorst & Villet, 2018).

Originally from the Oriental and Australasian regions, *Chrysomya megacephala* has rapidly expanded over the past 50 years to nearly all of Africa and the Americas, and it is now present also in parts of southwestern Europe (Badenhorst & Villet, 2018; Martínez-Sánchez et al., 2025). Considering the limited data available on the species' biology, ecology, and distribution across Europe, along with its potential implications for human health and forensic entomology, there is a clear need for studies focused on identifying the species' presence in new European areas and characterizing its biological and ecological traits in relation to local climatic conditions.

MATERIAL AND METHODS

Following the observation and identification of a male *Chrysomya megacephala* during an insect visual survey in September 2024 (https://www.inaturalist.org/observations/240721985), this study was conducted in the southwest of Romania, within the Dobrogea region, specifically in the "Dunele Marine de la Agigea" Nature 2000 site (ROSCI0073) (44.0893°N/28.6425°E). To verify and quantify the presence of *Chrysomya megacephala*, four carrion-baited traps were set up in the area, spaced approximately 100 m apart, at about 1.5 m height.

The simple traps were constructed from transparent 2-litre plastic bottles. A hole was cut into the middle section of each bottle to allow insects to enter. The bait (two traps with rotten European sprat (*Sprattus sprattus* (Linnaeus, 1758) and two with rotten Whiteleg shrimps (*Litopenaeus vannamei* (Boone, 1931)) was placed in a small plastic container in the upper part of each bottle. The lower section of the trap was filled with a solution of water and salt, which served to preserve the specimens until the trap was emptied and the samples were transferred to ethanol. Flies attracted to the bait entered through the hole in the bottle and eventually fell into the preserving solution at the bottom of the trap. The same applies to the mature fly larvae; as they attempted to move and find a place to pupate, they eventually exited the container holding the bait and fell into the preserving liquid. The traps operated for approximately three weeks, from October 26 to November 15, 2024, under temperatures ranging from 27.32°C to 1.68°C.

Both adult flies and their larvae were collected regularly from the traps (every 5 days), rinsed with distilled water to remove the salt, and then placed in 70% ethanol for further identification. Some of the adult flies were immediately dried and pinned, but most adult flies and larvae were stored in 70% ethanol after identification. The same method was applied to the other insect specimens found in the traps.

To identify the adults of *Chrysomya megacephala* in our sample, we used the identification keys from Irish et al. (2014), Ramaraj et al. (2014) and Lutz et al. (2018). Additionally, we aimed to identify the other dipteran species captured in the traps to gain a better understanding of the sarcosaprophagous Diptera community assemblage that *C. megacephala* has apparently become a part of in this region of Europe. We also searched for *C. megacephala* larvae in the samples, identifying them using Szpila (2010), Ramaraj et al. (2014), Sukontason et al. (2018) and Szpila et al. (2024). The remaining larvae were identified only to family level.

The pictures were taken using a stereo microscope (ZEISS SteREO Discovery.V20) with a photo-stacking function.

The specimens are deposited in the entomological collection of the Biological Marine Research Station Agigea, Romania; catalogue numbers BMRS-2025-DIP-001 to BMRS-2025-DIP-073 for Diptera specimens and BMRS-2025-HYM-001 to BMRS-2025-HYM-027 for Hymenoptera specimens.

RESULTS

Specimens examined

ROMANIA: Constanța county: "Dunele Marine de la Agigea" Nature Reserve, 44.088480°N/28.641589°E, 27 October 2024, shrimp-baited trap, Leg. Pintilioaie Alexandru-Mihai, 2♀ (Fig. 1A); same general location as the initial adult male (Fig. 1B) photographed 9 September 2024 by S. Petrovan.

In total, 73 adult flies and 1906 fly larvae were collected and identified, of which only two adults, both females, were identified as *Chrysomya megacephala*, while the largest number in the sample were identified as the congeneric and also non-native *Chrysomya albiceps* (Wiedemann, 1819) (Table 1). All the larvae belong to Calliphoridae. Overall, for the trapped fly adults we identified ten different species belonging to three different families (Table 1).

Additionally, parasitic Hymenoptera of two distinct species were also collected from the traps, attracted by the carrion bait and the presence of fly larvae: *Alysia cf. manducator* (Panzer, 1799) (Hymenoptera: Braconidae) and an unidentified species of Encyrtidae (Hymenoptera: Chalcidoidea) (Table 1).

During the collecting period, the average temperature was 15.6°C, and the average relative humidity was 74.72%.

DISCUSSION

The identification of only two adult individuals of *Chrysomya megacephala* in the carrion-baited trapping samples may suggest that the local population of this species was represented by a small number of flying adults at the end of October and the beginning of November. However, the species seems to become inactive at temperatures below 16°C (Martínez-Sánchez et al., 2025), which may explain the reduced number of adult specimens in the samples in this period of the year in Romania and the absence of any identified *C. megacephala* larvae. Equally, it is possible that this is still the initial stage of the invasion of this species in the region and the abundance remains low.

The dipteran assemblage associated with *Chrysomya megacephala* was dominated by Calliphoridae (n = 61), with fewer Muscidae (n = 11) and a single Faniidae specimen, reflecting similar patterns reported in a Mediterranean holm-oak pasture in Spain, where calliphorids predominated over muscids (Martínez-Sánchez et al., 2000). *Chrysomya albiceps* was the predominant species (n = 23), while *Lucilia sericata* and *Calliphora vicina* were codominant (n = 16 each). By contrast, *Calliphora vomitoria* was recorded in much lower numbers (n = 4). The reduced abundance of *C. vomitoria* may be attributed to its preference for large carcasses (Davies, 1990), which are probably scarce in the surrounding area. Additionally, the disparity in numbers between *C. vomitoria* and *C. vicina* likely reflects the latter's affinity for cooler and more humid conditions, corresponding to the sampling period during the second half of autumn (Davies & Ratcliffe, 1994). The low abundance of Muscidae (n = 11) and Faniidae (n = 1) in the samples may be explained by the thermophilic tendencies of some of the species, such *as Hydrotaea ignava* and *Muscina prolapsa*, coupled with their preference for more wooded habitats (Martínez-Sánchez et al., 2000).

The parasitoid assemblage of *Chrysomya megacephala* is not well studied, with only four hymenopteran species reported so far from Brazil: *Tachinaephagus zealandicus* Ashmead, 1904 (Encyrtidae), *Pachycrepoideus vindemmiae* (Rondani, 1875), *Nasonia vitripennis* (Walker, 1836) (Pteromalidae), and *Brachymeria podagrica* (Fabricius, 1787) (Chalcididae) (de Carvalho et al.,

Table 1. Number of fly and parasitic Hymenoptera species collected and identified from the four carrion-baited traps during this study at Dunele Marine de la Agigea.

Order	Family	Species	No. of specimens
Diptera	Calliphoridae	*Calliphora vicina* Robineau-Desvoidy, 1830	16
Diptera	Calliphoridae	*Calliphora vomitoria* (Linnaeus, 1758)	4
Diptera	Calliphoridae	*Chrysomya albiceps* (Wiedemann, 1819)	23
Diptera	Calliphoridae	*Chrysomya megacephala* (Fabricius, 1794)	2
Diptera	Calliphoridae	*Lucilia sericata* (Meigen, 1826)	16
Diptera	Faniidae	*Fannia* cf. *canicularis* (Linnaeus, 1761)	1
Diptera	Muscidae	*Hydrotaea ignava* (Harris, 1780)	1
Diptera	Muscidae	*Phaonia trimaculata* (Bouché, 1834)	2
Diptera	Muscidae	*Muscina prolapsa* (Harris, 1780)	3
Diptera	Muscidae	*Muscina stabulans* (Fallén, 1817)	5
Hymenoptera	Braconidae	*Alysia* cf. *manducator* (Panzer, 1799)	15
Hymenoptera	Encyrtidae	Undetermined	12

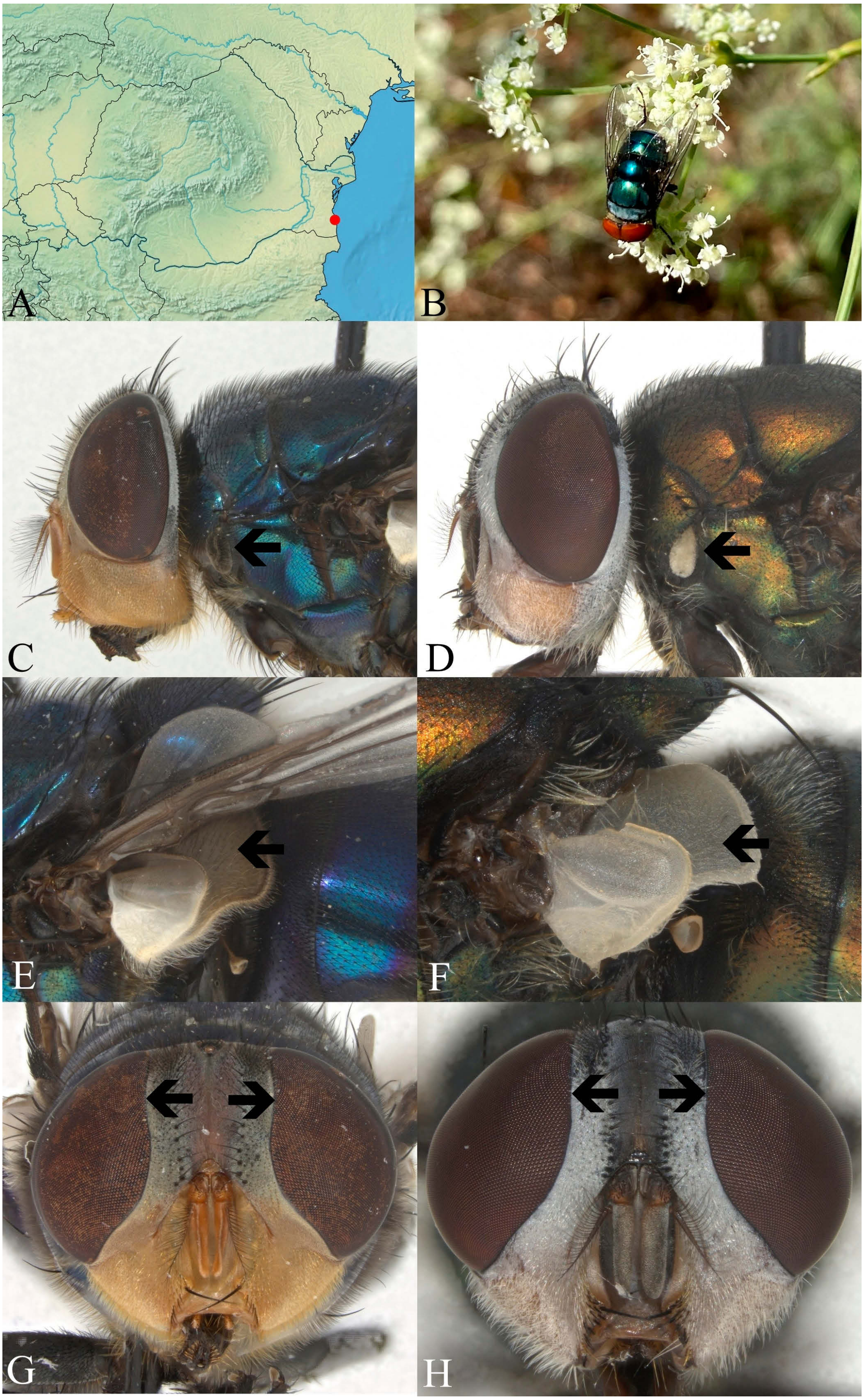

Fig. 1. Comparative plate showing the presence of *Chrysomya megacephala* in Romania and the differences between *Chrysomya megacephala* and *Chrysomya albiceps*. A – distribution of *C. megacephala* in Romania; B – male *Chrysomya megacephala* observed in September 2024 in Romania; C – anterior spiracle in *Chrysomya megacephala*; D – anterior spiracle in *Chrysomya albiceps*; E – basal area of calypters in *Chrysomya megacephala*; F – basal area of calypters in *Chrysomya albiceps*; G – frons of female *Chrysomya megacephala*; H. frons of female *Chrysomya albiceps*.

2003; Marchiori, 2004). In our sample, we identified two other parasitoid species, and species of *Alysia* are well-documented parasitoids of blow fly larvae (Calliphoridae) (Holdaway & Evans, 1930; Adetimehin et al., 2023; Sohn et al., 2023). However, no reports exist of *Alysia* species parasitizing the larvae of *Chrysomya megacephala*. The unidentified Encyrtidae species we trapped may also potentially parasitise *C. megacephala* larvae or pupae, as at least one species within this family is known to develop inside fly larvae (de Carvalho et al., 2003). Nevertheless, considering that no *C. megacephala* larvae were identified in our study, these aspects remain unknown and in need of verification, but such complex and novel ecological relations between insect larvae and their parasitoids are critically important in invasion ecology and in the potential control of the population dynamics of the non-native species (Jarret et al., 2022).

Given its recent expansion, the ecological and biological data on the Oriental latrine fly in Europe remain limited. A recent study on the *C. megacephala* population in Spain revealed that its activity peaks in September, when temperatures decrease (average 23°C) and humidity rises following the initial autumn rains (67% relative humidity); it avoids high summer temperatures (average 26°C) and becomes inactive below 16°C (Martínez-Sánchez et al., 2025). Under laboratory conditions, the development time from egg to adult was 9 days at 28°C, but extended to 26 days at 18°C in the Spanish population of *C. megacephala* (Martínez-Sánchez et al., 2025).

The activity dynamics of species with wide distributions, such as *Chrysomya megacephala,* varies according to geographic location and climatic conditions (Pereira et al., 2023; Hu et al., 2010; Martínez-Sánchez et al., 2025). Additionally, the type of tissue the larvae feed on affects their growth rate, which is an important factor in using blowflies to estimate the Post-Mortem Interval (PMI) (Villet et al., 2010; Martínez-Sánchez et al., 2025). Therefore, the information regarding species development in Spain should be interpreted with caution when applied to other parts of Europe, particularly away from the Mediterranean region. This highlights the need for similar studies in continental Europe to better assess the species' distribution and biology, from both a sanitary and forensic perspective. Due to its adaptability, rapid colonisation of organic material, rapid larval development, and vast and growing distribution, this species is increasingly relevant in terms of forensic importance (Martínez-Sánchez et al., 2025), and as such its presence in Romania and Eastern Europe is noteworthy and should be followed up by detailed surveys and ecological studies.

Chrysomya megacephala is now an almost cosmopolitan species, being distributed across all continents, except Antarctica (Badenhorst & Villet, 2018). In the wider European region, it was first recorded in 1978 in Canary Islands (Báez et al., 1981), followed by Madeira in 1989 (Báez, 1990), Spain in 1997 (Martínez-Sánchez et al., 2001), Malta in 1999 (Ebejer, 2007) and Portugal in 2006 (Prado e Castro & García, 2009).

The introduction pathways of the species in Romania are currently unknown. A plausible possibility is a human-mediated introduction, with various goods or products imported from other parts of the world, as the location of the species' discovery is near Constanța, one of the largest commercial harbours in Europe. Moreover, the introduction of this species by ships was also proposed by Illingworth (1926) and Báez et al. (1981). Another possibility that should be considered is the migration hypothesis, as it has been demonstrated that related species – such as *Chrysomya albiceps* – are capable of dispersing over 2 km per day (Williams & Villet, 2006).

Irrespective of how this species reached this part of Europe, it is highly likely that it will continue to spread and expand its range across the continent, moving into northern, cooler countries in the future, as temperatures continue to rise, similar to the case of the Mediterranean species *Chrysomya albiceps* in central and Eastern Europe (Rodrigues-Filho et al., 2023).

In Romania, *C. megacephala* can be confused with *C. albiceps* based on their habitus, as they share the same habitat and adult activity period and are attracted by the same carrion, as our study shows. However, on closer examination, *C. megacephala* have a dark anterior spiracle (Fig. 1C) (white in *C. albiceps*, Fig. 1D) and brownish basal calypters (Fig. 1E) (white in *C. albiceps*, Fig. 1F). Additionally, in males *C. megacephala,* the upper two-thirds of the eyes have enlarged facets (Fig. 1B), while in females, the frons widens in the middle, having convex edges (Fig. 1G). In comparison, the eyes in the males in *Chrysomya albiceps* are normally developed and the frons of the females does not widen in the middle, having parallel edges (Fig. 1H) (Irish et al., 2014; Ramaraj et al., 2014). The relatively distinctive aspect of adult males *C. megacephala* makes them a potentially suitable target for citizen science photographic recording, for instance via verifiable platforms such as iNaturalist, although invertebrate recording and identification there remains comparatively insufficient (Callaghan et al., 2022).

Chrysomya megacephala is regarded as one of the primary vectors of enteric bacteria, helminths, and protozoans (Xu et al., 2022), highlighting its importance. In a Thailand study, *C. megacephala* carried up to 12 times more bacteria than *Musca domestica* (Chaiwong et al., 2014). A study conducted in South Africa in 2013 on bacterial diversity found that *Chrysomya megacephala* can act as a vector for *Pantoea* sp. and *Myroides* sp., bacteria capable of causing various types of infections in humans (Brits et al., 2016). In a more recent study (Xu et al., 2022), the microbial communities of *C. megacephala* pupae were analysed, showing that approximately half of the bacteria identified at the species level were well-known pathogens or opportunistic pathogens, including *Escherichia coli*, *Providencia burhodogranariea*, and *Morganella morganii*.

Due to its frequent occurrence on corpses and extensive geographical distribution, *C. megacephala* is considered a significant insect in forensic entomology, as its life cycle aids in estimating the post-mortem interval (PMI) (Badenhorst & Villet, 2018). Studies have demonstrated that DNA can be extracted and identified from the larval guts of *Chrysomya megacephala*, even from corpses in advanced decay due to drowning, up to 36 hours after larval ingestion (Monthatong & Thongchaitriwat, 2015). Interestingly, the DNA found in the guts of *Chrysomya megacephala* adults could serve as a valuable indicator of mammal presence in a given area. This is particularly useful in remote, hard-to-access regions and for detecting elusive mammals that are difficult to track using traditional methods (Lee et al., 2015).

CONCLUSIONS

Based on a male photographed in September 2024, feeding on flowers of a plant from Apiaceae, and the subsequent collection of two additional females weeks apart in the same area, the presence of a population of *Chrysomya megacephala* in Eastern Europe is confirmed for the first time. However, most aspects of its presence and expansion in this region, and in fact, in its European range, remain unknown. Understanding the biology, ecology, and distribution of *C. megacephala* is essential for both forensic applications and for addressing potential public health risks. Further studies, including genetic analyses, could clarify the introduction pathways into this part of Europe and whether it was unintentionally imported across large distances directly from other continents, or it expanded progressively due to species range spreading out northwards, influenced by climate change, yet it has remained undetected in the wider Balkans region.

AUTHOR CONTRIBUTIONS. A.-M. Pintilioaie: writing – original draft preparation (lead); writing – review and editing (equal); methodology (equal); investigation (equal); conceptualisation (equal). S. Petrovan: writing – original draft preparation (supporting); writing – review & editing (equal); methodology (equal); investigation (equal); conceptualisation (equal).

CONFLICT OF INTEREST STATEMENT. The authors declare no conflicts of interest.

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