

## The American genus *Trichopoda* (Diptera: Tachinidae) in Europe – Decades of a misidentified invasive species

With 2 figures

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### Abstract

Despite its importance for biological control of heteropteran pests (Hemiptera) and remarkable features, the taxonomy of the genus *Trichopoda* remained confusing for a long time. Due to a recent taxonomic revision, new information about its species real distribution and host records were found out. An invasive species of the genus has been recorded for Europe for decades, but it has been misidentified as *Trichopoda (Galactomyia) pennipes* for a long time. Here we present the correct name for that alien species, *Trichopoda (Galactomyia) pictipennis*. Some comments about the identification of *Trichopoda* species introduced in other areas, such as Australia, are also made. The correct species identification, as well as the correct host records, is crucial for future studies regarding biological control, and to understand the possible impacts that this invasive species could cause to the local environment.

### Key words

Phasiinae, parasitoid, Hemiptera, alien species

### Zusammenfassung

Trotz ihrer Bedeutung für die biologische Bekämpfung von schädlichen Wanzenarten (Hemiptera) und ihrer außergewöhnlichen Merkmale, blieb die Taxonomie der Gattung *Trichopoda* lange Zeit verwirrend. Aufgrund einer kürzlich durchgeführten taxonomischen Revision wurden neue Erkenntnisse über die tatsächliche Verbreitung und über die Wirte der Arten gewonnen. Eine invasive Art der Gattung ist seit Jahrzehnten auch aus Europa bekannt, wurde jedoch lange Zeit fälschlicherweise als *Trichopoda (Galactomyia) pennipes* bezeichnet. Der korrekte Name für dieses Neozoon ist *Trichopoda (Galactomyia) pictipennis*. Weiterhin werden auch einige Bemerkungen zur Identifizierung von *Trichopoda*-Arten gemacht, die in anderen Gebieten, wie Australien, eingeführt wurden. Die korrekte Bestimmung der Arten ist ebenso wie die richtige Zuordnung der Wirtsbefunde von entscheidender Bedeutung für zukünftige Studien im biologischen Pflanzenschutz und zum Verständnis der möglichen Auswirkungen, die diese invasiven Arten auf die lokale Umwelt haben könnten.

## Stichwörter

Phasiinae, Parasitoide, Hemiptera, Neozoen

## Introduction

*Trichopoda* BERTHOLD, 1827, is probably one of the most remarkable genera of Tachinidae. Both by its stunning morphological features, such as the bright colors and the feather-like setae on the hind tibia, as well as for its importance in biological control, having as host innumerable important heteropteran pests (DIOS & NIHEI 2020). Despite its importance, the genus historically had a problematic taxonomy, with many described and synonymized names. The genus has a complicated morphology, as most species have sexual dimorphic features and also presents polymorphism, which contributed to its taxonomic problems. A morphological revision has been published recently (DIOS & NIHEI 2020), which provides a better understanding of the genus and its species boundaries. However, as the mentioned revision points out, more studies need to be done to fully understand some of its species and their boundaries.

The importance of *Trichopoda* species for biological control have been noted, and different studies dealt with their biology and the relationship between some of its species and their hosts (WORTHLEY 1924a, b; BEARD 1940, LILJESTRÖM 1992). For their importance controlling pests, some species of this New World genus have also been introduced in different parts of the world, such as in Hawaii, Australia, South Africa, New Zealand and Fiji Islands (DAVIS 1964, RAO et al. 1971, MICHAEL 1981, JONES 1988, BERG et al. 1994). In some cases, these introductions occurred accidentally, as happened in Europe (COLAZZA et al. 1996). There, the introduction occurred in Italy, with the first record of a *Trichopoda* in Europe from 1983 (TSCHORSNIG et al. 2012). Later, these flies were recorded in different places in Europe, such as Albania, Croatia, Cyprus, France, Germany, Greece, Malta, Netherlands, Portugal, Russia, Slovenia, Spain, Switzerland (COLAZZA et al. 1996, TSCHORSNIG et al. 2000, GROOT et al. 2007, ZEEGERS 2010, BYSTROWSKI 2012, OBRECHT 2014, PÉTRÉMAND et al. 2015, ALTMANN 2018, KAZILAS et al. 2020, ZIEGLER & STANDFUSS 2020) and even in Western Asia, in Israel (FREIDBERG et al. 2011), Turkey (KAZILAS et al. 2020), and in northern Africa in Egypt (EL-HAWAGRY et al. 2020). If the species was introduced several times, or if all specimens come from a single introduction with a posterior population spread is still unknown.

However, due to their complex taxonomic history and morphological similarities, some of these introduced species were wrongly identified along history. In this publication, we intend to elucidate some of these misidentifications, and give correct names to these introduced species of *Trichopoda* in Europe, Western Asia, Northern Africa, Australia, New Zealand, and Hawaii. This helps in

the interpretation of previous records and in the preparation of future studies.

## Material & Methods

Specimens were examined from different European countries (France, Italy, Greece). These specimens were from the second author personal collection (CZB), the third author personal collection (CTZS) and specimens from the personal collection of Lisa and Klaus Standfuss, Dortmund, Germany (CSD):

- 1 ♂ photographed, label data: “Frankrijk [= France] / Lot et Garonne / Buzet sur Balsie / 15-10-2003 / leg. Pennards” (CTZS).
- 1 ♂ dissected, label data: “France, Pyr. Or. / Estagel / Juni 2000 / leg. Pyr. Excursie / Diertax. Wageningen” (CTZS).
- 1 ♂ label data: “Siena, IT [= Italy] / Pontignano / 15-05-2000 / M. Willemse” (CTZS).
- 1 ♀ label data: “GREECE: Crete, Heraklion reg. / Selena mountain range, valley / southwest of Krasi S of Malia / 35°13'50"N 25°27'49"E / 30.iv.2018, 580 m / leg. C. Lange & J. Ziegler // 37.183 [= coll. no.]” (CZB).
- 1 ♂ same data as previous except “10.v.2018 // 37.005 [= coll. no.]” (CZB).
- 1 ♀ label data: “GREECE: Thessalia, Peninsula Pilio / Notio Pilio, village Platania / approx. 39°08'N 23°16'E, 5.ix.2014, 0–5 m / leg. K. Standfuss, coll. Ziegler // 36.125 [= coll. no.]” (CZB).
- 2 ♀ ♀ label data: “Platania/Volos /14.9.2018 / leg. Lisa Standfuss” (“Platania/Volos” means Greece, Thessalia, Peninsula Pilio near village Platania) (CSD).
- 1 ♂ same data as previous except “23.9.2018” (CSD).
- 1 ♂, 1 ♀ same data as previous except “15.9.2018 / leg. K. Standfuss” (CSD).

The first author also examined some specimens deposited at the State Museum of Natural History Stuttgart.

Specimens were examined using a Leica EZ4 stereomicroscope. For examining the terminalia, specimens were placed in a moist chamber for 48 to 72 hours, then the last abdominal segments were dissected and placed in a 10 % potassium hydroxide solution (KOH). The solution was heated for 5 to 7 minutes. Then, to neutralize the KOH, the terminalia were put in a 10 % solution of acetic acid for 2 minutes and carefully washed with water. After study, the terminalia were placed in glycerin in small tubes pinned under their corresponding specimens.

## Results and Discussion

From the examined specimens and their terminalia, we can conclude that the species introduced accidentally in Europe is actually *Trichopoda (Galactomyia) pictipennis* BIGOT, 1876, and not *T. (Galactomyia) pennipes* FABRICIUS, 1781 as it was previously assumed. The species are relatively similar, and the real boundaries of *T. pennipes* were not very clear before the revision of the genus was made. Both species can be identified following the key, redescriptions, illustrations and images provided in DIOS & NIHEI (2020). Examining both males and females, from different European

of KAZILAS et al. (2020). Only the species records by ZIEGLER & STANDFUSS (2020) are not published as *Trichopoda pennipes*, but as an unknown species similar to *T. giacomellii* sensu SANDS & COOMBS (1999) – a misinterpretation of *T. pictipennis*. The real *T. giacomellii* (BLANCHARD, 1966) is now a synonym of *T. pennipes*. Also examining photos from online sources (Academy & National Geographic 2021), we can observe only specimens of *T. pictipennis* (photos of the black colored female, and the males more brownish to yellow colored, with large yellow markings on the wing).

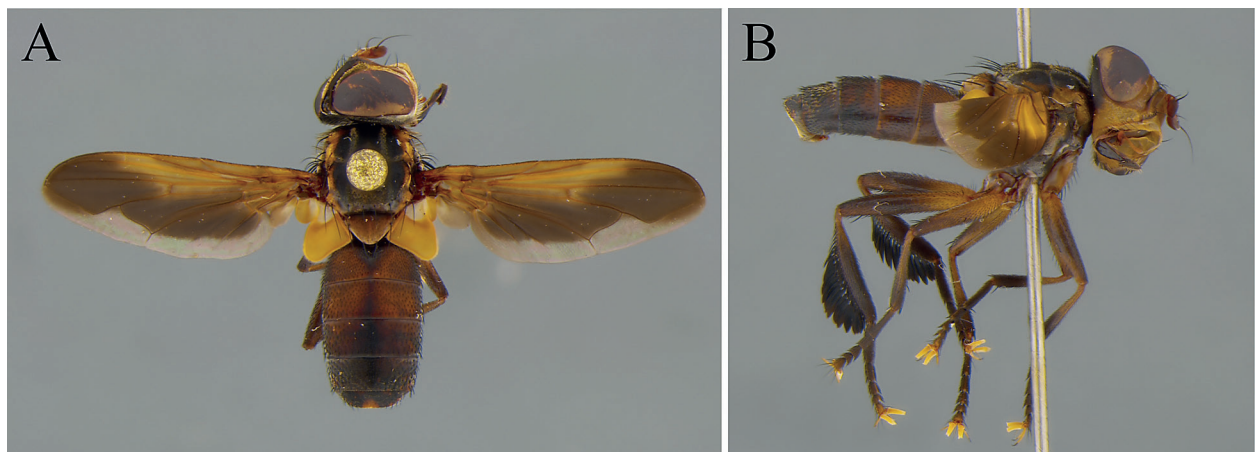


Fig. 1: *Trichopoda (Galactomyia) pictipennis*, ♂ (France, Lot-et-Garonne). A. Dorsal habitus. B. Lateral habitus. Body length 9 mm.

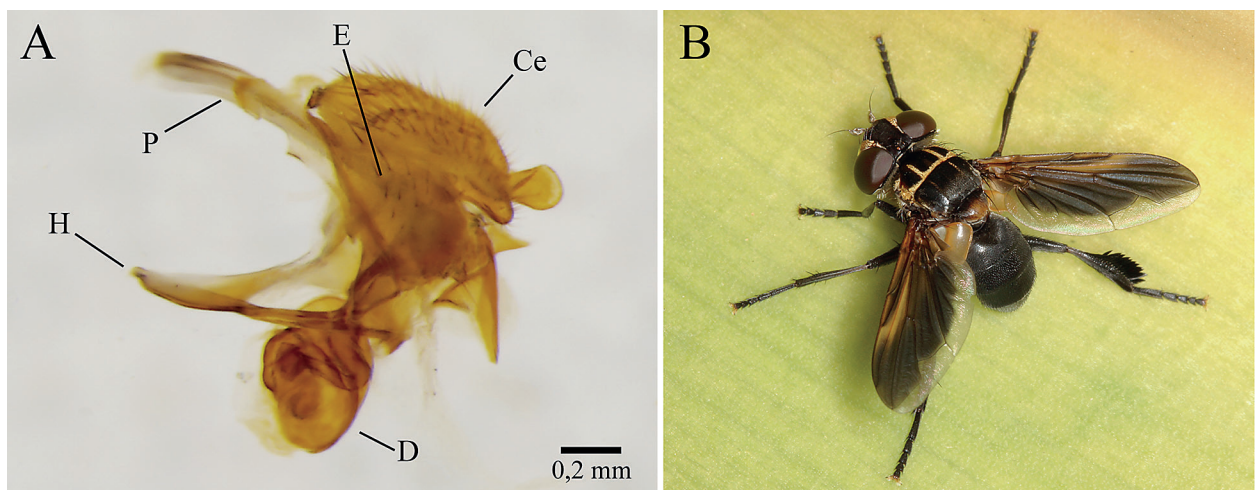


Fig. 2: A. *Trichopoda (Galactomyia) pictipennis*, ♂ (France, Estagel), dissected terminalia, left lateral view. Abbreviations: Ce = cerci, D = distiphallus, E = epandrium, H = Hypandrium, P = phallopodeme. B. Living ♀ of *Trichopoda (Galactomyia) pictipennis* on a leaf of *Drimia maritima*, showing the characteristic darker body coloration (Greece, Crete). Body length 9 mm.

localities, we can say that apparently only *T. pictipennis* is established there. In a recent publication (DARMANIN & CERRETTI 2019) recording the first *Trichopoda* for Malta, there is a photograph of a male, which is clearly *T. pictipennis*; the same can be said about the specimens from Croatia published in BYSTROWSKI (2012) and from Switzerland (OBRECHT 2014, PÉTREMAND et al. 2015) and also the nice photographs in the paper

COLAZZA et al. (1996) suggests that the accidental introduction in Europe probably came from North America, due to the intense freight exchanges between the United States and Italy. However, knowing that the species was wrongly identified, the introduction probably came from South or Central America, as there are no records of *T. pictipennis* for the Nearctic Region.

The specimens introduced in Australia and New Zealand are also *T. pictipennis*, based on terminalia illustrations (DIOS & NIHEI 2020) and photographs, but were previously identified as *T. giacomellii* (SANDS & COOMBS 1999). The population of *Trichopoda* there is apparently not so well established, but seems permanent, as there are some photographic records throughout Australia and one from New Zealand (Academy & National Geographic 2021). Maybe that could indicate some adaptability of *T. pictipennis* to different environments and hosts, and more studies could elucidate that.

In Australia, the species were introduced aiming to control *Nezara viridula* (LINNAEUS, 1758), but they can parasitize and develop in some native species, at least in laboratory conditions (SANDS & COOMBS 1999). In Hawaii there are suggestions that a *Trichopoda* species could have reduced the population of native nontarget fauna (HOWARTH 1991). In that case, the species introduced was *T. (Galactomyia) eupilipes* DIOS & NIHEI, 2020, previously identified as *T. (Galactomyia) pilipes* (FABRICIUS, 1805) (DIOS & NIHEI 2020). As for its hosts in Europe, despite the invasive *N. viridula*, there was a single record for the native *Graphosoma lineatum* (LINNAEUS, 1758) (COLAZZA et al. 1996).

The correct identification of species to export for biological control or even accidentally introduced invasive species is crucial aiming for better pest control efficiency and also avoiding negative impacting local communities. Many of the previous studies with *Trichopoda* species deal with *T. pennipes*, but some of these are really dealing with a different species. A review of these previous studies and the attribution of their data to the correct species would be important.

A next step could be to study these populations of *T. pictipennis* in Europe and Western Asia genetically, aiming to understand the relationships between their populations. It could enlighten the fact if there were different introductions in the western Palaearctic or only one. That would be interesting considering the biological control aspect, and possible future uses of this species. More research should also be done to check if native heteropterans are being used as host in Europe, which could be affecting local communities.

#### Updated host list

*Trichopoda pictipennis* BIGOT, 1876

Hemiptera–Pentatomidae

*Graphosoma lineatum* (LINNAEUS)–COLAZZA et al. (1996), as a single case record for *T. pennipes*

*Thyanta perditor* (FABRICIUS)–LUCINI et al. (2020)

*Nezara viridula* (LINNAEUS)–DIOS & NIHEI (2020)

#### Under laboratory conditions:

*Glaucias amyioti* (DALLAS)–SANDS & COOMBS (1999)

*Plautia affinis* (DALLAS)–SANDS & COOMBS (1999)

*Alciphron glaucus* (FABRICIUS)–SANDS & COOMBS (1999)

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