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The Tachinid Times

Issue 30

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February 2017

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This newsletter is distributed near the end of February each year. It is published simultaneously in hardcopy and online, both based on the same PDF generated from an InDesign file. Hardcopies are distributed to several libraries and to a few readers who request them.

INSTRUCTIONS TO AUTHORS

This newsletter accepts submissions on all aspects of tachinid biology and systematics. It is intentionally maintained as a non-peer-reviewed publication so as not to relinquish its status as a venue for those who wish to share information about tachinids in an informal medium. All submissions are subjected to careful editing and some are (informally) reviewed if the content is thought to need another opinion. Some submissions are rejected because they are poorly prepared, not well illustrated, or excruciatingly boring.

Authors should try to write their submissions in a style that will be of interest to the general reader, in addition to being technically accurate. This is a newsletter, not *Science* or *Nature*. Illustrate submissions with high quality images sent as separate files at the same time as the text. Text files sent with embedded images will not be considered for publication. All content should be original; if copyrighted material (online or in print) is used then permission from the copyright holder is needed. Submitted pictures of tachinids in the field will be considered for the cover, table of contents, or a special section in the newsletter.

Student submissions are particularly welcome. Writing about a thesis study or a side project involving tachinids is a good way to inform others about a study that is underway before it has generated formal publications.

Please send submissions for the 2018 issue of *The Tachinid Times* to the editor by the end of January 2018.

FRONT COVER *Paradejeania rutilioides* (Jaennicke) (Tachininae, Tachinini) on an oak leaf (*Quercus* sp.) in New Canyon, Manzano Mountains, New Mexico, USA. This is one of the largest tachinids in North America with a body length of ca. 17 mm.
Photo: J.E. O'Hara, 13 August 2016

TABLE OF CONTENTS *Pararchytas decisus* (Walker) (Tachininae, Tachinini) feeding from a flower in Sandys Canyon south of Flagstaff, Coconino National Forest, Arizona, USA.
Photo: J.E. O'Hara, 1 September 2015

BELOW Dusk descends on Valley of the Gods south of Bluff, southeastern Utah, USA.
Photo: J.E. O'Hara, 4 August 2016

Side effects of essential oils of *Monarda fistulosa* L. and *M. didyma* L. on the tachinid parasitoid *Exorista larvarum* (L.): a preliminary study

by Santolo Francati and Greta Gualandi

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This study was performed in the laboratory of Entomology at DipSA (University of Bologna). This was the subject of Greta's B.Sc. thesis and was performed under the supervision of Maria Luisa Dindo and the co-supervision of Santolo Francati.

Essential oils (EOs) are secondary metabolites produced by plant flowers, resin, wood, roots, fruits, seeds, and leaves. Although they are not fundamental for plant life, they may play important roles for plant survival, including defense against bacteria and fungi (Preuss *et al*. 2005, Zhilyakova *et al*. 2009). Moreover, larvicidal, repellent, ovicidal and anti-oviposition effects of EOs on different herbivore insect species have been shown (Isman 2000, Isman 2006, Masetti 2016).They also contain "essences", which confer characteristic scents to many fragrant plant species.

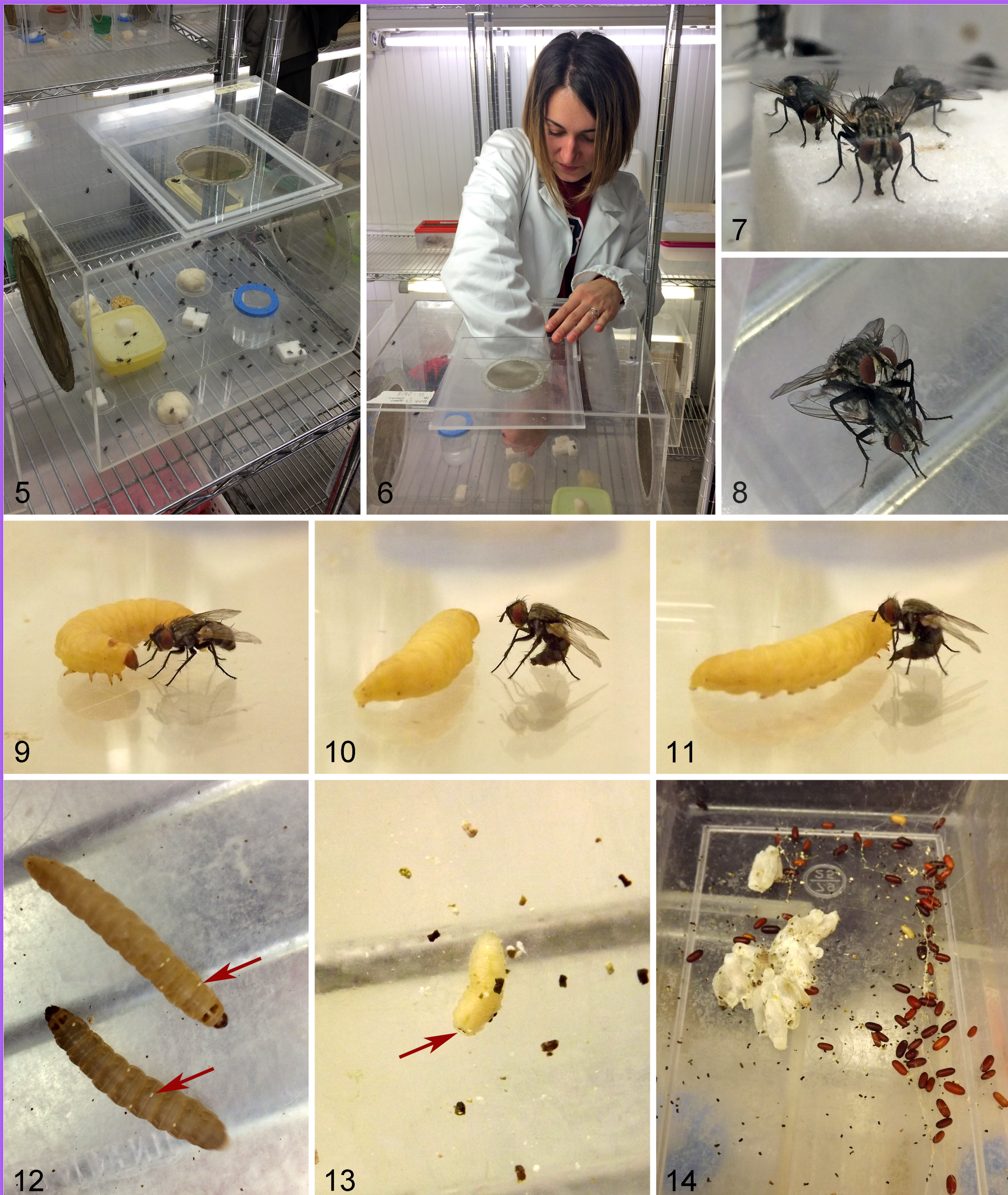
In recent years, following an increasing interest in sustainable pest control methods in agriculture, EOs have received growing attention as components of natural agrochemicals. This is because, besides their properties against the target microorganisms and insects, they show high volatility, low persistence and, in general, low toxicity to non-target animals (Isman 2006). Knowledge on this issue, in particular on the side effects of EOs on beneficial insects, is, however, still limited (Tillman 2008).

Monarda is a genus in the family of Lamiaceae endemic to North America. It includes annual and perennial flowering plants, some of which can grow up to 150 cm tall (Bellardi 2014). Many species are grown as ornamentals in different countries, because the flower color varies from red to pink or light purple. *Monarda* plants produce a high quantity of EOs and several species, including *Monarda fistulosa* L. (Wild bergamot, Figs. 1–2) and *M. didyma* L. (Oswego tea, Figs. 3–4), have a long history of use as medicinal plants by Native Americans. There are still few scientific studies on this topic (Zhilyakova *et al*. 2009).

Figures 1–4. 1–2. Plant and flowers of *Monarda fistulosa*. **3–4**. Plant and flower of *Monarda didyma*. (All photos by M.G. Bellardi)

Since 2012, in the framework of a project led by the Department of Agricultural Sciences (DipSA) of the University of Bologna (Italy), research has been conducted to verify the potential of the EOs of *Monarda* spp. in different fields, including plant protection from pathogens. As regards this issue, Minardi *et al*. (2016) showed that *M. didyma* and *M. fistulosa* EOs have an antimicrobial activity against *Pseudomonas syringae* pv. *actinidiae*, the causal bacterial agent of kiwifruit canker disease.

Our preliminary study was carried out as part of the above-mentioned project and was aimed at starting the assessment of the possible side effects of *M. didyma* and *M. fistulosa* EOs, in the event that they are used in agro-eco-



Figures 5–14. Rearing of *Exorista larvarum*. **5**. Cage with *E. larvarum* adults. **6**. Greta Gualandi changes the food in rearing cage. **7**. Flies feed on sugar cubes. **8**. Mating pair of *E. larvarum*. **9–11**. Oviposition sequence. **9**. Female fly locates a *Galleria mellonella* caterpillar. **10**. Fly prepares to oviposit. **11**. Fly extends ovipositor just before depositing an egg on the caterpillar. **12**. Multiple eggs on *G. mellonella* caterpillars (two eggs indicated by arrows). **13**. A mature *E. larvarum* larva has exited its host prior to pupariation. **14**. Puparia of *E. larvarum*. (Photos by G. Gualandi except for Fig. 6 by S. Francati)

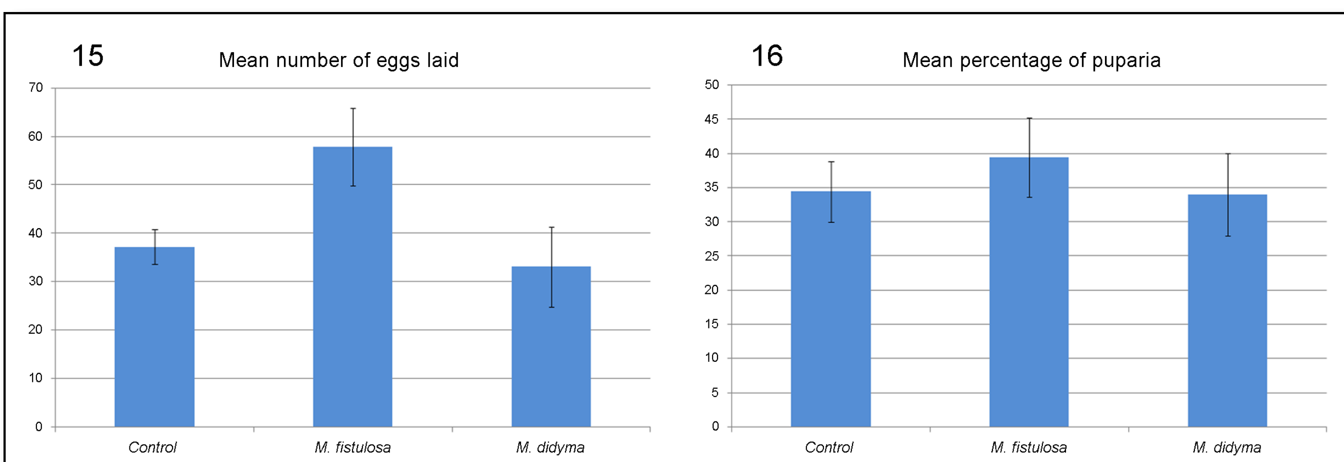
systems to control target plant pathogens or insect pests. More specifically, laboratory studies were conducted to assess the side effects on adult longevity and reproduction capacity of the tachinid *Exorista larvarum* (L.), which was selected as a model non-target species. *Exorista larvarum* is a polyphagous gregarious larval parasitoid of Lepidoptera, well distributed throughout Europe, northern Africa, and several Asian regions (Herting 1960, Cerretti & Tschorsnig 2010). In the 20th century, it was also used in inoculative releases against the gypsy moth, *Lymantria dispar* (Drury), in the northern United States and became established (Sabrosky & Reardon 1976).

A laboratory colony of *E. larvarum* was maintained in a rearing chamber (26 ± 1°C, 75 ± 5% RH, 16:8 L:D) at DipSA, using *Galleria mellonella* (L.) (Lepidoptera: Pyralidae) as a factitious host (Figs. 5–14). The flies were fed on sugar cubes and cotton balls soaked in a honey and water solution (Dindo *et al*. 2016). *Monarda didyma* and *M. fistulosa* EOs were hydrodistilled from the aerial parts of plants grown in the "Giardino delle Erbe" (Herb Garden) located in Casola Valsenio (Emilia Romagna Region, Italy) (Contaldo *et al*. 2011) and were supplied by M.G. Bellardi of DipSA. Their composition is given in Table 1.

Compound	***M. didyma***	***M. fistulosa***
α-caryophyllene	-	0.11 ± 0.01
β-caryophyllene	-	0.16 ± 0.01
Δ 3-Carene	4.45 ± 0.09	2.67 ± 0.04
δ-Cadinene	-	0.21 ± 0.02
α-Copaene	0.11 ± 0.01	-
α-Phellandrene	0.88 ± 0.04	14.21 ± 0.09
β-phellandrene	0.15± 0.01	18.08 ± 0.09
α-Pinene	0.21 ± 0.02	1.51 ± 0.03
β-Pinene	-	2.11 ± 0.06
α-Terpineolo	-	0.25 ± 0.05
γ-Terpinolene	9.26 ± 0.19	-
α-Thujene	-	1.88 ± 0.04
α-humulene	0.11 ± 0.01	-
1-Octen-3-olo	2.01 ± 0.11	-
Camphene	3.11 ± 0.09	-
Carvacrol methyl ether	-	3.99 ± 0.04
Epi-biciclosesquifellan-drene	0.12 ± 0.02	-
Germacrene D	0.35 ± 0.05	1.31 ± 0.04
Limonene	1.08 ± 0.04	-
Linalool	0.52 ± 0.03	-
myrcene	3.23 ± 0.08	8.81 ± 0.08
p-Cymene	10.57 ± 0.11	13.11 ± 0.09
Thymol	63.73 ± 0.23	31.59 ± 0.13
Thymol methyl ether	0.11 ± 0.01	-

Table 1: Chemical composition (%) of *Monarda didyma* and *M. fistulosa* essential oils (EOs). (Modified from Epifano 2014)

The experiment was conducted in 2015 and all tests were performed under the same controlled conditions described above. Newly emerged *E. larvarum* adults, obtained from the standard colony, were paired and placed inside 20x20x20 cm Plexiglas cages (1 couple per cage). For every replicate, 3 couples were tested, each corresponding to a treatment. The couples were exposed to sugar cubes respectively treated with 1 mL of either *M. didyma* (couple 1) or *M. fistulosa* (couple 2) EO solution diluted to 0.01% (Mattarelli 2014), or with distilled water (couple 3, maintained as control). Fifteen replicates were carried out, for a total of 45 couples. As the preoviposition period of *E. larvarum* lasts about three days, from the 3rd day after pairing, three *G. mellonella* mature larvae were daily exposed to each couple for 5 days, in order to verify the parasitoid female oviposition capacity (Dindo *et al*. 1999). The larvae were removed from



Figures 15–16. 15. Mean number (± SE) of eggs laid by *E. larvarum* females during the five days of observation. **16**. Percentages (mean ± SE) of *E. larvarum* puparia obtained from eggs.

cages after about 1 hr and the eggs that had been laid on their body were counted. The larvae were then placed in the rearing chamber inside 6 cm diameter plastic cups until puparium formation. The parameters considered for the result evaluation were the adult parasitoid mortality (= total number of dead adults), the mean number of eggs laid by females in the experiment period (= 5 days) as an estimate of fecundity, the percentages of puparia obtained from eggs (number of puparia/ number of eggs x 100), the percentages of adults emerged (number of adults/ number of puparia x 100) and the sex ratio (calculated as percentage of the adult females). The data for mortality were pooled for the 15 replicates and they were analyzed by 2x2 contingency tables using Yates correction for small numbers (<100). The other parameters were analyzed by One-way ANOVA. The percentages values were transformed for the analyses by the ARCSIN transformation (Mosteller & Youtz 1961). All statistical tests were done with STATISTICA 10.0 (StatSoft 2010).

The number of dead adults was the same (= 6) in the control and in the flies treated with *M. fistulosa* EO. This number was lower than that observed in the flies treated with *M. didyma* EO (= 9). We compared the data of the two EOs and the difference was not significant ($\chi^2 = 0.36$; df = 1, P = 0.55). Moreover, no significant difference was found among the two EOs and the control for the mean number of eggs laid by females (F = 3.64; gl = 2.12; P = 0.058), although the females exposed to *M. fistulosa* EO laid more eggs (Fig. 15). Also, for the mean percentages of puparia (F = 0.29; df = 2.12; P = 0.775) (Fig. 16) and of adults (F = 0.19; df = 2.12; P = 0.83) and for sex ratio (F = 0.18; df = 2.12; P = 0.775), no significant differences were found among treatments.

In conclusion, the results of our preliminary laboratory study did not show significant side effects of *M. didyma* or *M. fistulusa* EOs on *E. larvarum*, for any of the considered parameters. Survival and reproductive capacity, however, tended to be lower for the flies supplied with *M. didyma* EO compared with those treated with *M. fistulosa* EO and control flies. This tendency may be attributed to the different chemical composition of the two EOs and, in particular, to the higher thymol content found in *M. didyma* than in *M. fistulosa* oil (Table. 1). Thymol is the most abundant individual compound in thyme oil and has been proven to have pesticidal properties (Tak *et al*. 2016) also against *Varroa destructor* (Anderson & Trueman), a parasitic mite that attacks honeybees (Leza *et al*. 2015). It cannot be excluded, therefore, that *M. didyma* EO, rich in thymol, may, in the long run, affect *E. larvarum* fitness. Further research is necessary, also at a field level.

Acknowledgements

This study was performed under the project "Cultivation and marketing experience of *Monarda fistulosa* and *M. didyma* in farms of five Italian regions for insertion into ornamental, horticultural and medicinal market; antimicrobial evaluation of essential oil in Agriculture and in human and veterinary medicine" funded by Fondazione Cassa di Risparmio di Imola (Bologna, Italy) (coordinator: Maria Grazia Bellardi).

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A NEW TACHINID GENUS AND SPECIES RECORD FOR NORTH AMERICA: *ICELIOPSIS BORGMEIERI* GUIMARÃES

by John O. Stireman III[1] and Jane E. Dell[2]

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INTRODUCTION

The Iceliini are a small, enigmatic New World tribe of Tachininae consisting of three genera, *Icelia* Robineau-Desvoidy, *Iceliopsis* Guimarães, and *Erviopsis* Townsend, and five recognized species (Guimarães 1976). All known species are exclusively Neotropical in distribution with the exception of *Icelia triquetra* (Olivier), which ranges from Brazil, through Central America, and as far north as New York state (O'Hara & Wood 2004). Members of the tribe are generally medium-sized (ca. 7–12 mm), elongate, yellowish or grayish in color, and resemble Dexiini or Leskiini in general appearance. Species of Iceliini are relatively rarely collected and there is but a single host record (Lepidoptera; see below). Here, we report on the discovery of a specimen of *Iceliopsis borgmeieri* Guimarães from the U.S. state of Florida, a species never before recorded outside of Brazil.

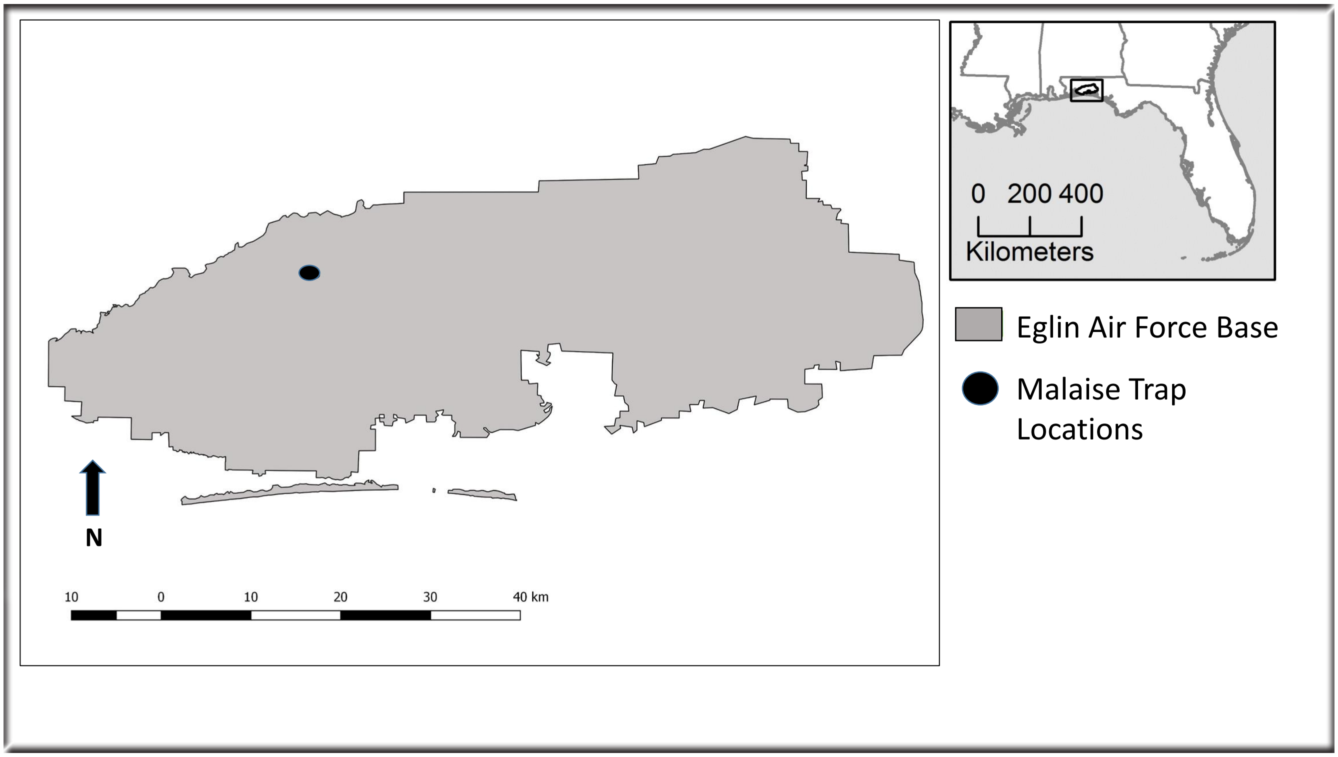


Figure 1. Map of Eglin Air Force Base (EAFB) located within the panhandle of Florida, USA. The left panel shows the location within EAFB of the burn units where specimen was captured.

COLLECTION AND IDENTIFICATION

The specimen reported here was collected during the course of a large scale ecological study examining the effects of fire on insect communities in the fire-dependent longleaf pine (*Pinus palustris*) forests at Eglin Air Force Base (EAFB) in northwest Florida (Fig. 1). EAFB is over 180,000 ha in size, is home to over half of the remaining stands of old-growth longleaf pine and is actively managed by prescribed fire on a 2–5 year return interval (Varner *et al*. 2005, Holliday 2001, Hiers *et al*. 2007). The climate is typified by hot, humid summers with frequent thunderstorms and lightning strikes, mild winters, mean annual temperature of 18.3°C, and 1580 mm of annual precipitation (Provencher *et al*. 2001). The area has little topography (0–100 m ASL) and is dominated by well-drained Lakeland series soils. Xeric sandhills and mesic flatwoods are the dominant vegetative communities found at EAFB. Longleaf pine is a foundation species and is typically monodominant in the overstory with a relatively open canopy throughout the site and high levels of understory plant diversity. The xeric sandhills habitat is comprised of shrubby hardwood species such as turkey oak (*Quercus laevis*), blackjack oak (*Q. incana*), and persimmon (*Diospyros virginiana*). The understory vegetation is dominated by several grasses, such as wiregrass (*Aristida stricta*), little bluestem (*Schizachyrium scoparium*), broomsedge (*Andropogon virginicus*), as well as dwarf huckleberry (*Gaylussacia dumosa*), evergreen blueberry (*Vaccinium darrowii*), runner oak (*Quercus minima*), saw palmetto (*Serenoa repens*), and gallberry (*Ilex glabra*).

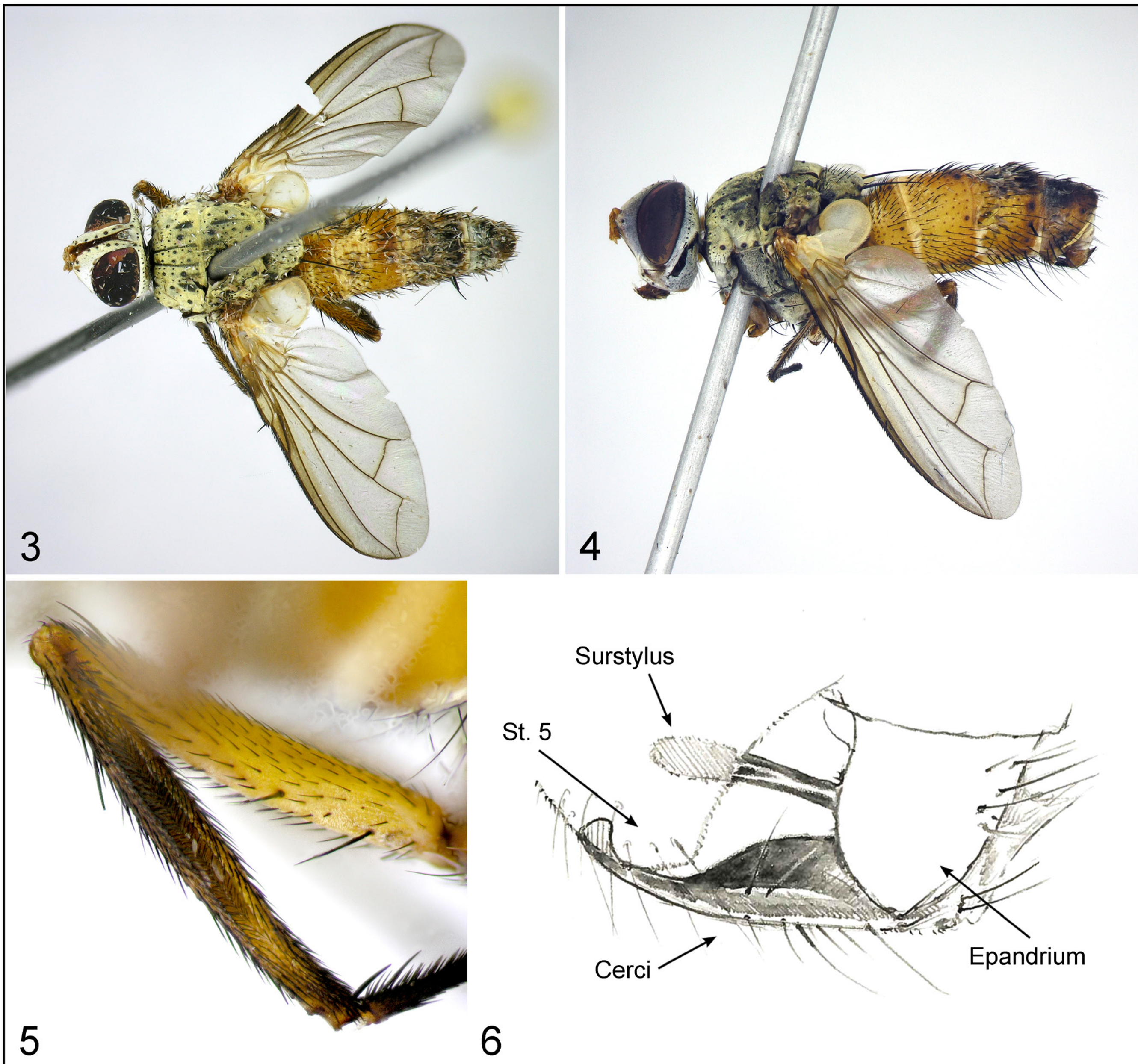
Figure 2. Malaise trap erected immediately after a prescribed fire in a longleaf pine forest. Traps were set up seven times in relation to each burn (before, during, immediately after, and then 2, 5, 10, and 12 months post-burn) to track the effects fire had on insect communities.

To address the question of the impact of fire on insect communities, a series of six, georeferenced Malaise traps (BioQuip Products Inc., model #2875AG) were erected to sample before, during, and five periods post-fire (immediately after, then at 2, 5, 10, and 12 months) (Fig. 2). Sampling was done in conjunction with three separate fires conducted as part of regular management burning in late May 2014.

One Malaise trap, sampled two months post-burn in a xeric sandhills stand, captured a male of *Iceliopsis borgmeieri*. The information from the three labels is as follows (a diagonal line [/] indicates a new line on the label:

(1) FL: Okaloosa Co./ Eglin Air Force Base/ 30.60997, -86.70266/ Malaise 8-July-2014/ J.E. Dell Earthwatch
(2) FL: Okaloosa Co./ Burn Block 3, Trap#6/ Earthwatch/ 8 July 2014 [original locality label]
(3) FL-S-M2708 [QR (quick response) code label with reference number for database]

Unfortunately, the specimen is in poor condition, lacking postpedicels, most legs, many bristles, and with one wing broken (Figs. 3, 4). In an attempt to remove the dusting of moth scales that covered the body, further damage was done to an already broken right wing (shown in its original condition in Fig. 3) and the distal portion was lost. Despite its poor condition, the specimen clearly matches *Iceliopsis*. Most crucially, the hind tibia is "…swollen on middle, with a longitudinal hairy groove on inner side" (Guimarães 1976: 175) (Fig. 5), an unusual trait in Tachinidae. In addition, the specimen possesses setal sockets for three strong genal bristles (*Icelia* has one or two) and abdominal syntergite 1+2 bears sockets indicating the presence of a pair of strong marginal setae (lacking in *Icelia*). In addition to these characters, the cerci and to a lesser extent the surstyli are somewhat exposed and bear a clear resemblance to those of *I. borgmeieri* Guimarães (Fig. 6). In particular, in lateral view the fused (suture-less) cerci terminate in a knob-like process, and the surstyli are slender and elongate, contrasting strongly with the broad, lobate surtstyli of *Icelia triquetra* (Olivier) (the only known North American iceliine). These unique genitalic characteristics, along with features of the external morphology, indicate that the specimen is very likely *Iceliopsis borgmeieri*, or a similar species. It does deviate slightly from the original description of *I. borgmeieri* in having the surstyli slightly spatulate rather than parallel-sided subapically, the dorsum of the thorax yellowish, and the abdomen less black on syntergite 1+2 and tergite 3, but *I. borgmeieri* was described from nine specimens and this difference could be intraspecific variation. We have not yet had the opportunity to compare the specimen directly with the holotype or paratypes in the Museu de Zoologia, Universidad de São Paulo, Brazil (MZSP). The specimen currently resides in Stireman's personal collection at Wright State University (JOSC).



Figures 3–6. *Iceliopsis borgmeieri* specimen from Eglin Air Force Base, Florida. **3**. Dorsal view (note lepidopteran scales covering the specimen from the dry Malaise trap and the apparent lack of black dorsal markings on T1+2 and T3). **4**. Left lateral view. **5**. View of the posterior surface of the left hind tibia illustrating the median, longitudinal groove thickly lined with inwardly pointing setae. **6**. Left lateral sketch of the genital capsule, illustrating the distinctive knobbed cerci and narrow, elongate surstylus. The distal portions of both structures are partially concealed beneath sternite 5 (St. 5), as indicated by the diagonal fill lines.

DISCUSSION

This record of *I. borgmeieri* represents a dramatic expansion of the known range of this genus and species. Previously, the species was only known from a restricted region of the Atlantic coast of southeastern Brazil in the states of São Paulo and Rio de Janeiro (Guimarães 1976). This suggests one of two possibilities, either *I. borgmeieri* is a widespread but rarely collected species (or species complex) across the Neotropical Region and into subtropical North America, or it has recently been introduced to Florida. The first hypothesis is possible, as some other tachinid species are known to exhibit similar broad ranges spanning the Neotropical and Nearctic regions (e.g., *Cholomyia inaequipes* Bigot, de Santis & Nihei 2016). But, it seems unlikely that this species of *Iceliopsis*, with its distinctive characteristics, would have so broad a range and yet not be collected or reported anywhere outside of southeastern Brazil until now. The second possibility seems much more likely.

Both São Paulo and Rio de Janeiro are densely populated states with large ports and extensive shipping trade with North America and elsewhere. Furthermore, Florida (and to a lesser extent the Gulf Coast of the United States) is well known for the hundreds if not thousands of alien tropical species that have colonized and established populations there. It is a likely site for inadvertent tachinid introductions from tropical regions, especially via parasitized hosts that may be associated with agricultural or forestry products.

Only a single host record has been reported for any member of the tribe Iceliini. The species *Icelia guagliumii* Guimarães was reared from *Diatraea impersonates* (Walker), a crambid stem borer of sugar cane (Guimarães 1975, recorded as *D. flavipennella* Box). This is among the most important pests of sugar cane in Brazil, having garnered the common name broca pequena da cana-de açúcar or "small sugar-cane drill" (do Rosário *et al*. 2007). The planidiaform larvae of *I. guagliumii* are likely deposited in the vicinity of entrance holes and crawl through the tunnels in search of host larvae, similar to the strategy of the stem-borer parasitoid *Lixophaga diataeae* (Townsend) (Roth *et al*. 1982). We infer that *Iceliopsis* probably also attacks some sort of stem-boring lepidopteran larvae that might be easily overlooked if transported within host plant tissue from Brazil to the U.S. It may take some time before we understand the distribution of *Iceliopsis borgmeieri* in the United States, what host(s) it is using there, and how it may have been introduced (or if it has been here all along).

NOTES ON ICELIINI SYSTEMATICS

Although the Iceliini were originally placed within the Dexiinae by Townsend (1936), several authors have argued for placement in the subfamily Tachininae based on both larval (Thompson 1963) and adult characters (Guimarães 1976, O'Hara & Wood 2004). Indeed, these flies highly resemble members of the Leskiini in general appearance, although they lack the strongly protruding lower facial margin characteristic of most Leskiini and the palpi are strongly reduced or absent in iceliines. Tschorsnig (1985) suggested that the tribe is closely allied with the Tachinini (sensu lato), with only minor differences in the structure of the distiphallus.

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Discovery of the tachinid *Triarthria setipennis* (Fallén) in Ottawa, Ontario, with notes on parasitism of the European earwig

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Figure 1. Lateral and dorsal views of a male *Triarthria setipennis* caught in Ottawa, Ontario in a Malaise trap on 19 June 2016 (CNC specimen number CNC557460).

Introduction

The European earwig, *Forficula auricularia* Linnaeus (Dermaptera), was accidentally introduced into North America early in the 1900s (Clausen 1978). It is now widespread throughout the continent and is locally common in parts of its range. It is an omnivorous species that favours dark and moist places and is most active at night. Earwigs can cause economic losses when they infest agricultural products but they are more commonly an annoyance around the home because of their propensity to creep into houses, invade patios, and disperse throughout gardens in search of food and shelter (Kuhlmann *et al*. 2002). There is a wide variety of insecticides, traps, and home remedies for earwig control.

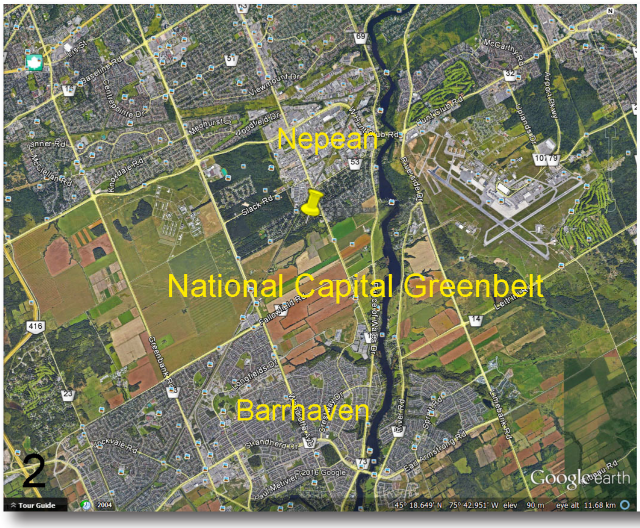
Two tachinids, *Triarthria setipennis* (Fallén) and *Ocytata pallipes* (Fallén), attack the European earwig within its European homeland and both were introduced into North America beginning in the 1920s (Clausen 1978). Only the former became established and through additional introductions and dispersal—presumably by humans and natu-

[1] http://bugguide.net/node/view/864396

[2] http://www.boldsystems.org/index.php/Public_SearchTerms?query=Triarthria

rally—is now recorded in the literature in the East from Newfoundland, New Hampshire, and Massachusetts and in the West from British Columbia south to California and inland to Montana and Utah (O'Hara 1996, O'Hara & Wood 2004). The true distribution of this parasitoid is clearly broader than these records suggest because the Internet site BugGuide has pictures of it from Wisconsin taken in 2013 and several records of it from southern Ontario, based solely on DNA barcodes (and without pictures), exist in the Barcode of Life Database (BOLD). The distribution of *T. setipennis* might well be transcontinental or nearly so in temperate North America. This is not surprising given that its host is readily transported by humans by a variety of means and new populations of *T. setipennis* could become established relatively easily in places where there are suitable conditions and a resident host population. This scenario of *Triarthria* expanding its geographic range is analogous to the sowbug (woodlouse) parasitoid *Stevenia deceptoria* (Loew) (Rhinophoridae) that was recently reported from Ohio by O'Hara *et al*. (2015).

We report here records for *T. setipennis* from Ottawa, Ontario. This is based on both wild-caught adults and parasitized European earwigs. This is the first report of *T. setipennis* for Canada based on examined specimens since the release and establishment of the species in British Columbia and Newfoundland. We also report that all specimens were of the light-coloured morph of *T. setipennis sensu* Kuhlmann (1992, 1995).



Figures 2–3. 2. Google Earth image showing the location of the Malaise trap (yellow pin) used in this study. The trap was situated on private property adjacent to the National Capital Greenbelt, a band of green space with woodlands, wetlands and farmland separating urban Ottawa from the suburbs of greater Ottawa. Woodland appears as dark green, farmland as light green or brown. **3**. The 6-metre Malaise trap shown *in situ* with JEOH for scale (photo taken on 24 June 2016).

Materials and Methods

Malaise trapping

All non-reared *T. setipennis* reported in this study were captured in a large 6-metre Malaise trap purchased from BioQuip Products Inc. (https://www.bioquip.com/search/DispProduct.asp?pid=2877). It was situated on private property on the southern edge of Ottawa in the urban community of Nepean at coordinates 45°19.02′N 75°43.20′W and at an elevation of 90m (Fig. 2). This is an urban property of one-quarter hectare with mature trees along the sides and it backs on to the National Capital Greenbelt (http://www.ncc-ccn.gc.ca/places-to-visit/greenbelt). On the south side of the property line is a 200m wide strip of mixed forest with a small stream and a 3m wide pathway passing through it. The pathway is lined with wildflowers in the summer and likely acts as a flight way for flying insects. South of this strip of woodland is a 2 km wide area of intensive agriculture including regular applications of fertilizers and pesticides during the growing season.

The Malaise trap was set up in late April 2016 and operated continuously until 11 October 2016 except for the period from 28 July to 19 August when it was used elsewhere. One end of the trap was attached to the trunk of a mature white pine (*Pinus strobus*) and the other end extended eastward into an open area dominated by a progression of wild flowers throughout the summer (Fig. 3). Two collecting heads were used for the first few days (one at each end) but the head next to the tree caught so few insects that its use was quickly discontinued. The single head was usually run "dry" with a piece of Ortho® Home Defense Max No-Pest® Insecticide Strip as the killing agent and a few strips of paper towelling to help prevent the larger insects from damaging the smaller ones. The collecting head was removed after dusk and reattached early the next morning to avoid capturing large quantities of moths. Tachinids were sorted and pinned daily or kept in a freezer and pinned a day or so later. Not all specimens of the commonest species, including *T. setipennis*, were kept from each day's catch. Each retained specimen was pinned, databased, and provided with a label giving the locality, date, collector and a unique identifier code linking its particulars to a record in the specimen database of the Canadian National Collection of Insects (CNC), Ottawa. This regular routine of daily sampling was interrupted twice, once during the period mentioned above when the trap was used elsewhere, and again from 23 September to 8 October when the trap was unattended but fitted with a collecting head filled with 95% EtOH. At the end of this period the head was emptied and the contents sorted. *Triarthia setipennis* and other tachinids from this sample were mounted from alcohol using the method described by O'Hara (1994b), then databased and labelled in the same manner as tachinids that were pinned fresh.

Earwig parasitism

Over the course of the summer of 2016, from June 14 to September 16, earwigs were collected on an irregular basis by the authors and a small team of friends, neighbours and family members. Earwigs were collected from various sites within greater Ottawa and from one community (Centreville) about 140 km southwest of the Malaise trap location (Table 2). They were found by searching dark, damp places where earwigs generally spend the day, such as under rocks, logs, and loose bark, and in and around patio furniture. More than half of the earwigs collected at the Nepean 1 site were found either alive on the mesh of the Malaise trap or dead in the collecting head. Some earwigs were kept alive in cages in the Diptera Unit of the CNC while others were killed and preserved in 75% ethanol. These preserved earwigs were later dissected and examined for signs of parasitism. Live earwigs from different collections were placed in separate cages and supplied with food and water. The first earwigs were provided with a variety of food items (Fig. 4) following Kuhlmann (1995) but this was soon changed to dry dog food (we used Kirkland's Nature's Domain Turkey Meal & Sweet Potato Formula) that was found to be satisfactory for earwig rearing by Carroll & Hoyt (1984) and others. Cages were examined frequently for the presence of puparia or adult flies. Tachinid puparia and adults were stored in a freezer and later mounted on pins, labelled, curated into the CNC Tachinidae collection, and databased into the CNC specimen database. Earwigs were kept in cages for several days to three months and then killed by freezing, dissected, and examined for signs of parasitism.

Figure 4. One of the cages used to rear earwigs.

Malaise trapping

Triarthria setipennis was one of the more common tachinid species caught in the Malaise trap over the course of the summer of 2016. The earliest specimen was caught on May 31 and the last during the period of 23 September to 8 October. A total of 49 specimens of both sexes were pinned, labelled and databased, and the dates of collection of these specimens are shown in Table 1. Additional specimens caught on days when *T. setipennis* was common in the sample were not counted and were discarded. *Triarthria setipennis* was especially common during the second half of June and into early July. Although data is lacking for July 28 to August 19, *T. setipennis* was caught occasionally after this time in both August and September, establishing that adults are most likely present and active throughout the summer in the Ottawa area. All examined specimens were of the light-coloured morph of Kuhlmann (1992, 1995).

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Table 1. Dates during May to September in 2016 when *T. setipennis* was captured in the Malaise trap. The trap was not in use during the period shown in light blue. It was generally run "dry" but 95% EtOH was used for the single sample covering the period of 23 September to 8 October.

Earwig parasitism

A total of 256 earwigs were examined throughout the course of this study (Table 2). Of this number, 145 were placed in 75% EtOH immediately or soon after collection and 111 were kept alive in cages for several days to three months. Seven incidences of parasitism were detected, representing parasitism rates of 0 to 6.5% among the seven sampled sites.

Location	Coordinates	Collection dates	No. of earwigs	No. of earwigs reared	No. parasitized	% parasitism
Ottawa, Nepean 1[1]	45°19.02′N 75°43.20′W	27.vi–7.ix.2016	50	0	0	0
Ottawa, Nepean 2[2]	45°19.01′N 75°43.22′W	4–29.vii.2016	31	7	2	6.5%
Ottawa, CEF[3]	ca. 45°23.4′N 75°43.0′W	21.vi–20.viii.2016	25	22	1	4.0%
Ottawa, Spadina Ave.	ca. 45°24.2′N 75°43.2′W	10.vii.2016	67	0	0	0
Ottawa, Barrhaven	45°16.00′N 75°45.59′W	13.vii.2016	17	17	1	5.9%
Ottawa, Osgoode	45°8.46′N 75°36.07′W	14.vi–17.vii.2016	61	61	3	4.9%
Centreville	44°24.31′N 76°54.59′W	19.vii.2016	5	4	0	0
Range/Totals		**14.vi–7.ix.2016**	256	111	7	0–6.5%

Table 2. Rates of parasitism of European earwigs by *T. setipennis* are shown for six locations within greater Ottawa and one location (Centreville) farther south. Earwigs that were not reared were killed in 75% EtOH and later examined for signs of parasitism.

[1] Malaise trap location.

[2] Property adjacent to Nepean 1.

[3] Central Experimental Farm (where the CNC is located), various locations.

Figures 5–10. 5. First instar of *Triarthria setipennis* (circled in red) in the thorax of a European earwig. **6.** Enlarged view of first instar in Fig. 5. **7.** First instar of *T. setipennis* (circled in red) in the thorax of an earwig. **8.** Enlarged view of first instar in Fig. 7. **9.** A respiratory funnel of a *T. setipennis* larva in the thorax of an earwig. **10.** Puparium of *T. setipennis* discovered in an earwig cage.

Details about each incidence of parasitism are as follows (in chronological order based on date of collection):

1. A live adult *T. setipennis* was found on August 2nd in the cage with earwigs collected from the Osgoode site on July 3rd. The puparium was not found.
2. A respiratory funnel of a *T. setipennis* larva was found in the thorax of an earwig collected from the Osgoode site on July 3rd and killed on October 4th (Fig. 9).
3. A first instar of *T. setipennis* was found in the thorax of an earwig collected from the Nepean 2 site on July 4th and killed on July 8th (Figs. 5–6).
4. A respiratory funnel of a *T. setipennis* larva was found in the thorax of an earwig collected from the Barrhaven site on July 13th and killed on October 17th. No larva was found in the earwig and no puparium or adult fly was found in the cage.
5. A live adult *T. setipennis* was found on August 8nd in the cage with earwigs collected from the Osgoode site on July 17th. The puparium was not found.
6. A first instar *T. setipennis* was found in the thorax of an earwig collected from the Nepean 2 site on July 25th and killed that day (Figs. 7–9). This larva was larger than the one in (3) above but it was clearly a first instar based on the shape of the cephaloskeleton.
7. A puparium of *T. setipennis* was found in the cage with earwigs collected from the CEF site between August 10th and 20th (Fig. 10). An adult fly did not eclose. The puparium was not discovered until the cage was terminated in November.

Discussion

This study documents for the first time the presence of *T. setipennis* in the Ottawa area. We cannot say for sure how long it has been in the area, but former Ottawa dipterists who collected frequently in the area up until a decade ago, in particular D.M. Wood and J.R. Vockeroth, did not come across the species. A small release of *T. setipennis* in Ottawa in 1992 (O'Hara 1994a) was thought to have failed in establishing the species, but no special monitoring of earwig populations was undertaken in the years following the release. We cannot rule out the slim possibility that the release was successful. Regardless of whether *T. setipennis* was successfully introduced into Ottawa or arrived here by other means, the lack of any specimens of it in the CNC prior to last summer (2016) suggests that it has not been in the area for many years.

Ours was not a rigorous experimental study of *T. setipennis* biology, but it did establish, as expected, the European earwig as a host for the Ottawa population of this species. We detected parasitism at four sites in the Ottawa area even though a relatively low number of earwigs were examined. Rates of tachinid parasitism are typically dependent on a number of factors and fluctuate from year to year and from place to place, so the rates reported here (0 to 6.5%) from a few sites during one summer may not be representative of "typical" parasitism for the region. A large scale study conducted over three years in central Europe by Kuhlmann (1995) found that parasitism rates of *T. setipennis* in the European earwig were generally in the range of 0–13%, although one sample had a rate of 20.7% and another 46.9%.

The present study provides data on an interesting morphological aspect of *T. setipennis*. Current authors recognize *T. setipennis* in Europe as a single species (e.g., Cerretti 2010, Tschorsnig *et al*. 2013), although it has a dark and light colour morph. The former has a broad black vitta antero-medially on the dorsum of the thorax and the latter has two narrow black vittae in place of a single broad one (cf. images in plate II D–E in Kuhlmann 1992 and drawings in fig. 3 in Kuhlmann 1995). Some earlier authors (e.g., van Emden 1954) recognized the dark morph as *T. setipennis* and the light morph as *T. spinipennis* (Meigen). Kuhlmann (1992, 1995) found differences in the biology of the two morphs, and though he treated both as *T. setipennis*, he had some reservations in doing so (see also Kuhlmann *et al*. 2002). He realized that the biological differences in the morphs might have implications for the broader establishment of the species in Canada, writing (Kuhlmann 1995: 515): "It could be possible that both morphs of *Triarthria* were previously introduced to Canada. If this is the case then long-term field studies should be conducted to determine which morph is the best adapted." We found only the light morph during our study (Fig. 1).

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New and interesting Tachinidae from Greece

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Abstract

Interesting records of Tachinidae from Greece are described, based on recent trips to Greece by Dutch dipterists. Four species are mentioned for the first time from Greece, *Gonia maculipennis*, *Loewia papei*, *Macquartia viridana* and *Plesina claripennis*, of which the second and last are also new records for Europe. It seems fair to say that compared to many other European countries, the Greek tachinid fauna is still understudied.

Figures 1–2. Views of two localities visited by the author. **1**. Lesser Prespa Lake in northwestern Greece, at the Macedonian and Albanian border. This is one of the best preserved lakes in the Balkans (together with Skadarsko Lake on the border of Montenegro and Albania). In the background are the Albanian Mountains. **2**. Gorge at the lower part of the Taygetos Mountains on the Peloponnesos Peninsula, looking down at the plain at Sparti. Gorges like this one are rich in Tachinidae and Rhinophoridae.

Introduction

In recent years, our knowledge of the Tachinidae from southern Europe has rapidly developed. The fauna of the Iberian Peninsula was treated by Tschorsnig (1992) and Tschorsnig *et al*. (1997). The fauna of Italy was treated by Cerretti (2010). Hubenov (2008) gave a checklist of the Tachinidae from the Balkans. The fauna of Greece is relatively little investigated. Cerretti & Ziegler (2004) provided data on 130 species they collected from mainland Greece and gave the total number of known species from the mainland as 302 and from Greece as 334. They observed that data from the islands and from the Peleponnesos Peninsula are largely lacking. Hubenov (2008) provided a checklist of the tachinids of the Balkans and listed 331 species from the whole of Greece. His checklist, however, lacks annotations.

Several Dutch dipterists have visited Greece in recent years. I visited the Pindos Mountains in 2005, Pindos again and Prespa in 2015 and the Peloponnesos in 2016 (Figs. 1, 2). Gerard Pennards visited Lefkas in 2004 and Zakynthos in 2008. Wouter van Steenis visited Sterea and the Peleponnesos in 2012. Crete was visited by John Smit in 1996 and by André van Eck in 2008, as was Rhodos. The Tachinidae collected by these dipterists were donated to the author.

This article presents the results of these trips, as far as they are new or otherwise interesting.
The species are treated in alphabetical order sorted by subfamily. Localities are ordered from north to south. Records are by the author, unless indicated otherwise. All material mentioned is stored in the author's collection.

Results

Subfamily Dexiinae

Stomina caliendrata (Rondani, 1862). Lefkas: Genli, 1 male, 21.vi.2004, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Stomina calvescens Herting, 1977. Zakynthos: Agios sostis, 2 males, 7.vii.2008, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Zeuxia aberrans (Loew, 1847). Peloponnesos: Messinia, Kardamyli, Exochori, Viros Gorge, 36°54′N 22°17′E, 500 m, 1 male, 13.v.2016. Recorded for Greece by Hubenov (2008).

Zeuxia erythraea (Egger, 1856). Peloponnesos: Arcadia, Kato Lousi, 37°58′N 22°08′E, 1000 m, 1 male, 9.v.2016. Recorded for Greece by Hubenov (2008).

Subfamily Exoristinae

Amphicestonia dispar Villeneuve, 1939 (Figs. 3–4). Western Macedonia: Prespa, Mt. Devas, 40°49′N 21°02′E, 1350 m, 1 female, 15.v.2016 (hilltopping); Peloponnesos: Archaea, Kalavryti, Vrachni, 38°02′N 22°11′E, 1200 m, 1 male, 10.v.2016; Arcadia, Theoktisto, 37°49′N 22°08′E, 500 m, 1 male, 9.v.2016. Several records by Cerretti & Ziegler (2004).

On the one hand, this species is highly distinctive: only 3 postsutural dorsocentral setae present, scutellum black with erect apical setae, base of radial vein with one very strong seta, sixth costal section longer than fourth. The male has distinct sexual patches of specialized hairs on the ventral side of tergite 4 (Fig. 3; shown also in figs. 1C,D in Cerretti *et al*. 2014, based on a specimen from Greece). Many of these features are shared with the genus *Lydella* Robineau-Desvoidy, 1830, from which *Amphicestonia* differs by the low number of humeral setae (2 strong ones and sometimes a smaller inner one) and the narrow vertex (narrower than width of one eye). In the male, there is a strong keel between the sexual patches. These patches are located in a strong depression in the fourth tergite and covered with very long, fluffy hairs.

On the other hand, this species is difficult to recognize because its variability is much larger than the literature would suggest. Both of my males have strong discal setae on both tergites 3 and 4, and therefore do not key out to *Amphicestonia* in the Palaearctic generic key of Tschorsnig & Richter (1998). Also, they have a bare prosternum, which was thought to be a characteristic of only *A. perplexa* Mesnil, 1963, described from Tadjikistan. The shape and size of the sexual patches in the male as well as the long setae on the hind metatarsus (Fig. 4), however, agree with *A. dispar*. The conclusion is that *A. dispar* is much more variable than previously understood.

Figures 3–4. *Amphicestonia dispar*, male. **3**. Lateral view of abdomen showing large sexual patch and the central keel separating it from the patch on the other side. **4**. Lateral view of hind tarsus, showing long setae. (Photos by author)

Baumhaueria microps Mesnil, 1963 (Fig. 5). Ioannina: Konitsa, Mt. Trapezina, 40°02′N 20°47′E, 1 male, 8.v.2005; between Vikos – Elafotopos, 39°55′N 20°41′E, 5 males, 4.v.2005.

Specimens found in numbers on flowers of *Euphor-*

bia sp. Already mentioned from three localities in Greece by Cerretti & Ziegler (2004). Apparently, the species is not rare in the Pindos Mountains; however, it is difficult to find due to the lack of flowers in early spring.

Figure 5. *Baumhaueria microps*, lateral habitus, showing the characteristic small eye. (Photo by J. Almeida)

Gonia maculipennis Egger, 1862 (Fig. 6). Western Macedonia: Prespa, Psarades, 40°49′N 21°04′E, 850 m, 5 males, 14.v.2016. **First record for Greece and the Balkans**.

The specimens were observed late in the afternoon on flowers of a *Bellis*-like plant together with *Gonia ornata* Meigen, 1826. They could not be found around noon. According to Tschorsnig *et al*. (2013), the distribution of this conspicuous species is disjunct: a western population in Spain and an eastern one in eastern Europe.

Figure 6. *Gonia maculipennis*, dorsal habitus. (Photo by P. Alvarez Fidalgo)

Pseudogonia rufifrons (Wiedemann, 1830). Zakynthos: Agios sostis, 1 female, 9.vii.2008, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Phorocera grandis (Rondani, 1859). Epiros: Kranea, NE of Metsovo, 39°53′N 21°19′E, many specimens, 17.v.2015. Several records by Cerretti & Ziegler (2004).

This species was found in very large numbers in a pine forest heavily infested by *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775). In Central Europe, *Euproctis* Hübner, 1819 is considered to be the primary host, although host records are available for *Thaumetopoea* Hübner, 1820 (Stipdonk & Zeegers 2010). For this record, *Thaumetopoea* seems to be quite likely the host as well.

Subfamily Phasiinae

Besseria zonaria (Loew, 1847). Crete: Kalamafka, 2 males, 2.v.1996, leg J. Smit. Recorded for Greece by Hubenov (2008).

Cistogaster mesnili (Zimin, 1966). Lefkas: Genli, 3 males, 21.vi.2004, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Clairvillia pninae Kugler, 1971. Rhodos: Trianda, Filerimos, 1 male, 17.ix.2008, leg A. van Eck. Recorded for Greece by Hubenov (2008).

Clytiomyia dupuisi Kugler, 1971. Lefkas, Genli, 1 male, 21.vi.2004, leg Pennards; Crete: Rethymno, Maroulas, 1 female, 26.iv.2008, leg A. van Eck. Recorded for Greece by Hubenov (2008).

Clytiomyia sola (Rondani, 1861). Ioannina: Mt. Vikos, 1 male, 24.vi.2004, leg G.W.A. Pennards; Thessalia: Pilion, Tsangarada, Myiopotamos, 39°22′N 23°12′E, 1 male, 14.v.2012, leg W. van Steenis; Sterea Ellada: Fthiotida Mt., S. of Iti, 650 m, 38°45′N 22°24′E, 1 male, 15.v.2012, leg W. van Steenis; Crete: Melambes, 1 female, 6.v.1999, leg J. Smit. Recorded for Greece by Hubenov (2008).

Cylindromyia auriceps (Meigen, 1838). Gliki, 1 male & 1 female, 30.vi.2004, leg G.W.A. Pennards; Thessalia: Pilion, Tsangarada, Myiopotamos, 39°22′N 23°12′E, 1 female, 14.v.2012, leg W. van Steenis; Zakynthos: Agios sostis, 1 male, 9.vii.2008, 1 male & 1 female, 13.vii.2008, leg GWA Pennards; Peloponnesos: Akrogiali, river mouth, 36°57′N 22°09′E, 1 female, 17.v.2012, leg W. van Steenis; Crete: Rethymno, Platanias, 1 female, 27.iv.2008, leg A. van Eck. Recorded for Greece by Hubenov (2008).

Cylindromyia pilipes (Loew, 1844). Zakynthos: Agios sostis, 2 males, 8.vii.2008, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Cylindromyia rufipes (Meigen, 1824). Thessalia: Pilion, Tsangarada, Myiopotamos, 39°22′N 23°12′E, 1 female, 14.v.2012, leg W. van Steenis. Recorded for Greece by Hubenov (2008).

Cylindromyia xylotina (Egger, 1860). Peloponnesos: Karyes, 25 km. N. of Sparti, 890 m, 37°18′N 22°25′E, 1 female, 18.v.2012, leg W. van Steenis. Recorded for Greece by Hubenov (2008).

Gymnosoma clavatum (Rohdendorf, 1947). Rhodos: Ialissos, 36°24′N 28°10′E, 1 female, 30.iv.2003, leg J. Smit; Crete: Rouvas Gorge, 1 male, 4.v.1999, leg J. Smit. Recorded for Greece by Hubenov (2008).

Gymnosoma dolycoridis Dupuis, 1961. Thraki: Evros, 1 male, 28.iv.2000, leg W. van Steenis; Zakynthos, Agios sostis, 1 male, 17.vii.2008, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Labigastera nitidula (Meigen, 1824). Crete: Rethymno, Platanias, 1 male, 27.iv.2008, leg A. van Eck. Recorded for Greece by Hubenov (2008).

Leucostoma tetraptera (Meigen, 1824). Zakynthos: Agios sostis, 1 female, 14.vii.2008, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Phasia mesnili (Draber-Mońko, 1965). Zakynthos: Agios sostis, 1 female, 9.vii.2008, 1 female, 13.vii.2008, leg G.W.A. Pennards. Recorded for Greece by Hubenov (2008).

Subfamily Tachininae

Loewia brevifrons (Rondani, 1856). Peloponnesos: Archaea: Kalavryti, Vrachni, 38°02′N 22°11′E, 1200 m, many specimens, 10.v.2016. Recorded for Greece by Hubenov (2008).

Loewia papei Cerretti, Lo Giudice & O'Hara, 2014. Peloponnesos: Archaea: Kalavryti, Vrachni, 38°02′N 22°11′E, 1200 m, 1 male & 1 female, 10.v.2016. **First record for Europe**.

The specimens were collected from umbellifer flowers amongst a large number of *Loewia brevifrons*. The species was previously only known from Turkey.

Macquartia viridana Robineau-Desvoidy, 1863. Ioannina: Vikos Gorge near Vikos, 39°56′N 20°42′E, 2 females, 5.v.2005. **First record for Greece**.

Nemoraea pellucida (Meigen, 1824). Peloponnesos: Archaea: Kalavryti, 38°04′N 22°08′E, 750 m, 1 female, 10.v.2016. Recorded for Greece by Hubenov (2008).

Plesina claripennis Mesnil, 1953. Zakynthos: Mt. Vrachionas, 756 m, 1 male, 16.vii.2008, hilltopping, leg G.W.A. Pennards. **First record for Europe**.

Previous records of this species from Europe were misidentifications of *P. nigroscutellata*. Therefore, this seems to be the first genuine record for Europe.

Plesina nigroscutellata Cerretti & Tschorsnig, 2008. Zakynthos: Mt. Vrachionas, 756 m, 3 males & 1 female, 16.vii.2008, hilltopping, leg G.W.A. Pennards.

Recorded from Crete by Cerretti & Tschorsnig (2008); not previously recorded from the Greek mainland.

Both species of *Plesina* were found together walking on rocks at a hilltop while waving their wings in a tephritid-like way (G.W.A. Pennards, pers. comm.).

Tachina praeceps Meigen, 1824. Ioannina: Vikos Gorge near Klidonia, 39°57′N 20°40′E, 1 male, 9.v.2005; Vikos Gorge near Vikos, 39°56′N 20°42′E, 1 male & 1 female, 5.v.2005; Ioannina: Aristi, 1 female, 25.vi.2004, leg G.W.A. Pennards; Zakynthos, Agios sostis, 2 males & 1 female, 9.vii.2008, leg G.W.A. Pennards; Kreta: Venerato, 2 males, 7.v.1999, leg J. Smit.

Cerretti & Ziegler (2004) mentioned only one record. Given the records above, this species is actually widespread and not rare in Greece.

Conclusions

This article provides new and interesting records of Tachinidae from Greece. It mentions four species new for Greece, including two new to Europe, raising the total number of Tachinidae recorded for Greece to 335. This is still relatively low in comparison with well investigated countries like the Netherlands (336 species, Zeegers *et al*. 2016) and Italy (650 species, Cerretti 2010). It seems fair to say that the Greek tachinid fauna can be expected to be much richer than currently known.

Acknowledgements

I would like to thank my Dutch colleagues André van Eck, Gerard Pennards, Jan & John Smit and Wouter van Steenis for sharing their interesting material. Zdravko Hubenov kindly helped me with finding relevant literature. Jorge Almeida and Piluca Alvarez kindly gave permission to use their photos. Pierfilippo Cerretti kindly shared his thoughts on *Amphicestonia*.

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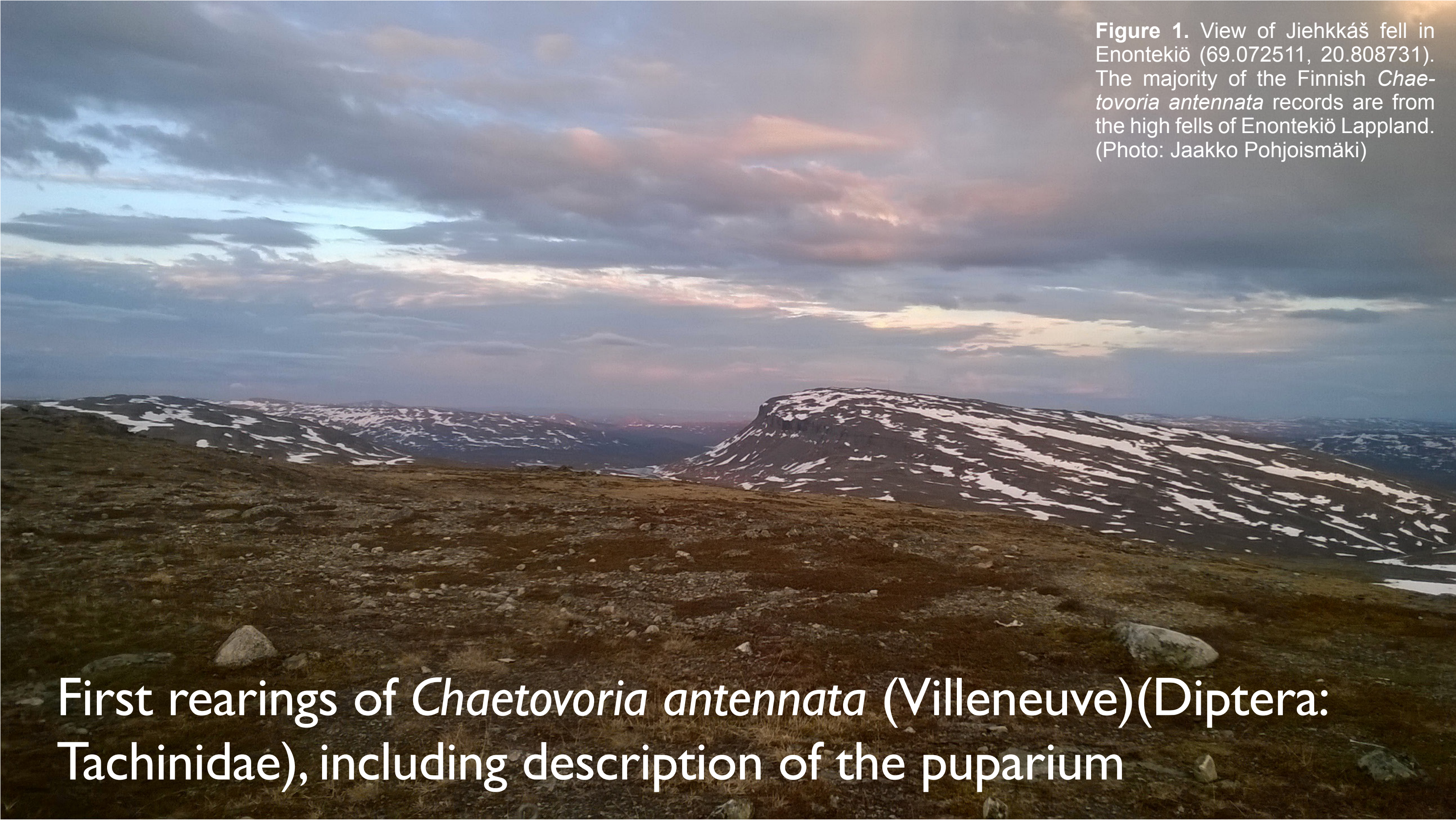

Figure 1. View of Jiehkkáš fell in Enontekiö (69.072511, 20.808731). The majority of the Finnish *Chaetovoria antennata* records are from the high fells of Enontekiö Lappland. (Photo: Jaakko Pohjoismäki)

First rearings of *Chaetovoria antennata* (Villeneuve)(Diptera: Tachinidae), including description of the puparium

by Håkon Haraldseide[1] and Jaakko Pohjoismäki[2]

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Introduction

Chaetovoria antennata (Villeneuve) is a rarely collected arctic-alpine specialist, whose distribution is restricted to northernmost Scandinavia and the Alps.

A total of 21 specimens, including one male reared from *Anarta melanopa* Thunberg (Lepidoptera: Noctuidae), are known from Finland (EntDatabase 2016). All Finnish records are from fell habitats above treeline in Inari and Enontekiö Lapland (Fig. 1). Only two specimens are known from Norway, one male from Finse (Rognes 1983) and one reared male from Troms in northern Norway, the puparium of the latter serving as the basis for the description below.

There are no published host records for *Chaetovoria* prior to the observations presented here, although there is a record in the online EntDatabase that is based on the same specimen from Finland discussed below. The tribe to which *Chaetovoria* belongs, the Voriini (Dexiinae), are almost exclusively parasitoids of Lepidoptera (Tschorsnig & Herting 1994).

Material and Methods

Two specimens were examined, as follows.

1♂ [the aforementioned Troms specimen]: NORWAY, Karlsøy: Reinøy, Stakkvik (EIS 171). Ex larva Symphyta (Hymenoptera) from *Betula*. July 2002, Ove Sørlibråten leg. (Natural History Museum, Oslo). The puparium is in a gelatin capsule together with the remnants of the host's cocoon. The dorsal cap of the operculum is missing and the ventral cap is detached. Figures and length estimation were based on the imagined position of a reattached ventral cap.

1♂ [also recorded in EntDatabase] (Fig. 2): FINLAND, Li: Inari, Kaunispää. Ex larva *Anarta melanopa*, 23 August 2000, Juhani Itämies leg. (Zoological Museum, University of Oulu, Oulu). Unfortunately no puparium was preserved from this rearing.

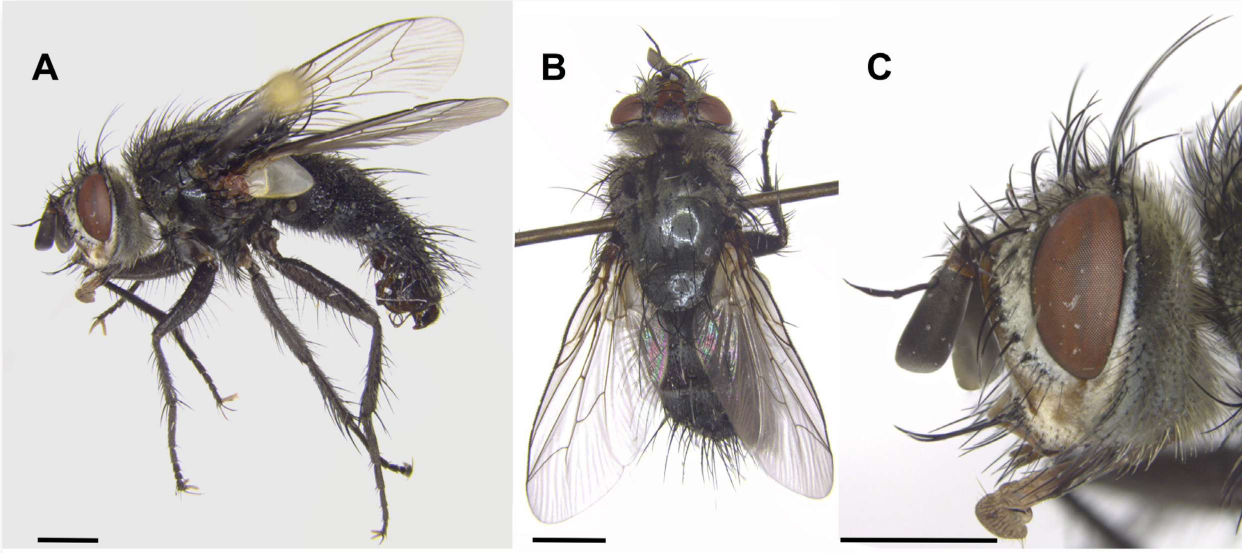

Figure 2. Male *Chaetovoria antennata* from Inari, Finland. **A**. Lateral view. **B**. Dorsal view. **C**. Head. Scale: 1 mm. (Photos: Jaakko Pohjoismäki)

Puparium

The puparium is 7 mm long (estimated as explained above) and 3.2 mm wide, reddish-brown, cylindrical and slightly ovoid in shape (Fig. 3A, B). Its surface texture is dull with fine transverse striations; these are only slightly deeper along segmental divisions. Bands of spines completely absent. Lateral muscle scars not visible. Posterior spiracles situated above the longitudinal axis (Fig. 3C). Spiracular plate matt blackish and in the shape of a tilted numeral 8. Posterior spiracles small and shiny black with three radiating slits each (Fig. 3D). Anal plate transversely oval with the opening slit-like.

Notes on biology

Not much is known about the biology of *Chaetovoria antennata* and the species is rarely observed in the wild. As with many arctic-alpine tachinids, the adults have been observed sitting on rocks or low vegetation on mountain tops (Tschorsnig *et al*. 2003). From Finland there are two larger series collected as side catches from pitfall traps: 7 specimens, 4.vii–12.viii.2007, from Ánnjaloanjebákti (69.173381, 21.386069) and 6 specimens, 9.vii–15.vii.2009, from Urttašvággi (69.220880, 21.070171), both localities in Enontekiö Lapland (EntDatabase 2016). Collecting such a high number of specimens from pitfall traps is unlikely to be an accident; rather these observations indicate that the flies spend much time running on the ground. This would also fit the observation of *Anarta melanopa* as a host, since its larvae live on various low shrubs on fell tops. The moth is also one of the commonest noctuid species present in the above treeline fell habitats throughout the Nordic countries (Silvonen *et al*. 2014).

As *Chaetovoria antennata* have been reported visiting flowers (Tschorsnig *et al*. 2003), pan traps could be ideal for catching the species in the right habitats, especially in places where collecting is difficult due to unpredictable or changing weather conditions. Monitoring arctic-alpine specialists like *C. antennata* has some urgency as the high arctic regions are expected to be most affected by impeding climate change.

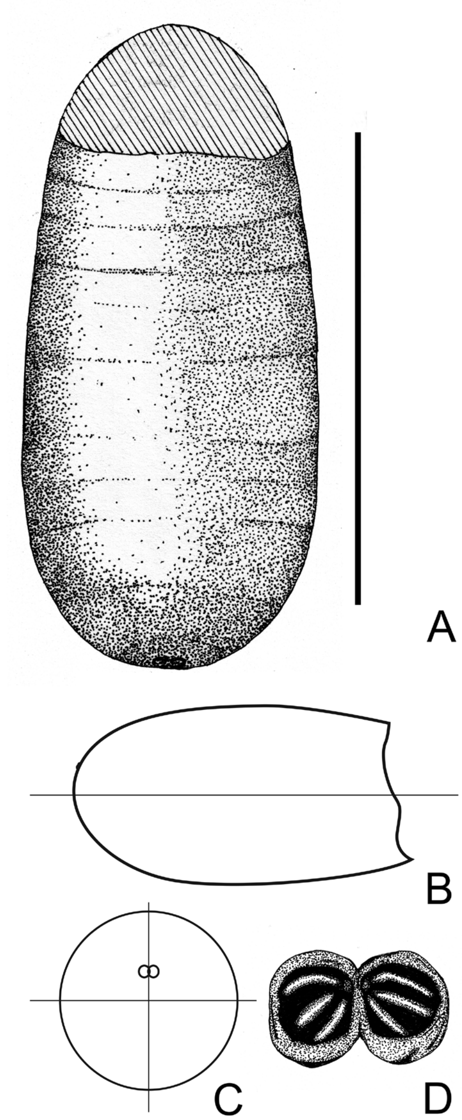

Figure 3. *Chaetovoria antennata*, puparium. **A**. Dorsal view. **B**. Lateral view. **C**. Posterior view. **D**. Posterior spiracles. Scale bar for 3A: 5.0 mm.

Epilogue

The examined specimen from Inari, Finland, has been DNA barcoded. The sequence data was released recently (Pohjoismäki *et al*. 2016) and is publicly available through the Barcode of Life Database (BOLD 2016) and GenBank (GenBank 2016).

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FIRST RELEASE OF NORTH EUROPEAN TACHINID DNA BARCODES

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It is my delight to announce the release of the DNA barcodes for the first 366 species of Tachinidae sequenced as part of the Finnish Barcode of Life (www.finbol.org) initiative (Fig. 1, in part). An overview of the data has been published in PlosONE (Pohjoismäki *et al*. 2016) and is open access. The data is available in the Barcode of Life Database (BOLD) (http://www.barcodinglife.com/) as well as in GenBank (https://www.ncbi.nlm.nih.gov/genbank/). The easiest access to the whole dataset is through BOLD's Digital Object Identifier System (http://dx.doi.org/10.5883/DS-TACFI).

The data covers the majority of Finnish tachinid species and includes a number of rare taxa from elsewhere in Europe. My hope is that the data will serve as a good basis to facilitate species identification and address outstanding issues in taxonomy. As we report in the paper, many tachinid taxa have cryptic variation or taxonomic conflicts, and some taxa may have unjustified division between genera. Among the interesting issues to solve in the future are the numerous cases where barcode sequences are nearly identical between Palaearctic and Nearctic taxa. Sorting out their true species identities and rightful names is a waiting challenge.

Collector projects such as those compiling DNA barcodes are never finished. Our project started in 2010 and every year since then there have been interesting species to add. Despite the release of our data and paper, I am still collecting and including additional species into BOLD where they will be available for the online barcode identification tool. In addition, their photos are available through the taxonomy browser. The barcodes for species that were not included in the published study will be made publicly available in due time when a larger patch of specimens has been accumulated. If you have Palaearctic species of interest to add to our barcode collection, please do not hesitate to contact me.

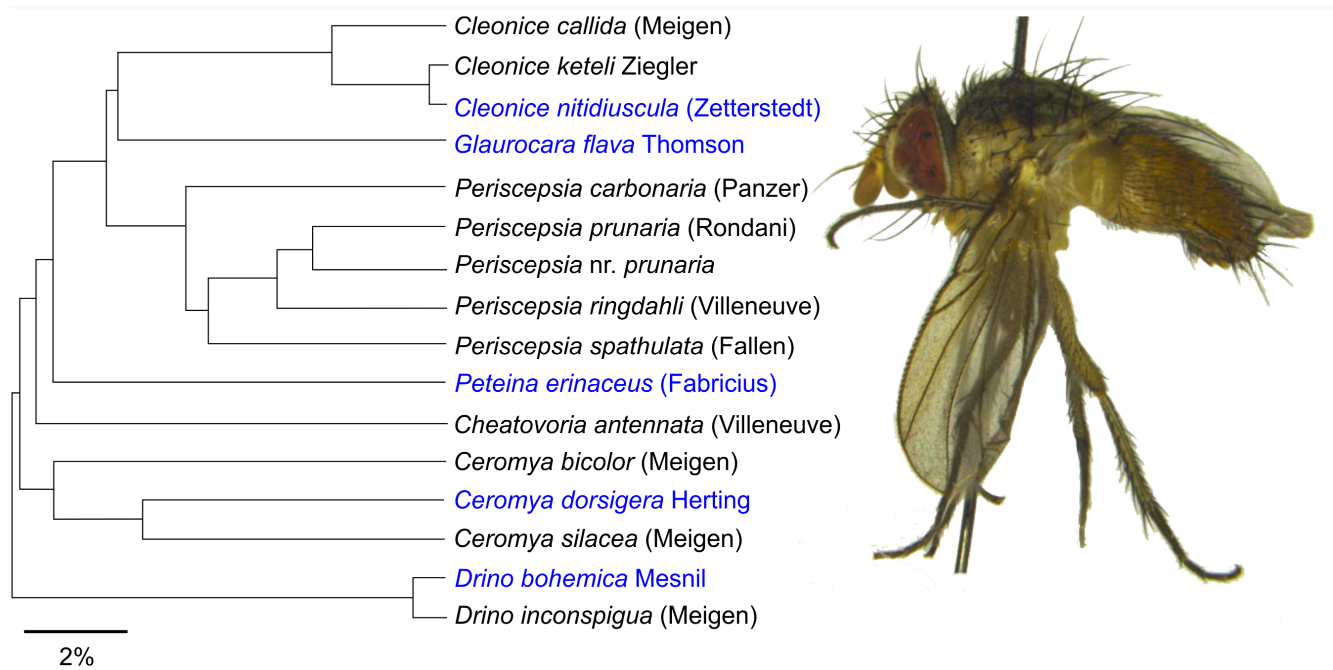

Figure 1. Neighbor-Joining tree for DNA barcode sequence similarity for some example tachinids. The species that have been sequenced since the publication of Pohjoismäki *et al*. (2016) are shown in blue. The tree does not depict true phylogeny between genera and is used here only to illustrate species differences. The pictured specimen is a male of *Ceromya dorsigera* Herting from Kitee, Finland, representing the second Finnish record of the species.

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The Tachinidae of Singapore

by Rudolf Meier

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I have been working in Singapore since 2002, but until recently I worked very little on Singapore's Diptera fauna. This had always bothered me, but I did not see a good way to work on the Diptera diversity in a tropical country because I did not see a realistic way to sort specimens to species without the help of many specialists (and there was no funding for them). However, this recently changed because we can now use cheap "NGS barcodes" for species discovery (Wong *et al*. 2014, Meier *et al*. 2016). The barcodes only cost <50 cents per specimen and thousands of specimens can be sequenced without doing much morphological damage to the specimens. After sequencing the specimens, we group them into putative species based on genetic distances (i.e., we do "pre-sorting" based on molecular data) and we can gain interesting insights into the distribution and abundance of the putative species within the country. Of course, these putative "molecular species" should ideally be confirmed with morphological data. We therefore image one specimen per molecular cluster and place all of the images on a website called *Animals and Plants of Singapore* (http://nathist.science.nus.edu.sg). I hope that this website develops into a portal that eventually has an image for all multicellular species in the country. Currently, we have ca. 4500 species online but we are regularly adding more. Of course, nobody knows how many species there are in Singapore. I am starting to suspect that it is somewhere between 50,000 and 100,000. So, plenty of work to do.

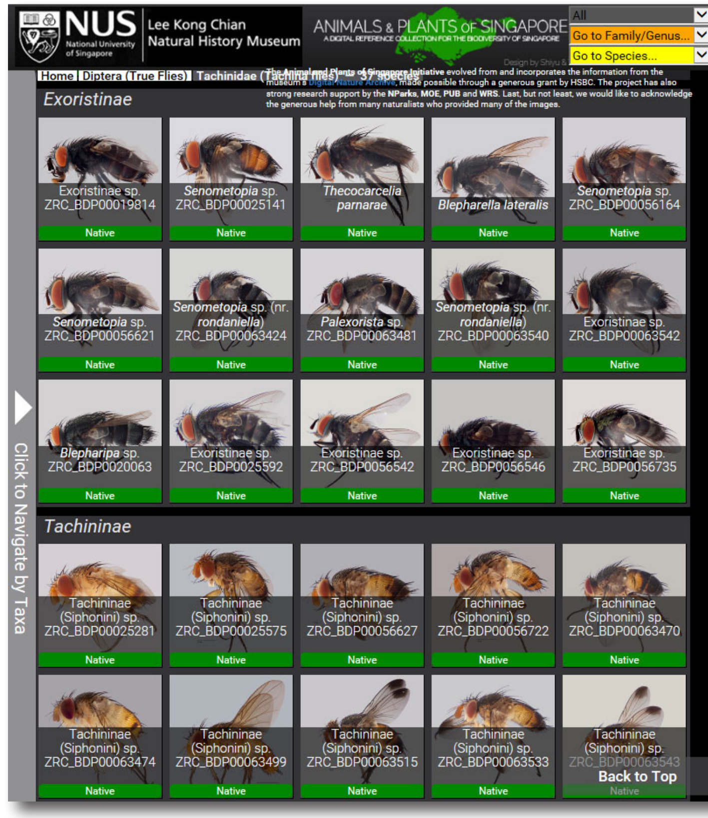

Figure 1. Webpage on Tachinidae on the *Animals and Plants of Singapore* website.

Of the 4500 species on the website, about 1000 are Diptera (http://nathist.science.nus.edu.sg/#A-Arth-Hexa-Dipt) and ca. 40 are Tachinidae (http://nathist.science.nus.edu.sg/#A-Arth-Hexa-Dipt-Tachinidae) (Fig. 1), but this number will go up very rapidly once we start sequencing more calyptrate flies. For each species there is a thumbnail on the family page. When clicked, a larger image appears in a Zoomify™ format that allows for magnifying particular body parts.

I extend an open invitation to tachinologists for help with the identification of these Singaporean tachinids to subfamily, genus, or species level. The material is, of course, also available for loan, and all dipterists are welcome to visit Singapore when passing through the country. The old Raffles Museum of Biodiversity Research moved into a new building with better facilities (http://lkcnhm.nus.edu.sg/) and we regularly host visitors.

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Student News

Juan Manuel Perilla López

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I am an entomologist from Colombia (Fig. 1) and since my early undergraduate studies at the Universidad Nacional de Colombia (Bogotá, Colombia) I have been interested in flies. First I focused on fruit flies and later I switched to research on gall midges associated with grasses during my Master's degree at South Dakota State University (USA). I have been interested in the study of tachinids for a number of years but because these flies are not well known in my country I am just now starting to learn about this bristly fascinating world. I began my Ph.D. studies in January 2016 in the Stireman Lab at Wright State University (Ohio, USA). For the past year I have been able to engage in field and museum studies of Tachinidae in the laboratories of Drs. Diniz and Pujol-Luz at the Universidade de Brasilia, Brazil, where I was involved in collaborative projects focused on *Archytas* Jaennicke (Fig. 2) and *Phytomyptera* Rondani. I was also able to examine several collections of Tachinidae in Brazil and Colombia during this time.

Figure 1. Juan Manuel collecting flies in a forest clearing near Santa María, Boyacá, Colombia. (Photo by M.A. Perilla Romero)

My Ph.D. research is focused on studying the phylogenetic relationships within the tribe Polideini and will include a revision of the genus *Chrysotachina* Brauer & Bergenstamm. The Polideini are a relatively small tribe in the subfamily Tachininae with about 140 described species, but display a great amount of morphological variation (e.g., body size ranges from about 3 mm (*Lypha* Robineau-Desvoidy spp.) up to 17 mm (*Hystricia* Macquart spp.)), a broad geographic distribution (from the Neotropics to the circumboreal region up to 70°N), a diverse array of hosts (including Lepidoptera, Hymenoptera, Orthoptera, Blattaria, Chilopoda, Scorpiones and Araneae), and contains numerous undescribed species (especially in the Neotropics) (O'Hara 2002).

O'Hara's (2002) work was an excellent modern revision of the Nearctic Polideini and sets the stage for revising the more diverse and difficult Neotropical polideines. In a recent morphological analysis of the Tachinidae by Cerretti *et al*. (2014), the genera *Loewia* Egger and *Petagnia* Rondani are clustered with the Polideini *sensu* O'Hara (2002). However, preliminary molecular analyses support Polideini as a monophyletic group and suggest that this clade is characterized by a rapid rate of diversification (Stireman *et al*., in prep.).

The New World genus *Chrysotachina* (Fig. 3) is most diverse in the Neotropics and was traditionally recognized by a metallic coloration. However, O'Hara (2002) expanded the genus boundaries to include non-metallic forms, synonymizing the Neotropical non-metallic genera *Exoristopsis* Townsend, *Helioplagia* Townsend and *Neoerigone* Townsend under this name. Revision of these non-metallic *Chrysotachina* is needed to properly evaluate the monophyly and limits of this genus.

Do you have Polideini specimens in your collection or at your institution? If you do, then please contact me! I would love to include them in my phylogenetic and revisionary studies.

Figure 2. A male *Archytas* poses for a picture on the author's finger in Brookings Co., South Dakota, USA.

Figure 3. *Chrysotachina longipennis* O'Hara from near Springfield, West Virginia, USA (in J.O.Stireman's collection at Wright State University, Dayton, Ohio, USA).

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Student News

James Lumbers

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I started my PhD. in October 2016, being co-supervised by David Yeates and Bryan Lessard (CSIRO), and by Dave Rowell (ANU). My project is a systematic revision of the tachinid genus *Rutilia* Robineau-Desvoidy, 1830, a relatively large genus containing 52 described species, most of which are endemic to Australia. *Rutilia* species are among the most visually appealing Diptera, and important parasitoids of scarabs and other plant feeding beetle larvae.

Rutilia species are generally large (1–2 cm) and robust flies (Figs. 1, 2), most frequently caught while either hill-topping or feeding on flowers. Many species display striking iridescence across their thorax and abdomen, although overall colouration is rarely a useful character for species level identification. *Rutilia* is most diverse in Australia, with 49 of the 52 described species only recorded on this continent. They have been collected throughout Australia in most environments, with the exception of the alpine and especially arid regions. *Rutilia* has a slightly unusual taxonomic traditional of being split into subgenera, of which there are currently seven, as well as two species (*R. micropalpis* Malloch, 1929 and *R. scutellata* (Enderlein, 1936)) thus far unassigned to a subgenus. ANIC's collection currently holds representatives from all seven subgenera as well as *R. micropalpis* (33 described species). Most of the remaining species are found throughout other Australian collections, however, several holotypes are located in Europe.

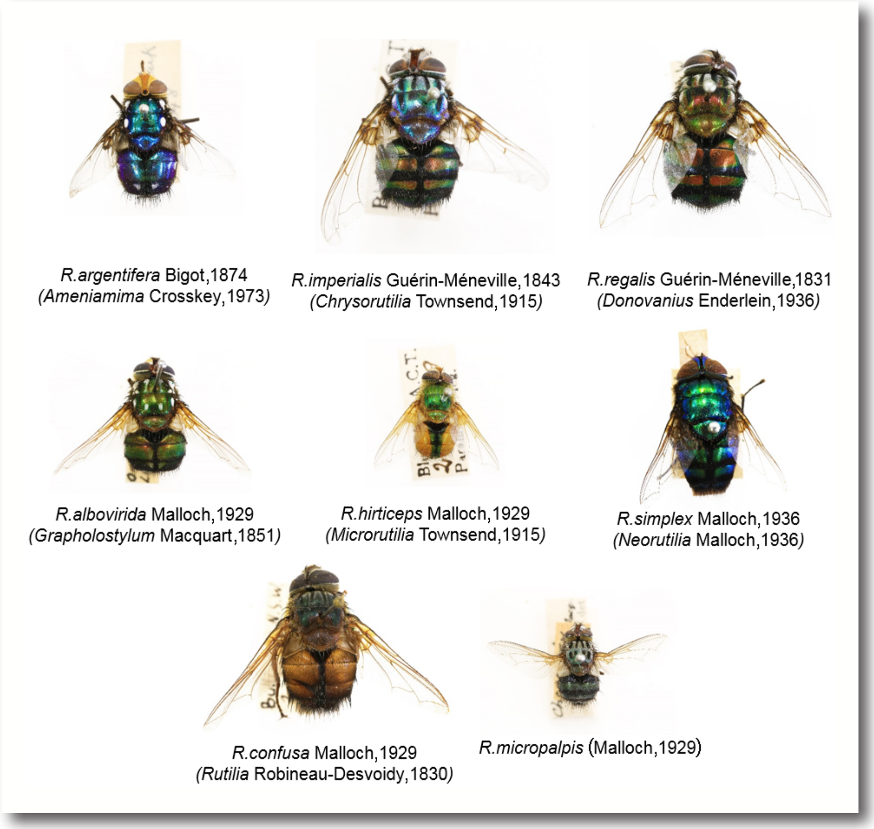

Figure 1. Representatives from each of the seven subgenera (in brackets) plus *R. micropalpis* from ANIC's collection.

My path to tachinid systematics has been somewhat circuitous: towards the end of my undergraduate science degree at ANU (double-majoring in chemistry), I took an elective 2nd year course in invertebrate zoology, taught by David Yeates and Dave Rowell. I enjoyed this course immensely, and subsequently began volunteering at the ANIC in my free time. Embedded with David Yeates' Diptera group, I began learning about everything from conducting fieldwork to collection management. The following year I chose to do an elective undergraduate research

Figure 2. *Rutilia* sp. (probably *R. vivipara* (Fabricius, 1805)) being harassed by an Australian bush fly (more than likely *Musca vetustissima* Walker, 1849) in Ngarkat National Park, South Australia. (Photo by Tom Semple)

project through ANIC, and also in association with Jeff Skevington from Agriculture and Agri-Food Canada, who was at the time working on Australian Syrphidae. This project was an insect biodiversity survey and involved the weekly collection and sorting of four 6-meter Malaise traps over the course of five months, which in some weeks yielded several kilograms of arthropods. It is satisfying to see that after three years, the almost 100 litres of residues generated from this project are still yielding interesting material.

After completing my undergraduate degree I was still uncertain as to which field to specialize in. After receiving an honours scholarship for organometallic chemistry I chose to remain at ANU for another year, however, I was still volunteering at ANIC during this time, and with the help of David Yeates and Bryan Lessard, was able to secure a Ph.D. scholarship in taxonomy the following year for a systematic revision of Australian *Rutilia*. I already had a particular interest in *Rutilia* after collecting them on holiday in North Queensland a year prior. Given my familiarity in the ANIC collection, and extensive laboratory experience with chemistry, I decided that a combined morphological/molecular project was an opportunity too great to pass up. Thus, I decided to switch fields and devote myself to entomology.

My Ph.D. research comprises both a morphological revision of the genus *Rutilia*, and a molecular phylogeny which will also consider various outgroups within the Dexiinae. Using R.W. Crosskey's (1973a) revision of the tribe Rutiliini (now within the subfamily Dexiinae) as a starting point, I am revising the undescribed material that was either omitted from Crosskey's revision, or has since been collected – around half of the 4600 or so specimens in ANIC's *Rutilia* collection. In addition to getting my head around the morphology, I am currently working on databasing ANIC's *Rutilia* to generate distribution maps.

Figures 3–4. 3. (top) Some of ANIC's Diptera group displaying the results of a recent field trip. From left to right: ANIC Director David Yeates, me (James Lumbers), and 2nd Year Ph.D. student Xuankun Li (studying bombylid systematics and asiloid phylogeny). (Photo by Alan Landford) **4.** (bottom) Collecting *Rutilia* on vegetation around the edges of the Eucla dunes - Eucla National Park, Western Australia.

Beginning in my second year, my phylogenetic analysis will utilise anchored-hybrid enrichment sequencing that requires high quality DNA samples from *Rutilia*. In the absence of such material already existing at ANIC, I have had to start from scratch, spending almost two months conducting fieldwork throughout the southern quarter of Western Australia, as well as a few locations in northeastern New South Wales (Figs. 3, 4). I am currently planning trips in the near future to South Australia's Eyre Peninsula, as well as to Mt. Moffatt in central Queensland's Carnarvon National Park, a legendary *Rutilia* hotspot. Finally, I'm looking forward to liasing with various agricultural agencies and collections to improve host records for *Rutilia* which, at present, are sparse (Crosskey 1973b, Logan 1999).

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Book announcement

by Joachim Ziegler
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MESSAGE FROM JOACHIM ZIEGLER

Figure 1. Joachim Ziegler investigates a *Dracunculus* plant while collecting on the Pelion Peninsula in Greece in June 2015. (Photo by wife Christiane Lange)

I came to the end of my employment as curator of Diptera and Siphonaptera at the Natural History Museum in Berlin on 31 January 2017 (Fig. 1). As is the current practice in Germany, I retired upon reaching the age of 65.5 years and from that day gave up my official functions at the Museum. At the moment no decision has been taken about a possible successor. Loans from the collection will from now on be supervised by Jenny Pohl (jenny.pohl@mfn-berlin.de).

I am hoping that I shall still be able to complete several projects as an Honorary Associate of the Museum. As I live outside Berlin, I shall be working mainly at home. However, my official Museum email address should still function up to the end of 2017.

ANNOUNCEMENT ABOUT *DIPTERA STELVIANA*, VOLUME 2

Ziegler, J., editor (2016) Diptera Stelviana. A dipterological perspective on a changing alpine landscape. Results from a survey of the biodiversity of Diptera (Insecta) in the Stilfserjoch National Park (Italy). Volume 2. *Studia dipterologica*. Supplement 21. 448 pp. [To purchase a copy of this book, please contact Dr. Andreas Stark, Ampyx Verlag, at Stark@ampyx-verlag.de.]

After an unexpectedly long period of gestation, the second volume of *Diptera Stelviana* was published on 23 December 2016 (Fig. 2). It begins with a guest foreword by Professor Martens and a critical foreword by the editor on the consequences for biodiversity research of the "Nagoya Protocol". Also included is a comprehensive historical survey of dipterological research in South Tyrol since 1860. In the main part, further results are published from the survey of the Diptera in the South Tyrol part of the Stilfserjoch National Park (Parco Nazionale dello Stelvio), Italian Alps. Five Malaise traps were used, which were set up during the vegetative period of 2005 along a transect from the submontane to the alpine altitudinal zones (940 m to 2135 m).

In the first part of this series, published in 2008, a total of 25,280 specimens of Diptera were dealt with. In the current volume results on a further 25,687 specimens of Diptera are presented. The identified flies belong to 900 species and represent 27 Diptera families. The results are given in 29 individual reports in which 29 international specialists have collaborated. Although there have been dipterological investigations in the study area since 1860, an additional

476 species have been found among the identified Diptera that were not previously known from South Tyrol. Although the fauna of Italy is rich and relatively well known, the present investigations in the Stilfserjoch National Park have nevertheless added a further 109 species as new records for Italy. In both volumes of *Diptera Stelviana*, 1,248 species are recorded for the first time from South Tyrol and 357 species for the first time from Italy.

The family Tachinidae is dealt with in particular detail in the second volume. In addition to the results from the trap captures, extensive recent collections with a hand net have been analysed. Two special contributions deal with taxonomic problems and contain the descriptions of two species new for science in the genera *Chrysosomopsis* and *Dinera*. In addition a review is given of the Tachinidae that were collected between 1860 and 1960 in the region of the present day province of Bozen-South Tyrol and in the present Stilfserjoch National Park. For this the literature was evaluated and historic material was examined from collections that are still in existence. Based on the collections that could be revised, the published information has been critically checked and corrected where required. As a result, a comparison with recent collections has for the first time been possible. A total of 270 species of Tachinidae has been recorded in the Stilfserjoch National Park, 360 species in South Tyrol, and 370 species in the entire study area. Species of Tachinidae that are particularly characteristic are assigned to the typical environments in the study area, namely the alpine grasslands, the montane coniferous forest and the montane inner-alpine dry grasslands. Fifteen percent of the South Tyrol species are missing or have become extinct. Whereas all the species known historically from the alpine zone were found again during the present investigation and only a few species (3%) from the montane zone were missing, the proportion of missing species rises very sharply in the region of the planar to submontane zone: 79% of the Tachinidae that are known only from historical finds lived in the valleys. The causes of this drastic faunistic impoverishment in the South Tyrol valleys are considered to be intensive agriculture and habitat destruction.

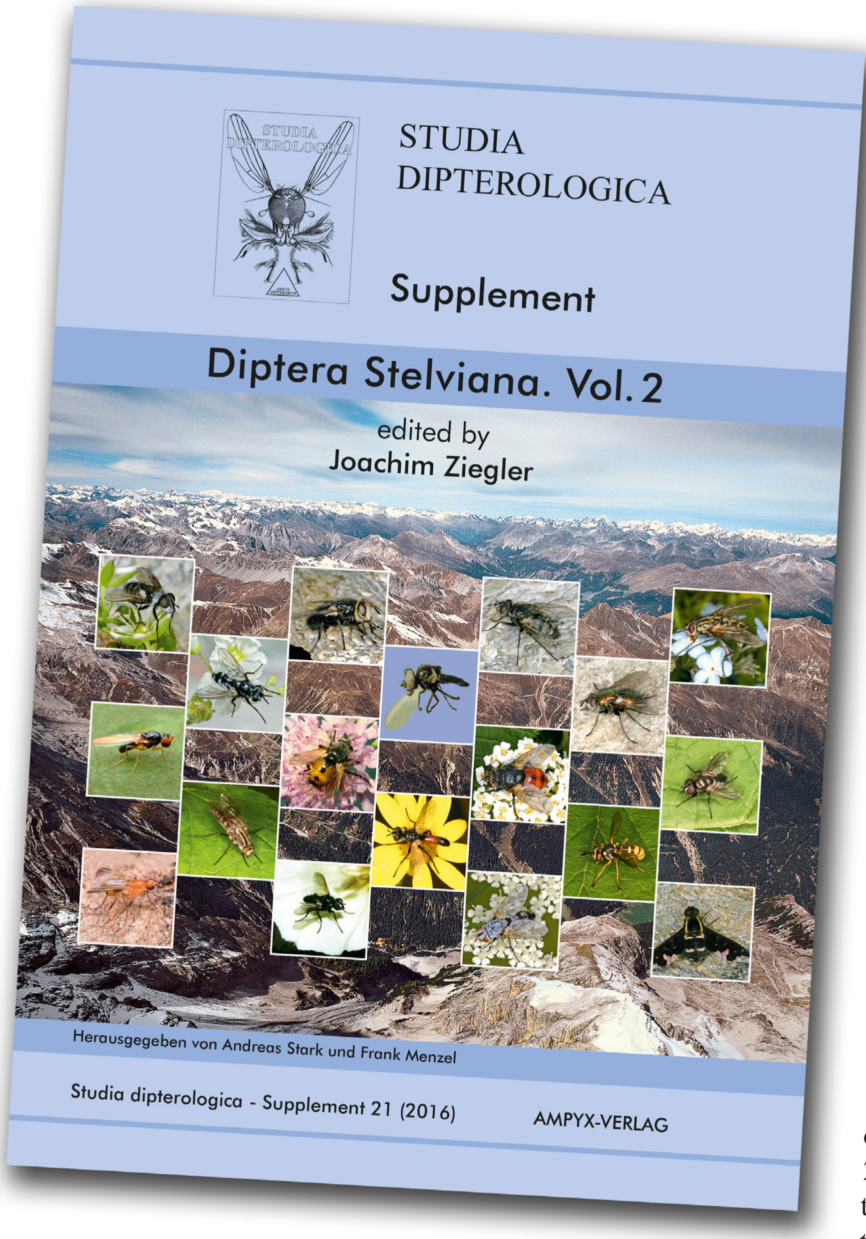

Figure 2. Cover of *Diptera Stelviana*, volume 2.

Eleven maps and 16 diagrams, 137 drawings and 45 photographs of morphological details, 20 other photographs as well as 52 photographs of living flies in their natural habitats (altogether 282 figures) illustrate the contributions. Seven taxa are described as new for science: *Apiloscatopse ziegleri* Heanni (Scatopsidae), *Chrysosomopsis macrocercus* Zeegers, Ziegler & Tschorsnig (Tachinidae), *Dinera fuscata occidentalis* Ziegler (Tachinidae), *Lonchaea stelviana* MacGowan (Lonchaeidae), *Megaselia ziegleri* Disney, Weber & Prescher (Phoridae), *Meoneura pohlae* Stuke (Carnidae), and *Pneumia glabella* Wagner (Psychodidae).

The second volume of *Diptera Stelviana* concludes with an overview of the results, a bibliography for the general part, summaries in Italian and German, a list of the collaborating authors, an index of the illustrations of Diptera species, and an index of the dipterological names.

Catalogue announcement

Preliminary host catalogue of Palaearctic Tachinidae (Diptera)

by Hans-Peter Tschorsnig

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Herewith I let you know that I will retire from the Stuttgart museum (SMNS) at the end of April 2017. From May on I will be present in the museum only about two days per month, but people can always reach me via my e-mail address (above, which will remain valid or slightly change during 2017).

The Palaearctic tachinid-host catalogue on which I have been working these last years will be made available for all as a pdf-file from the end of April 2017 at http://www.nadsdiptera.org/Tach/WorldTachs/CatPalHosts/Home.html. My thanks to Jim O'Hara who made this possible. I plan to provide a revised version of this catalogue every two or three years and would be grateful if omissions or errors could be brought to my attention. Breeders who want to have their reared Palaearctic tachinid material identified are invited to contact me.

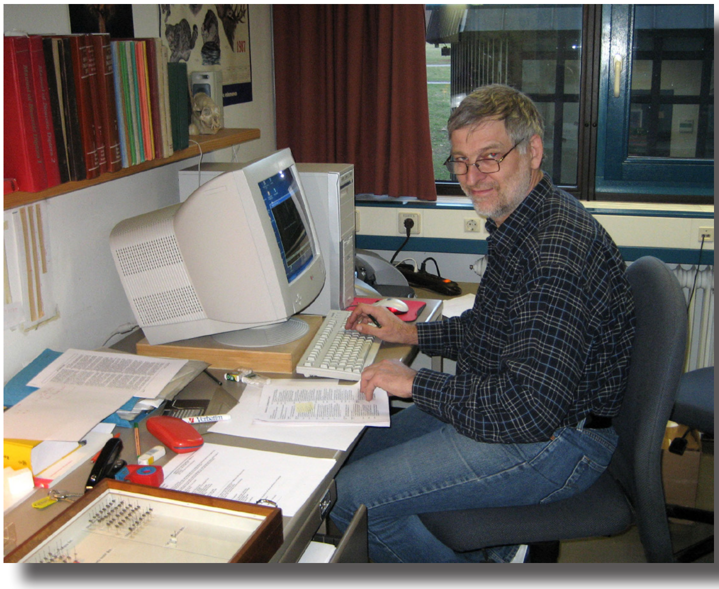

Figure 1. Peter Tschorsnig at his desk in the Stuttgart museum in 2008. (Photo by J.E. O'Hara)

Thank you and best wishes,

Peter

About the catalogue

The aim of this catalogue is to provide information which is as correct as possible and as easy to use for the reader as possible, instead of an unannotated and often confusing mere listing of all records under the originally published parasitoid/host names. This catalogue is based on all available information which became known to the author (by critical study of existing catalogues, published papers and internet sources, checking of complete volumes of many journals, results of own revisions and identifications of material, occasionally also personal communications of colleagues). The content of the catalogue is preliminary in so far as it was not (yet) possible to find, consult or understand all possible sources. Major gaps exist for China; only easily accessible literature for the Palaearctic part of this country was used, and only such in which the scientific names of the hosts were given. Gaps also exist for some other (mainly Asian or eastern European) countries.

Tachinid Bibliography

Included here are references on the Tachinidae that have been found during the past year and have not appeared in past issues of this newsletter. This list has been generated from an EndNote 'library' and is based on online searches of literature databases, perusal of journals, and reprints or citations sent to me by colleagues. The complete bibliography, incorporating all the references published in past issues of *The Tachinid Times* and covering the period from 1980 to the present is available online at: http://www.nadsdiptera.org/Tach/WorldTachs/Bib/Tachbiblio.html. I would be grateful if omissions or errors could be brought to my attention.

Please note that citations in the online Tachinid Bibliography are updated when errors are found or new information becomes available, whereas citations in this newsletter are never changed. Therefore, the most reliable source for citations is the online Tachinid Bibliography.

I am grateful to Shannon Henderson for performing the online searches that contributed most of the titles given below and for preparing the EndNote records for this issue of *The Tachinid Times*.

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