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# A first detection of *Exorista segregata* (Rondani, 1859) (Diptera: Tachinidae) as a larval parasitoid of *Orgyia trigotephras* Boisduval, 1829 (Lepidoptera: Erebidae) from Tunisia

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## Abstract

**Background** The tachinid parasitoid, *Exorista segregata* (Rondani, 1859) (Diptera: Tachinidae) is a polyphagous fly recorded on larvae of lepidopterans. Larvae of the Erebidae, *Orgyia trigotephras* Boisduval were collected from Northern Tunisia and reared in the laboratory at INRGREF. Larvae were kept individually until emergence of parasitoid's adults.

**Results** Morphological data including dissected genitalia was used to identify *E. segregata* as a parasitoid of *O. trigotephras* larvae.

**Conclusion** The larval parasitoid, *E. segregata* is recorded from a new host *O. trigotephras* for the first time in Tunisia. This species could be considered in the programs of biological control of different lepidopterans' pests in Tunisia and neighboring countries.

**Keywords** Biocontrol, *Exorista segregata*, *Orgyia trigotephras*, Parasitism

## Background

*Exorista* Meigen (Rondani 1859) (Diptera: Tachinidae) is one of the largest genera in the tribe Exoristini (Exoristinae) belonging to the family Tachinidae (Tachi 2011). This genus comprises approximately 150 species worldwide, mostly distributed in Russia, Asia (Herting and Dely-Draskovits 1993), Middle East (Kugler 1963, 1966), Egypt (Bezzi 1909; Hafez and El-said 1970), Southern Europe (Sabrosky and Reardon 1976; Herting and Dely-Draskovits 1993) and North Africa (Sabrosky and Reardon 1976). The species *E. segregata* is a polyphagous fly

recorded on larvae of more than 20 different hosts in of order Lepidoptera, mainly on: Arctiidae, Lymantridae, Lasiocampidae, Noctuidae, Nymphalidae, Pieridae, Saturniidae, Thaumetopoeidae and Zygaenidae (Kara and Tschorsnig 2003; Cerretti and Tschorsnig 2010; Tschorsnig 2017). The Erebidae, *Orgyia trigotephras* Boisduval is a polyphagous pest feeding on *Quercus* spp., namely *Q. suber* L., *Q. ilex* L. (Villemant and Fraval 1993; Chakali et al. 2002) and *Q. coccifera* L. (Ezzine et al. 2010; Hammami et al. 2019), on *Pistacia lentiscus* L. (Ezzine et al. 2010; Bella et al. 2011; Hammami et al. 2019) and *Retama monosperma* L. (Dionisio 2002). In its outbreak, the pest causes a wide damage of shrub species, as observed in 2005 in northeastern Tunisia (Ezzine et al. 2010). The pest occurred with two generations per year, a spring generation (from April to June) and an autumn generation (from October to December) in the north of the country (Ezzine et al. 2014). Females are wingless and lay eggs in a single egg mass including 140–250 eggs

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in the cocoon on the host plant on which they pupate (Ezzine et al. 2010).

In Tunisia, tachinid flies have so far remained very poorly studied. In the present study, morphological data including dissected genitalia was used to identify, diagnose and report *E. segregata*, the parasitoid of the erebid's moth, *O. trigotephras* in Tunisia.

## Methods

This work was conducted at Northeastern (Cap-Bon, alt. 432 m; 36°52' N, 10°48' E) and Northwestern (Sejnane, alt. 48 m; 37°11' N, 9°11' E) Tunisia from 2013 to 2019. A total of 34 specimens of *E. segregata* were collected from the 3rd, 4th and 5th instars larvae of *O. trigotephras*, sorted and reared in the laboratory at the INRGREF, until emergence of the parasitoids. Emerged adult flies were conserved in ethanol 75% until identification.

The morphological characters of adult flies (male and female) were used to identify them using the keys of Tschorsnig and Herting (1994) and Tschorsnig and Richter (1998). The genitalia dissection was carried out according to O'Hara (1983) and O'Hara and McIntyre

(1984) protocols. Briefly, the abdomen was carefully removed at its junction with the thorax and cleaned in cold KOH (10%) at room temperature for 1 day, followed by neutralization in acetic acid (20%), dehydration in ethanol (70 and 95%) and washing in distilled water. Dissected Terminalia was then stored in glycerin in microvials pinned beneath the source specimens.

## Results

**Male body length:** 8–12 mm. **Head:** frons yellowish-gray contrasting with silvery gray face. Parafrontals are heavily covered with fine black hairs that continue onto parafacial (fronto-orbital plate) almost to the end of the frontal row (Fig. 1a, b). Eyes with dense and long hairs (Fig. 1b, c), bristles above the vibrissa rise to the level of the lowest frontal bristle or further (Fig. 1b). Presence of ocellar bristles behind the level of the anterior ocellus (Fig. 1c). **Thorax:** black, moderately gray to yellowish-gray pruinulent. The scutellum is chiefly dark reddish black and black basally (Fig. 1a). **Abdomen:** with broad shining black bands intermediately on tergites, abdominal sternites of male is highly shining (especially on segments



**Fig. 1** *Exorista segregata* (male): **a** adult; **b** head and eyes; **c** ocellar bristles; **d** abdomen

4 and 5) (Fig. 1a). The fifth abdominal segment is rather thickly covered with strong, erect bristles and hair-like bristles at least on the apical half (Fig. 1d). Tergites ventrally dusted further than half especially on 1st, 2nd and 3rd abdominal segments (Fig. 1d). In the female, median black stripe is linear but slightly. Legs: Hind tibia irregularly bristled, with 3 longer bristles anterodorsally (Fig. 1a).

**Male terminalia:** The Syncercus broadly flattened over its whole length, narrowing to acute apex, with black hairs (Fig. 2a). The Surstylus is long and thin at most half as long as the Syncercus (Fig. 2a, b). The Postgonite broad, provided with curved tip and strong bristle approximately on the anterior margin (Fig. 2b). The Epandrium is broadly haired (Fig. 2a, b).

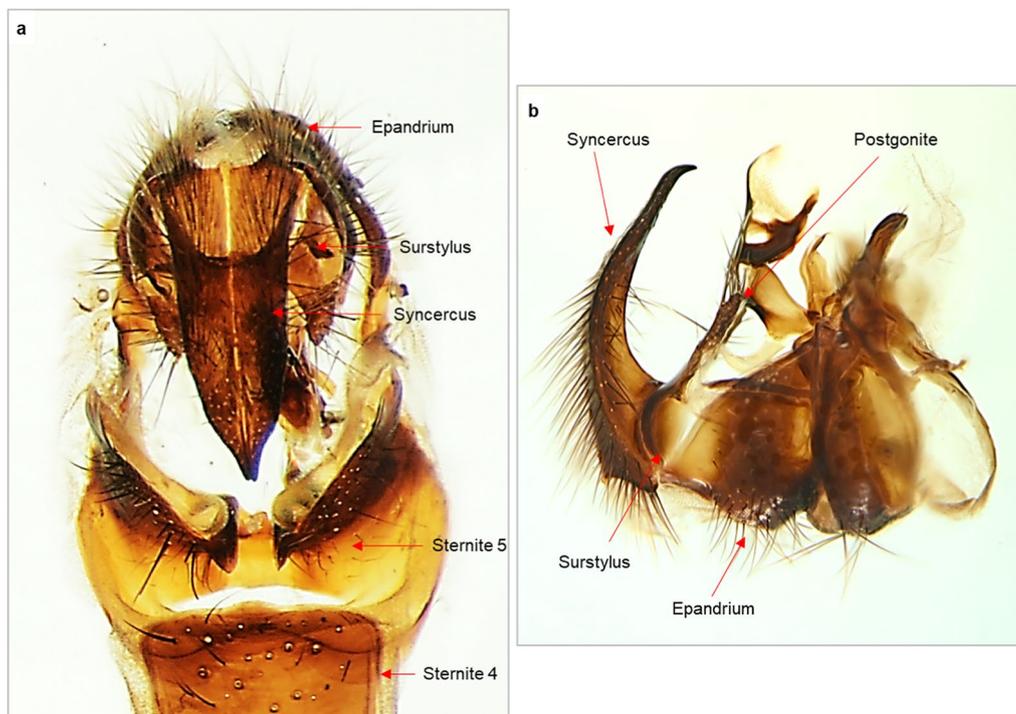
**Female ovipositor:** In ventral view, the sternite with short base and wider than long. Paraproct elongated and slightly narrowed (Fig. 3a). Long and rectangular sternite with long bristles (Fig. 3a). The dorsal and the lateral views display the circus elongated and narrow (Fig. 3b, c). The female has one spermatheca (Fig. 3a).

## Discussion

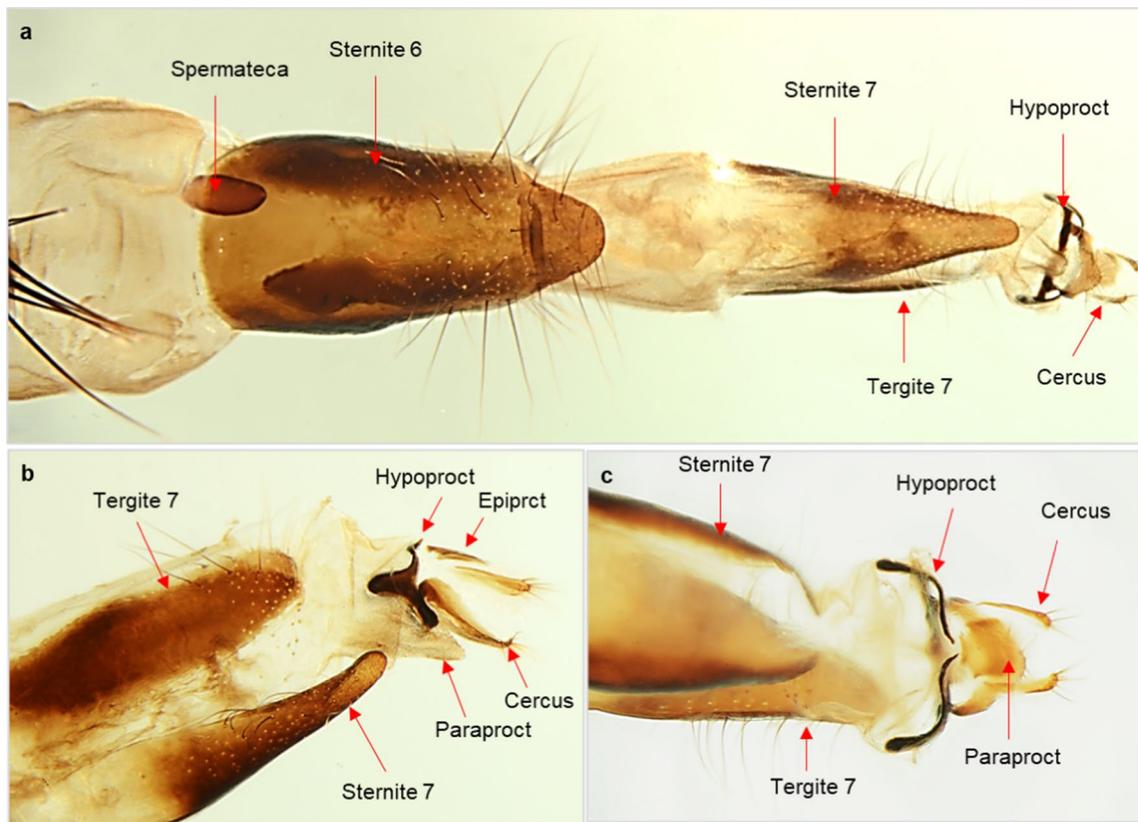
Tachinids are found in nearly all terrestrial environments throughout the world including deserts, forests, grasslands, mountains, and tundra, and at times may constitute a large proportion of flies observed in particular

habitats (Stireman et al. 2006). Many studies have shown that tachinid oviposition behavior can be elicited in response to tactile-chemosensory cues associated with the host's cuticle (Burks and Nettles 1978), and laying can take place on, in the host, outside of it, or in the biotope it frequents (food or passageway). For species of the genus *Exorista*, females lay unincubated eggs on the caterpillars and beetle larvae (Livory et al. 2011). In Tunisia, Tachinid flies have so far remained very poorly studied. *E. segregata* was reported for the first time by Rabasse and Babault in 1975 on larvae of *Lymantria dispar* (Lymantriidae) in the Northwestern of the country and on *Psilogaster loti* (Lasiocampidae) in Djerba (coast of Tunisia in the southern part of the Gulf of Gabes). Kugler (1963) recorded it also as a parasitoid of *Orgyia dubia* in many localities in the Middle East. This species was also known as a parasitoid of *L. dispar* in Southern Europe (Sabrosky and Reardon 1976) and was introduced into the biological control program against this pest between 1906 and 1907. Then, this tachinid fly was introduced against Pine processionary moth, *Thaumetopea pityocampa* in the Southern Europe (de Boer and Harvey 2020) and thereafter Northern Africa.

Diptera male terminalia is a key morphological source of characters used to distinguish and demonstrate diversity of species (Sinclair et al. 2013). In this study, the characters confirm the identification of



**Fig. 2** Male terminalia of *E. segregata*; **a** ventral view; **b** lateral view



**Fig. 3** Ovipositor of female of *E. segregata*: **a** ventral view; **b** lateral view; **c** dorsal view

the specimens as *E. segregata*. Thus, based on what is known about this species and in the light of the above information, this paper presents a first detection of *E. segregata* as a parasitoid of the larvae of *O. trigotephras* in Tunisia.

## Conclusions

In Tunisia, the diversity of Tachinidae is poorly studied. Therefore, more investigations are needed to understand the biology of these dipteran parasitoids as they are important group for reducing populations of many forest pests. In addition, these species could be used in the programs of Integrated Pest Management in Tunisia and neighboring countries.

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## Author contributions

SH designed the project, performed the field and laboratory work and wrote the paper. OE planned and designed the research experiments, performed data analysis and reviewed the paper. CB performed the morphological identification of Diptera parasitoids and reviewed the paper. MLB supervised and provided funding acquisition, administration and validation. All authors read and approved the final manuscript.

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## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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