

THE TACHINID TIMES

ISSUE 27

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— is it a tachinid?

Tachinid vs. centipede

Expedition Down Under

Rearing tachinids
in remote Greenland

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DISTRIBUTION

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.

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 2015 issue of *The Tachinid Times* to the editor by the end of January 2015.

FRONT COVER This flashy tachinid with two-toned wings is *Uramya indita* (Walker). It is perched on a leaf of an Arizona sycamore in Marjilda Wash on the east side of the Graham Mountains, Arizona, USA.

Photo: J.E. O'Hara, 6 August 2011

TABLE OF CONTENTS *Macromya crocata* Reinhard drinks from the edge of Ramsey Creek on the Hamburg Trail in Ramsey Canyon, Huachuca Mountains, Arizona, USA.

Photo: J.E. O'Hara, 30 May 2013

BELOW Monument Valley, Navajo Tribal Park, Arizona, USA.

Photo: J.E. O'Hara, 5 June 2013



Studying tachinids at the top of the world



Figure 1. A landscape from Traill island. (Photo: Tomas Roslin)

Notes on the tachinids of Northeast Greenland

by Tomas Roslin¹, James E. O'Hara², Gergely Várkonyi³ and Helena K. Wirta¹

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Introduction

Over the past seven years, we have spent several weeks every summer exploring the host-parasitoid foodwebs of Northeast Greenland. To sample host larvae for rearing, we have crawled over the ground, turned over rocks and swung our sweep nets. To catch adult parasitoids (and adult hosts) in flight, we have used Malaise traps, pitfall traps, pan traps and extensive hand netting. This field work has primarily been implemented by Tomas Roslin and Gergely Várkonyi, while Jim O'Hara has helped identify the tachinids from the catches. Helena Wirta has coordinated the molecular



Figure 2. Zackenberg Research Station. (Photo: Gergely Várkonyi)

work shedding additional light on the fauna and its host associations. As our previous reports from this area have been focused on disentangling the structure of the larger food web by various means (Roslin *et al.* 2013, Várkonyi & Roslin 2013, Wirta *et al.* 2014), we here wish to summarize our findings from an explicit tachinid perspective. Thus, our primary focus will be on the tachinid fauna and its ecology in Northeast Greenland. From a geographic perspective, our specific emphasis will be on the Zackenberg Valley, with additional observations from Traill Island.

Study area

Starting in 2007, the first two summers were spent on Traill Island (72°33'N 23°35'W; Fig. 1). In 2009, we moved our activities some 200 km to the North, to the Zackenberg Valley (74°30'N 21°00'W). Here, the Aarhus University, Department of Bioscience (Denmark), operates the Zackenberg Research Station – a facility providing excellent logistic support in an otherwise inaccessible region (Figs. 2, 3).

Both study sites are located in the high-Arctic zone of Northeast Greenland, and part of the Northeast Greenland National Park. With a size equaling Western Europe, this park forms one of the largest uninhabited areas of the globe. While the interior of the park is covered by the Greenland Ice Sheet, the coastal area is characterized by continuous permafrost soil with a maximum active layer thickness varying from 20–100 cm. The mean monthly air temperature ranges between –20°C and +5°C (Meltofte & Rasch 2008).

On Traill Island, our activities were focused on the Karupelv Valley, at an elevation of less than 200 m.a.s.l. In the southeast, this valley is bordered by the mountain of Svinhufvuds Bjerge (1378 m.a.s.l.) and in the northwest by Kongeberge (1884 m.a.s.l.).

At Zackenberg, we have focused our activities on the Zackenberg river valley. Being located farther north than Traill Island, this area is characterized by a slightly more “lush” vegetation, as shown by a higher component of *Salix* (still only some cm in height). The overall flora of the Zackenberg Valley consists of >150 vascular plant species (Bay 1998). The main vege-



Figure 3. Habitats of the Zackenberg Valley from the ground and the top of Dombjerg Mtn. (Photos: Gergely Várkonyi)

tation types include fen, grassland, salt marsh, *Cassiope tetragona* (Linnaeus) Don (Ericaceae) heath, *Vaccinium uliginosum* Linnaeus (Ericaceae) heath, *Dryas* Linnaeus (Rosaceae) heath dominated by the hybrid of *D. octopetala* Linnaeus and *D. integrifolia* Vahl, snowbeds with *Salix arctica* Pallas (Salicaceae), abrasion plateaus, fell-fields, and lake vegetation (Bay 1998).

Within the Zackenberg area, we have distributed our sampling efforts across multiple complementary techniques, with the aim of documenting both the adult parasitoid community associated with Lepidoptera, and the host associations of individual parasitoids. For the specific methods used for both purposes, see Várkonyi & Roslin (2013), Roslin *et al.* (2013) and Wirta *et al.* (2014).

As a specific advantage for anyone attempting to establish trophic interactions within a host-parasitoid web, Northeast Greenland is characterized by a depauperate flora and fauna. With a total terrestrial fauna and (vascular) flora of approximately 500 and 170 species, respectively (Roslin *et al.* 2013), this scores as one of the least diverse regions in the world. At Zackenberg, the local lepidopteran community comprises 20 species representing 11 families (for a list of species involved, see Várkonyi & Roslin 2013; beyond this list, *Psycho-*

polata (Duponchel) (Geometridae) and *Euxoa drewseni* (Staudinger), *Polia richardsoni* (Curtis), *Sympistis nigrita* (Boisduval) and *Syngrapha parilis* (Hübner) (all Noctuidae; Höykinpuro 2010).

Methods for establishing host associations

Our initial efforts at establishing host associations for the parasitoids of the area were based on the traditional rearing of hosts until the hatching of either the adult host or its parasitoid. For this purpose, we collected and reared more than 400 lepidopteran larvae from Traill Island, and 1450 larvae from Zackenberg. In the next phase of the project, we applied novel techniques based on molecular information for the same purpose. Here, we used order-specific primers for selectively amplifying the DNA of one species in each interspecific interaction. Using this technique, we were able to sequence gut contents of adult flies and parasitoid contents of host larvae (for details, see Wirta *et al.* 2014). Excitingly, the former approach has proven sensitive enough to allow us to amplify DNA remaining in the



Figure 4. (Left) A female *Peleteria aenea* reared from a larva of *Apamea zeta*. (Right) Adults of *P. aenea* are often seen on semi-open sandy ground in sunny weather. The two strong setae on the lower portion of the parafacial (arrow) easily distinguish *Peleteria* from other Greenland tachinids. (Photos: Gergely Várkonyi, ex. Zackenberg Valley)

phora sabini (Kirby) (Geometridae) was detected as a species new to the area in 2013 by TR). Their hymenopteran parasitoids include 27 species representing three hymenopteran families (Ichneumonidae with 19 species, Braconidae with seven species, and Eulophidae with one species; for species, see Várkonyi & Roslin 2013). Traill Island features a handful of additional lepidopteran species, but here our rearings were focused on eight: *Gynaephora groenlandica* (Wocke) (Lymantriidae), *Boloria* spp. (Nymphalidae; *B. polaris* (Boisduval) and/or *B. chariclea* (Schneider), from neither of which the larva has been described), *Entephria*

gut of the adult parasitoid – even after metamorphosis (discussed by Rougerie *et al.* 2011).

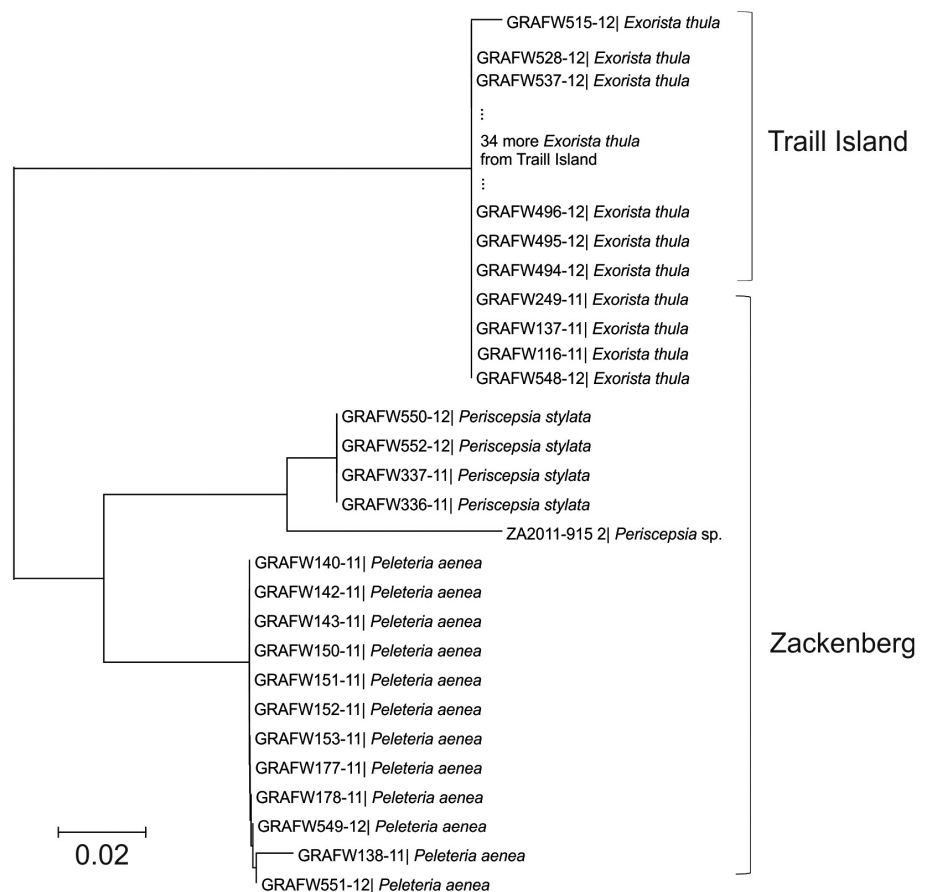
In exploring the best source of host DNA for identifying host remnants from parasitoids, we made an interesting discovery regarding the impact of tachinid morphology and lifestyle: when we extracted DNA separately from the head, thorax, and abdomen of parasitoids, the head of tachinids yielded significantly more identifiable sequences than did other body parts – a pattern contrasting with that observed for wasps (see Wirta *et al.* 2014). This difference among parasitoid orders may be linked to differences in their biology: as tachinids emerge from their puparia by first inflating and

then deflating a balloon-like ptilinum from behind the face, host DNA may be caught in the resultant folds of the ptilinum as it is retracted into the head. This shows how basic knowledge of tachinid biology may help the molecular ecologist in selecting appropriate samples.

The tachinid fauna of Zackenberg

On Traill Island, we detected only one species of tachinid from more than 400 host larvae reared and Malaise traps run over a full summer. This species was *Exorista* sp. (Exoristinae; see below for the identity of this species). At Zackenberg, our even more extensive sampling of the fauna revealed the presence of the same *Exorista* species, along with two other tachinids, *Periscepsia stylata* (Brauer & Bergenstamm) (Dexiinae) and *Peleteria aenea* (Staeger) (Tachininae) (Fig. 4). Quite remarkably, a single sequence of parasitoid DNA detected from within a host larva indicated the presence of a tachinid species never observed as an adult fly in the area (Figs. 5, 6). This sequence differs from *P. stylata* by 5.4% and was detected within a larva of *Boloria chariclea* (in this case, the host *Boloria* was identified to species on the basis of its DNA barcode) with no higher match for any previously barcoded tachinid species. This pattern either suggests the occurrence of cryptic variation within *P. stylata*, or the existence of another species of *Periscepsia* new to Zackenberg. Hence, our DNA-based methods proved useful in revealing the tachinid species richness in this Arctic area (Wirta *et al.* 2014).

Figure 5. A phylogenetic hypothesis for tachinid haplotypes detected in Zackenberg, Northeast Greenland. This phylogeny is based on DNA sequences of the barcoding gene region, and reconstructed by the neighbor-joining technique.



of what really is *fasciata*. These specimens show me clearly why *fasciata* appeared on the Greenland list of Diptera, but whether these variable specimens really represent a different species from the *thula* or whether *thula* is more variable on Traill Island is a matter for gene sequencing to sort out.... Perhaps *thula* is a variant of *fasciata*, but I would not like to say so without seeing more specimens from northern Greenland and Europe.” (e-mail from M. Wood to James O’Hara on January 10, 2009).

To resolve the issue of what *Exorista* species occurs in Northeast Greenland, we have now sequenced a set of tachinids from both Traill Island and Zackenberg for the CO1 barcoding region. To construct a molecular phylogeny for this material, we used the program MEGA5 (Tamura *et al.* 2011), applying both neighbour joining and maximum likelihood techniques with default values. Here, the specimens from both Traill Island and Zackenberg form a single cluster, and are thus of the same species (Fig. 5). This was a somewhat unexpected outcome given the previously observed variation in morphology. We also sequenced several specimens identified as *E. thula* by M. Wood from Ellesmere Island and Banks Island and these clustered with our *Exorista* from Traill Island and Zackenberg. We therefore feel confident that our species is *E. thula*, if indeed

this is a valid species. We further sequenced other *Exorista* specimens that were identified as *E. thula* (Yukon), *E. fasciata* (Finland), *E. larvarum* (Linnaeus) (Canada and Western Europe), and *E. mella* (Walker) (Canada and United States). For these the results were far from clear, suggesting that the identifications – and the characters upon which they were based – are unreliable. There is clearly a need for further molecular and morphological work to resolve this difficult Holarctic species complex.

Host associations of individual species

Based on our efforts to understand the biology and host use of tachinids in Traill Island and Zackenberg, we offer the following observations on individual species (see also Várkonyi & Roslin 2013):

Exorista thula has been reared thrice from *G. groenlandica* at Zackenberg (for details, see Várkonyi & Roslin 2013), and 40 times from the same host species on Traill Island. Our molecular techniques add an interesting twist to these observations, as in Zackenberg this parasitoid was detected from three *Apamea zeta*

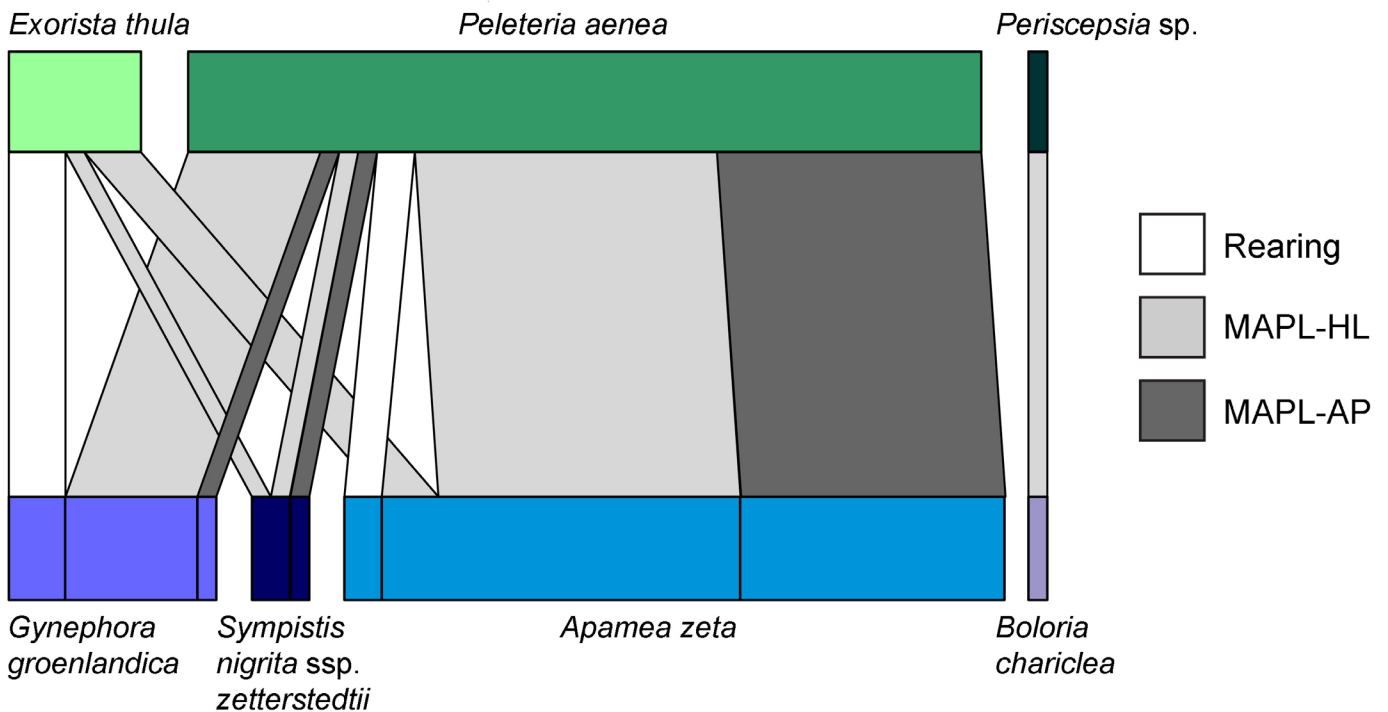


Figure 6. The food web of tachinids and their lepidopteran hosts found in Northeast Greenland, as resolved by three different techniques: traditional rearing (applied to 1450 host larvae), MAPL-HL (Molecular Analyses of Parasitoid Linkages; Host Larvae as the source, as applied to 1195 host larvae), and MAPL-AP (Adult Parasitoids as the source, as applied to 76 adult flies; redrawn from Wirta *et al.* 2014).

(Treitschke) larvae and from one of *Sympistis nigrita* ssp. *zetterstedtii* (Staudinger) (Fig. 6). In addition to the material examined as larvae, we also screened a set of host pupae for the presence of parasitoid DNA (Wirta *et al.* 2014): twenty individual pupae were collected in the wild, representing two species (19 pupae of *Gynaephora groenlandica* and 1 pupa of *Polia richardsoni*). Among the pupae of *G. groenlandica*, we detected three cases of parasitism by *E. thula*.

Peleteria aenea is a common species at Zackenberg, but was not encountered on Traill Island. Yet, it is known from all around Greenland and the Canadian Arctic (Morewood & Wood 2002). While our observations from traditional rearing have previously led us to concur with Morewood & Wood (2002) that this species parasitizes *A. zeta* and not *G. groenlandica* (Várkonyi & Roslin 2013), our molecular data offers a more diversified view of the host use by this species. While *P. aenea* has been reared twice at Zackenberg from a large larva and a prepupa of *A. zeta*, it is also found in *G. groenlandica* and *S. nigrita* ssp. *zetterstedtii* (Fig. 6). At Zackenberg, adults of this species are most often encountered in July (Várkonyi & Roslin 2013).

The ecological significance of high-Arctic tachinids

Our quantitative screening of large sets of host larvae tells us about the general prevalence of tachinids in the harsh climate of Northeast Greenland. On Traill Island, the average parasitism rates of *Exorista thula* on *G. groenlandica* reached 17 to 31% in two different materials collected in 2007 and 2008 by TR and by Juha Höykinpuro, respectively (summarized in Höykinpuro 2010). Within the Karupelv Valley, these rates differed significantly between smaller sites, reaching levels as high as 67% on sandy soils (Höykinpuro 2010). At Zackenberg, parasitism rates by tachinids were notably lower: of 1195 host larvae screened for the presence of parasitoid DNA, only 2.4% tested positive for tachinids (Wirta *et al.* 2014). This finding suggests low parasitism rates at Zackenberg as a whole, and is further supported by the rearing records from Zackenberg: out of a total of 1450 rearings of Lepidoptera larvae, only five (0.3%) produced tachinids. In general, these findings suggest substantial variation at both a local (among sampling sites within the Karupelv Valley) and regional scale (between Traill Island and Zackenberg, as separated by >200 km). Nonetheless, they reveal that even in the High Arctic, biotic interactions involving tachinids are diverse.

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Progress towards a molecular phylogeny of Tachinidae, year two

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Image: J.E. O'Hara

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We reported last year (Stireman *et al.* 2013) in *The Tachinid Times* on our collaborative project, funded by the U.S. National Science Foundation, to study the phylogeny of Tachinidae on a worldwide scale. Since that report, we have made some significant progress towards our goal of assembling a robust phylogenetic tree for Tachinidae. Notably, Cerretti *et al.* (in press) completed a phylogenetic study using 135 morphological characters from 180 tachinid genera. Results from this study largely reflect, with some interesting exceptions, what we are finding from preliminary analyses of our molecular data. Although sampling of taxa and genes for the molecular phylogeny is not yet complete, we will give here a brief update on progress and results so far.

The original goal for the project was to sample five genes from 200–300 tachinid genera representing all of the 59 (or so) recognized tribes. Because a great deal of material had already been accumulated at the time the project officially began, the major difficulty we faced was sampling the smaller, more restricted tribes (see Fig. 1). About half of the tachinid tribes include 30 or fewer described species and just a handful of genera, and ten of these are not found in North America. Some of these smaller tribes undoubtedly represent lineages that are of key importance in

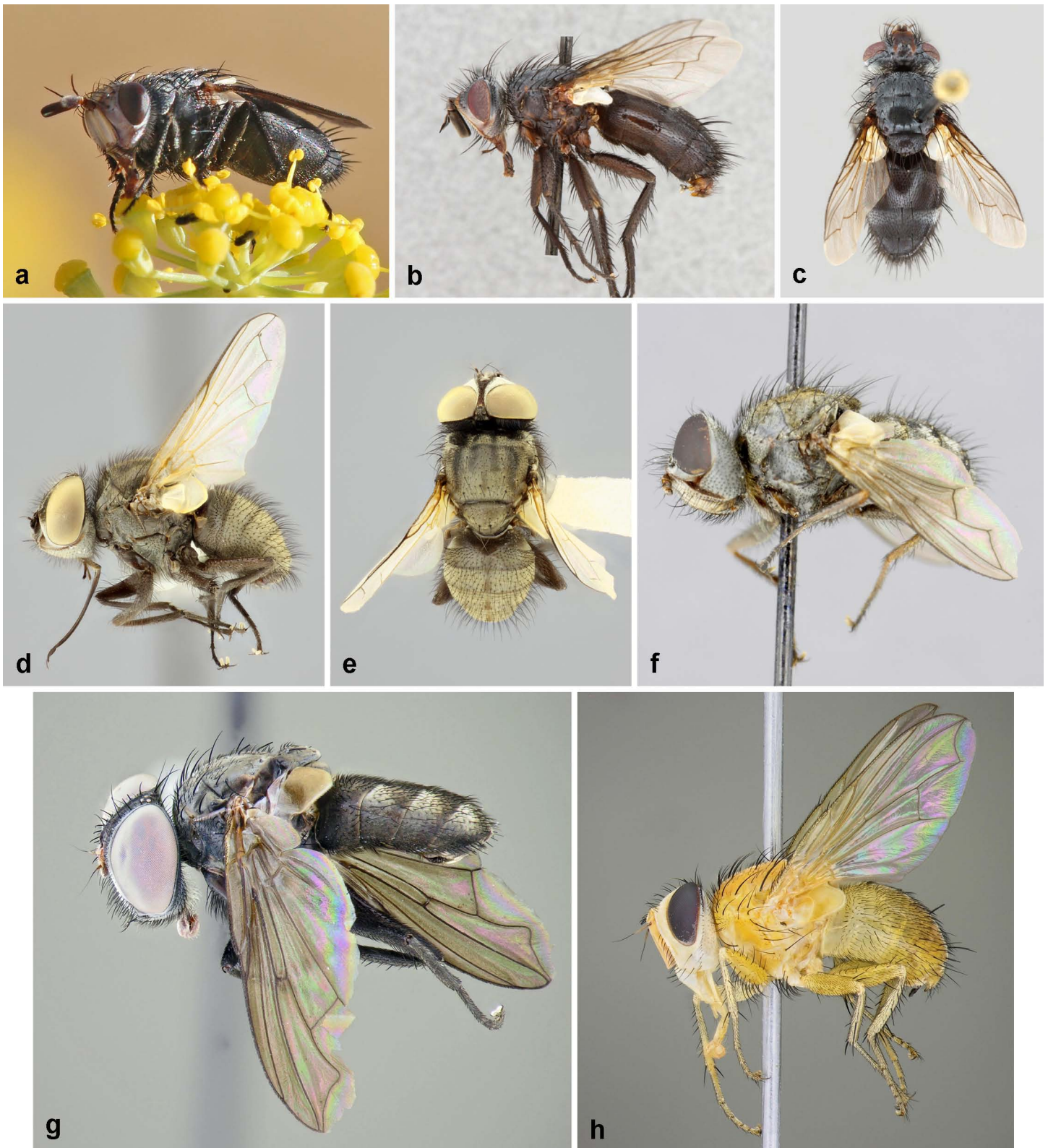


Figure 1. Haves and have-nots. Examples of tachinid genera from small, obscure tribes that we have recently sampled (f–h), or hope to obtain (a–e). **a.** *Germaria hispanica* Mesnil (Spain). **b, c.** *Germaria angustata* (Zetterstedt) (Carcross sand dunes, Yukon, Canada). **d, e.** *Imitomyia sugens* (Loew) (Morinville, Alberta, Canada). **f.** *Rondaniooestrus apivorus* Villeneuve (Swartberg Pass, Western Cape, South Africa). **g.** *Myiotrixia prosopina* Brauer & Bergenstamm (Mt. Allan, Conondale National Park, Queensland, Australia [26°38.39'S 152°38.07'E]; type locality of this species in Australia is unknown). **h.** A probable new genus of Glaurocarini (Mt. Moffatt, Carnarvon National Park, Queensland, Australia).

helping us understand tachinid phylogeny and its implications for the evolution of host use and other characters, while others are possibly nested within larger tribes. We have made some good progress during the last year in obtaining representatives of these smaller tribes. Jaako Pohjoismäki and Theo Zeegers recently sent Palaearctic representatives of Nearerini, Pelatachinini and Germariochaetini, as well as important genera in other tribes. During our recent trip to Australia (see report elsewhere in this newsletter) we were able to obtain specimens of Glaurocarini (Fig. 1h) and the endemic Myiotrixini (Fig. 1g). Last year's trip to South Africa (Cerretti *et al.* 2013) yielded Rondanioestrini (Fig. 1f), parasites of honeybees, and specimens of the isolated genus *Litophasia* Girschner, one of the only tachinids without a developed subscutellum. Rudi Schnitzler in New Zealand is generously sending material of the tribe Occisorini, an endemic radiation that makes up a significant part of the tachinid fauna of New Zealand.

We are still lacking material from seven tribes, some of these widespread across the Palaearctic and/or Nearctic regions but rare. We would especially be grateful for any material from these missing tribes: Imitomiyini (widespread; Fig. 1d,e), Iceliini (Nearctic/Neotropical), Doleschallini (Oriental/Australasian), Anacamptomyiini (Afrotropical/Oriental/Australasian), Protohystriciini (Australasian [New Zealand]), Freraeini (Nearctic/Palaearctic), and Germariini (Palaearctic/Nearctic [Yukon]; Fig. 1a–c).

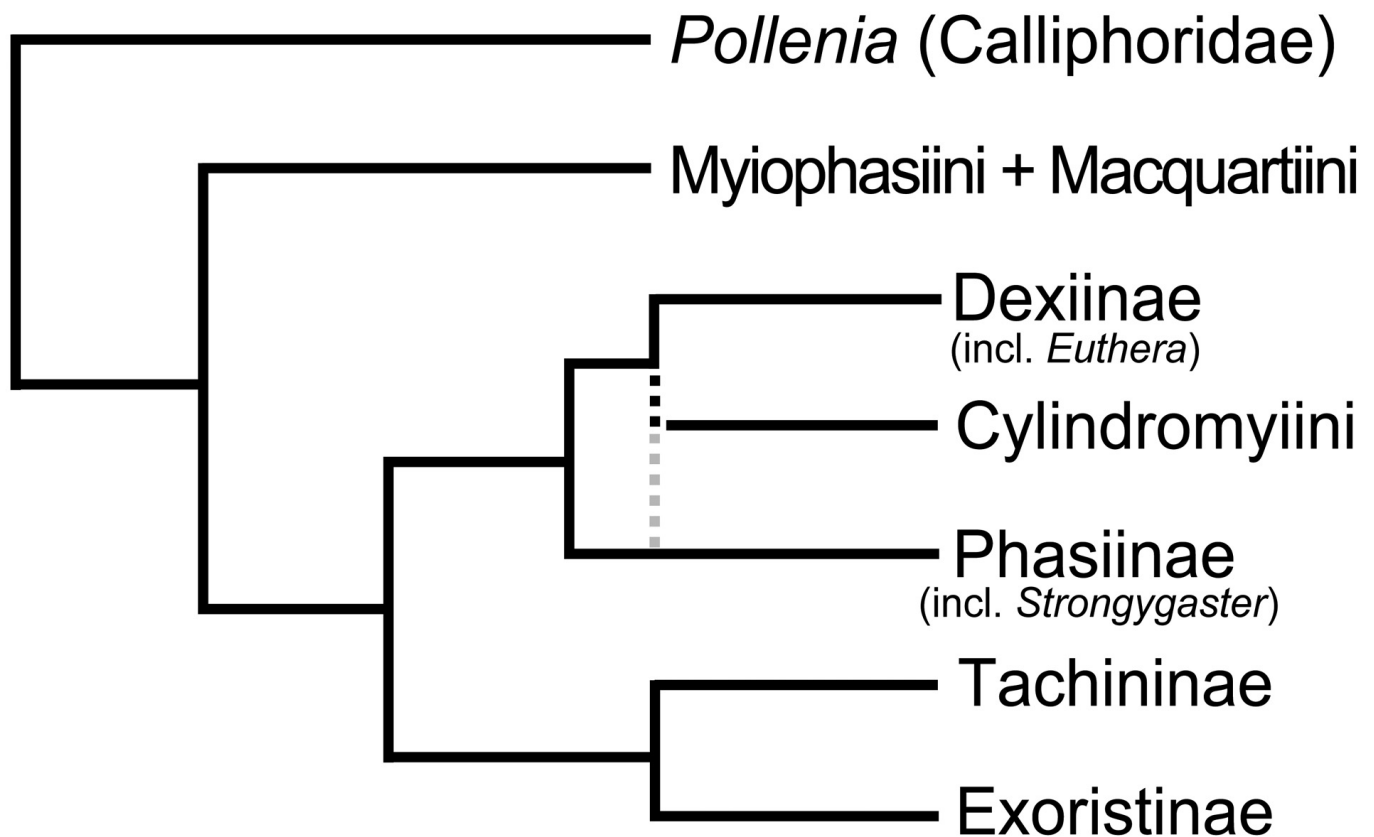


Figure 2. Summary of some major results from ongoing analyses of tachinid phylogeny using molecular data.

Progress on sequencing work in the Stireman Lab is moving along. We are focusing first on the 28S and CAD genes, and have these sequences nearly complete for about 300 genera. We anticipate adding 30–50 additional genera to this total, including specimens from our recent Australia trip. We will be focusing next on MAC and MCS, two genes that are being newly developed (along with a few others) for phylogenetic use by Moulton. In a smaller pilot study (22 tachinids, 9 genes) that will be submitted soon for publication, these last two genes showed very good potential for resolving tachinid relationships. In addition to sequencing the MAC, MCS and LGL genes for the pilot study, Blaschke has been using these genes to focus on the phylogeny of Phasiinae. His results so far are reported in his recently defended Master's thesis (http://trace.tennessee.edu/utk_gradthes/2393/).

Although we are still in the process of assembling and analyzing data, there are some interesting early results that we can share (Fig. 2). First, our results suggest that the calliphorid subfamily Polleniinae is the nearest relative of tachinids. *Pollenia* Robineau-Desvoidy is a genus of widespread (and widely introduced) common flies that are parasitoids of earthworms. We also have evidence for an early-branching lineage within Tachinidae consisting of beetle parasitoids in the tribes Myiophasiini and Macquartiini, which may be the sister to all remaining tachinid tribes. Both of these results are exciting for their implications for the early evolution of host use in Tachinidae. Our results regarding subfamily monophyly are not yet wholly clear. While Exoristinae are strongly supported as monophyletic, Tachininae are very weakly so. We find Dexiinae to be monophyletic, but Cylindromyiini sometimes groups with Dexiinae instead of the remaining Phasiinae. Some tribes are monophyletic, but many are not, including Voriini, Thelairini, Phasiini, Minthoini, Leskiini, Ernestiini, Eryciini, Goniini, and Ethillini. Blondeliini, a tribe of particular interest to our project, is largely composed of a single monophyletic lineage, but certain aberrant genera (e.g., *Phyllophilopsis* Townsend, *Trigonospila* Pokorny) appear to have a more basal position within Exoristinae (see also Stireman 2002, Tachi & Shima 2010). Our data are able to place certain tribes whose subfamily placement has been debated; for example, we find *Euthera* Loew near the base of the Dexiinae, and *Strongygaster* Macquart well-nested within Phasiinae (see also discussion in Cerretti *et al.* in press).

Our picture of tachinid phylogeny grows clearer each time we add new data to the analysis, and we should soon have a fairly complete outline of tribal relationships. As usual, a close look at the details will bring up numerous additional questions that will keep us busy for years to come.

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We especially thank Jaako Pohjoismäki (University of Eastern Finland, Joensuu, Finland) for sending material of Neaerini and Pelatachinini, as well as important genera in other tribes; Theo Zeegers (Soest, Netherlands), who supplied material of Germariochaetini; and Rudi Schnitzler (Landcare Research, Auckland, New Zealand) for sending a sampling of New Zealand Tachinidae. Martin Hauser and Steve Gaimari (both of California Department of Food and Agriculture, Sacramento, United States), Neal Evenhuis (Bishop Museum, Honolulu, United States), Jeff Skevington (Canadian National Collection of Insects, Ottawa, Canada), Diego Inclan (University of Padova, Padova, Italy), and Greg Dahlem (Northern Kentucky University, Highland Heights, United States) all provided important specimens for the project. Thanks to Matthew Duncan (Wright State University, Dayton, United States) for taking photos of *Myiotrixa prosopina* and the new genus of Glaurocarini, to Shannon Henderson (Canadian National Collection of Insects, Ottawa, Canada) for taking photos of *Germaria angustata*, and to Piluca Álvarez (Madrid, Spain) for providing an image of a live *Germaria hispanica*. Support for this study from U.S. NSF DEB-1146269 (Stireman) and U.S. NSF DEB-1146290 (Moulton) is gratefully acknowledged.

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On the biology of *Loewia foeda* (Meigen) (Diptera: Tachinidae)



Figure 1. *Loewia foeda*, live female (Karmøy, Norway).

by Håkon Haraldseide¹ and Hans-Peter Tschorsnig²

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INTRODUCTION

Parasitization of non-insect arthropods in Tachinidae is rare and only four species have been documented as chilopod parasitoids: *Eloceria delecta* (Meigen) (Giard 1893a, 1893b; Herting 1960), *Loewia foeda* (Meigen) (Thompson 1915) and *Loewia* sp. (Cerretti & Tschorsnig 2010) from the Palaearctic Region, and *Chromatocera harrisi* (Reinhard) (Reinhard 1935, O'Hara 2002) from the Nearctic Region.

The genus *Loewia* Egger is mostly Palaearctic in distribution, with the presence of one Holarctic species (*L. foeda*) in the Nearctic Region (Wood & Wheeler 1972) possibly due to an introduction. Centipede hosts have been recorded from two of the 17 currently known species of *Loewia* (see Cerretti *et al.* 2014): *L.*

foeda reared from *Lithobius* sp. (Thompson 1915), and a species of *Loewia* that is probably *L. brevifrons* (Rondani) reared from *Eupolybothrus fasciatus* (Newport) (Cerretti & Tschorsnig 2010, Cerretti *et al.* 2014). It is likely, however, that all species of *Loewia* are parasitoids of chilopods.

There are two important works on *L. foeda*: Thompson (1915) with descriptions and figures of the three larval instars and Wood & Wheeler (1972) that reviews the taxonomic history, describes and illustrates the adult, and briefly discusses its life history.

Presented below are the results of field observations of *L. foeda* (Fig. 1) in Norway and experiments and dissections that show that *L. foeda* practices direct larviposition. The puparium is described for the first time.

MATERIAL AND METHODS

Field observations were made at various locations in Karmøy (Slettavatnet and Grodvatnet) in western Norway.

For the larviposition experiments a five deciliter glass jar was used, with a cover of elastic fabric held in place with a rubber band. Larviposition was filmed with a compact camera placed on top of the jar with the lens protruding through a hole cut in the fabric. After a couple of hours the host was checked for signs of parasitization and the video analyzed. Females used for these experiments were collected near Slettavatnet on 12.viii.2013 (while host-searching) and 18.viii.2013 (while feeding).

Females used for dissections were from Slettavatnet (Karmøy) and Finnvik (Suldal) in western Norway (leg. H. Haraldseide; several specimens hand-netted in the field), and Köln in Germany (leg. J. Wehlitz-Franzen; five specimens collected in Malaise traps, July–August 1989). Nine females in total were dissected.

Puparia were found under moss and bark, but most often in the transition zone between rotting wood/bark and soil. Host centipedes were not found but several puparia had centipede segments stuck to them, so the puparia were almost certainly those of *Loewia foeda*. These puparia fit the description of the third larval instar given by Thompson (1915) and also closely match the puparium of a *L. foeda* female housed in Staatliches Museum für Naturkunde (Stuttgart) (from Slovakia, reared in 1966 but without host information). The puparium of *L. foeda* was unknown to Herting (1960) and Ziegler (1998) and they cited Thompson (1915).

The host, *Lithobius forficatus* (Linnaeus), was identified by the first author using Andersson *et al.* (2005).

FIELD OBSERVATIONS

Adults have been recorded in Norway from the beginning of July to the end of August, with single specimens as late as the end of September. They are uncommonly observed, but this is probably due more to their unimpressive habitus and lifestyle than to their rareness. They visit flowers of Daucaceae (*Angelica sylvestris* L., *Heracleum sphondylium* L.) but are most often seen resting on stones or foliage (cf. observations of *L. crassipes* (Mesnil) in Turkey by Bystrowski 2011). Host-searching can typically be observed as follows: the female scuttles energetically and seemingly somewhat systematically over the substrate and disappears under stones, bark and into other crevices where the host is to be expected, only

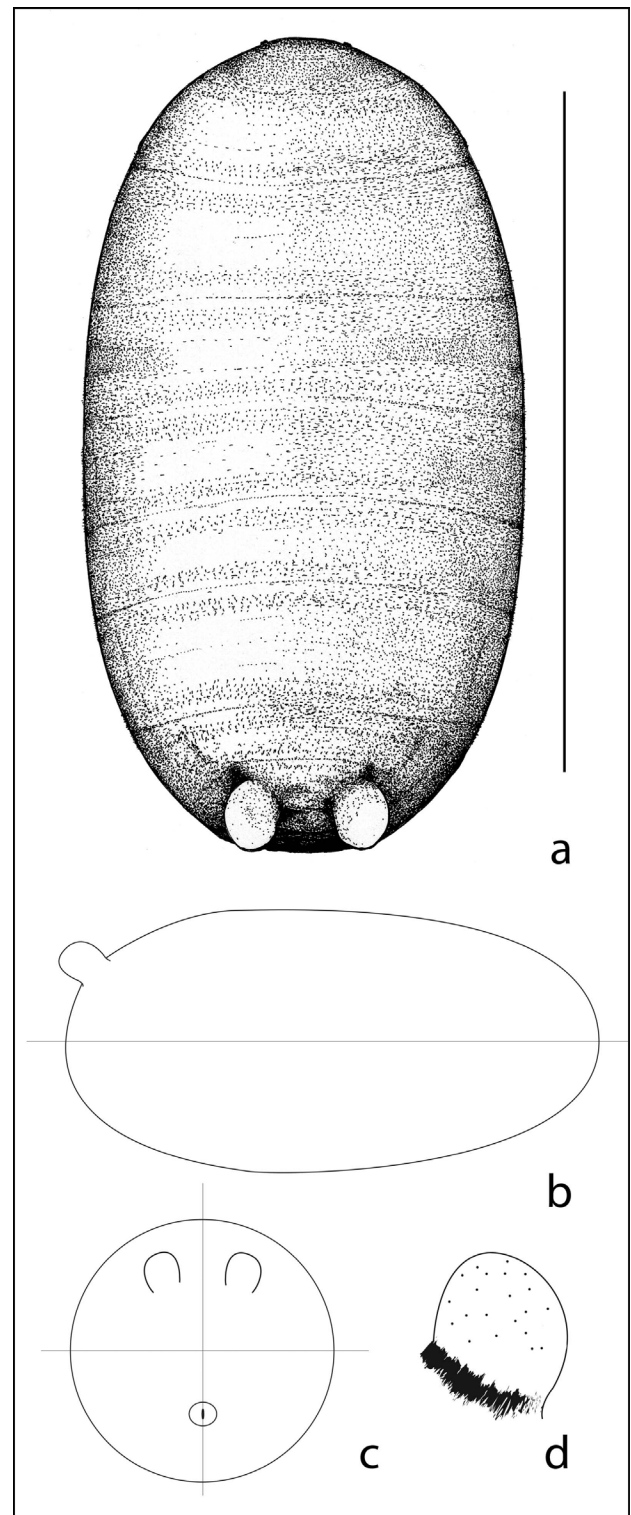


Figure 2. *Loewia foeda*, puparium. **a.** Dorsal view. **b.** Lateral view. **c.** Posterior view. **d.** Right posterior spiracle. Scale bar for (a): 5.0 mm.

to reappear seconds later and continue. Once an area is searched it flies a short distance and continues.

PUPARIUM

Eight puparia were examined. They are 6.0–6.5 mm long and 3.0 mm wide, reddish-brown to black, cylindrical and blunt, sometimes slightly widening posteriorly, occasionally a little bit dorsoventrally compressed. Surface texture smooth and dull with transverse striations, segmental divisions usually clearly visible. Complete bands of minute spines present dorsally and ventrally (Fig. 2a,b,c). Lateral muscle scars sometimes well de-

surface (Fig. 2d). Anal plate situated posteroventrally, circular to slightly oval, sometimes poorly defined and opening slit-like.

Of the eight puparia collected during the winter of 2012/2013, three showed signs of hymenopteran hyperparasitization and one contained a dead ichneumonoid larva/prepupa.

EXPERIMENTS ON LARVIPOSITION

The first author made experiments to determine what type of oviposition strategy is used by *L. foeda*. One female fly at a time was placed in a jar together with a single centipede (later identified as *L. forficatus*). The experiment was done twice. In the first experiment, a previously host-searching female was used. The second experiment used a female caught while it was feeding on a flower of *Angelica sylvestris*. After two hours the results were the same, but the second female showed much less interest in the centipede and the attacks were less frequent. It should be noted that in the second experiment a semi-teneral centipede was used and this might have had a secondary effect.

In the first 10 minutes the first female made contact with the centipede six times (first contact after two minutes). The second female made contact only once (first contact after 30 seconds).

The attacks were extremely fast (Fig. 3). The fly runs up on the side of the centipede or lands directly on it and clings on to its dorsolateral surface. The centipede reacts violently and twitches; in doing so the fly flies off, leaving the centipede in an agitated state, jerking both its head and tail while fleeing.

Whenever the fly came too near the head of the centipede, it retreated and flew off. *Loewia* nearly always attacked when the centipede was still, only very rarely making contact with a moving centipede.

Immediately after both trials several first instars were observed on the hosts' posterior two-thirds: recumbent larvae were observed on the lateral soft membranous area and erect larvae were visible on the ventral sclerotized parts of the segments. Counts of the larvae deposited on the host were not possible due to the difficulty in handling the live centipede.

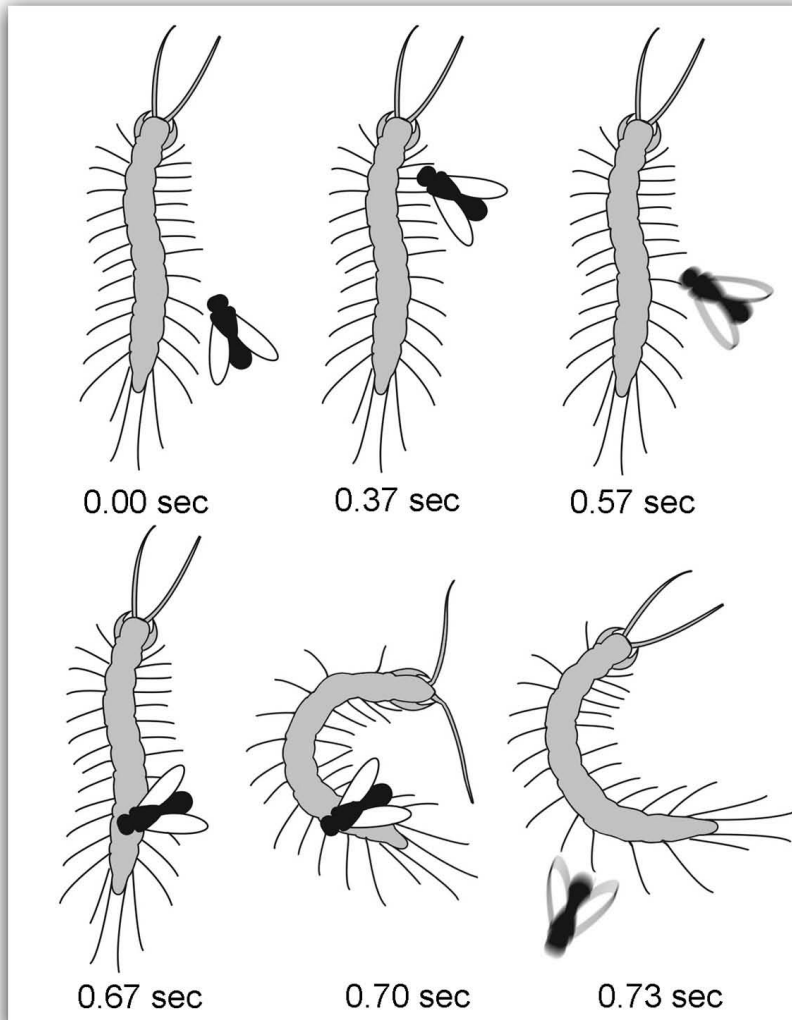


Figure 3. Typical attack of a female *Loewia foeda* on *Lithobius forficatus*, schematically.

fined. Anterior spiracles small, black, with 4–6 circular openings which are asymmetrical in position and number. Posterior spiracles shiny, large, well separated, knob-like, globular and protruding (almost stalked), situated posterodorsally; no spiracular slits are visible, but scattered punctures are shining through the smooth

DISSECTION OF GRAVID FEMALES

Mature and immature first instars were arranged in slightly oblique rows of 5–6 within a coiled uterus, which filled much of the abdomen. Although all nine dissected females (including the ones from the larviposition experiments) were gravid, only five contained mature first instars (Fig. 4). The larvae, especially the younger ones, were separated from each other by an extremely fine membrane, but this membrane always remained connected with the uterus when the larvae were moved with a pin. It is obvious that these membranes consist of the remains of the former eggshells which are now more or less glued together and to the uterus.

The flies of German origin used for the dissections were immediately killed in the fluid of a Malaise trap, and the Norwegian material by freezing, so it very unlikely that there was enough time for hatching of the larvae from eggshells in the uterus after the death of the female.

No evidence for internal larval nourishment was found; mature first instars (on the average approximately 0.7 mm in body length) were no larger than their immature siblings.

The two females used in the experiments were almost depleted of larvae when they were dissected: 30 mature larvae were counted in the first female and about 100 in the second female. The dissection of another female, with the uterus filling nearly the entire abdomen, yielded more than 300 larvae which were fully developed or nearly so.

DISCUSSION

The question of larvipary versus ovarvipary is one of definitions but also sometimes blurred by facultative

responses. An ovarviparous species might appear to be, or may sometimes be, larviparous if the larva breaks the chorion at or just before deposition. Most authors define larvipary by the presence of nutritive glands in the uterus. In Tachinidae, “larvipary” has been regarded as the misinterpretation of ovarvipary by Wood (1987) and O’Hara (2008). Herting (1960) concluded that larvipary does not occur in Tachinidae based on the lack of evidence of nutritive glands in the uterus. Meier *et al.* (1999) defined viviparous species as those that deposit live larvae, meaning that the larvae hatch from their egg shells within the female. They further divided viviparity into larviparity and pupiparity, with the latter term reserved for species that retain a larva within the female until it forms a puparium (i.e., only Streblidae). Given this definition of larvipary, which is defined by the hatching of eggs internally rather than the nutritive nature of the uterus, *L. foeda* is in our opinion truly larviparous rather than ovarviparous. In ovarviparous species, mature first instars hatch from their eggs immediately after being deposited on a host or substrate, and to the casual observer this may be mistaken for larvipary.

It could be assumed that a dipteran centipede parasitoid would rather avoid direct contact with the host, which is a potentially dangerous animal to a fragile fly. The sudden direct attack, as was observed during our experiments, was therefore unexpected at first. However, there exists a plausible explanation for this behavior: an exposed centipede host, once located by a female tachinid, should be immediately attacked before it gets the chance to escape under the substrate beyond the reach of the fly. There are probably limited opportunities for larviposition and any chance must be acted upon.

Judging from the immediate success of the experiments it is believed that *Lithobius forficatus* is a natural host of *L. foeda*.

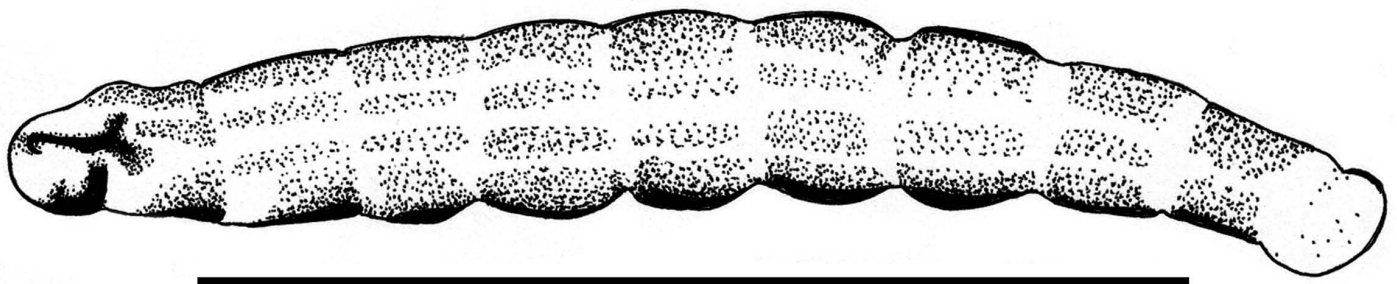


Figure 4. Mature first instar larva from the uterus. Scale bar: 0.5 mm.

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Figure 1. Epiphyte-laden tree in the lush rainforest of Lamington National Park, Queensland. (Photo: P. Cerretti)

Chasing tachinids 'Down Under'

Expeditions of the Phylogeny of World Tachinidae Project

Part II

Eastern Australia



Figure 2. *Rutilia regalis* Guérin-Méneville, one of the first tachinids described from Australia (from Guérin-Méneville 1831: pl. 21).

Preamble

Last year we documented in the pages of this newsletter an expedition to the Western Cape of South Africa in search of tachinids for the “Phylogeny of World Tachinidae” project (Cerretti *et al.* 2013). The project itself was discussed in a separate article (Stireman *et al.* 2013). In this issue of *The Tachinid Times* we discuss our expedition to eastern Australia in late 2013. This trip took place so recently that we have yet to fully identify our material and as a result cannot record here all of the taxa we collected. Instead, we will add the taxa to a webpage we have created about this expedition. The webpage is up and running and currently provides specific information about each collecting locality and includes images of most of the places. The webpage is located here:

<http://www.nadsdiptera.org/Tach/WorldTachs/TachPhylo/PhyloexpeditionAustralia2013.html>

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Introduction

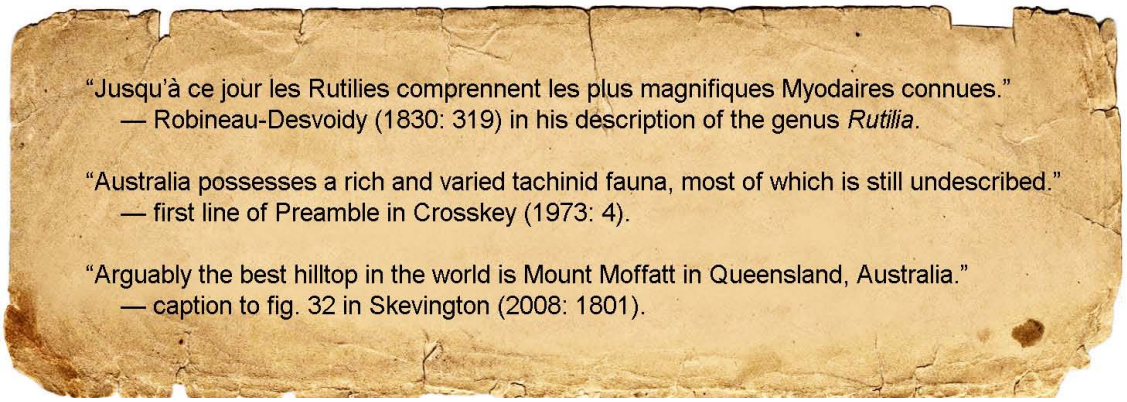
There is a mystique about Australia that dates back to the earliest accounts of this island continent. Merchant ships from Europe and later voyages of discovery through the 1600s and 1700s told about a vast land inhabited by strange animals quite unlikely those of anywhere else. Gradually, specimens of the more conspicuous and common species began to trickle back to Europe and were eagerly examined and named by specialists of the day.

on a specimen in the Banks collection (now housed in the Natural History Museum, London) that was possibly collected during one of the voyages of Captain Cook in the latter half of the 1700s (Crosskey 1973a).

The first tachinid genera to be described from Australian material were named *Rutilia* and *Palpostoma* by French dipterist Robineau-Desvoidy (1830), who in this same work also described more than a dozen other currently-valid genera that have since been recorded from Australia. Some of the prettiest rutiliine species were described soon after by French entomologist Guérin-Méneville (1831, 1838, 1843) and given the sort of names usually reserved for more prized catches like beetles, butterflies and birds: *decora*, *imperialis*, *mirabilis* and *regalis* (Fig. 2).

The peculiarities of the Australian bird fauna led Sclater (1858) to recognize the Australian Region as one of six "natural primary ontological divisions of the earth's surface". The Australian Region of Sclater was not so different from the Australasian/[Oceanian] Region of today, comprising as it did Australia, New Guinea, New Zealand, and many islands in the Pacific Ocean. Wallace (1876) reviewed and synthesized a wealth of knowledge about the distribution of animals and concluded that the six regions founded on birds by Sclater (1858) worked well for other animals too, after some fine tuning of the boundaries.

The six biogeographic regions of Sclater and



"Jusqu'à ce jour les Rutilies comprennent les plus magnifiques Myodaires connues."
— Robineau-Desvoidy (1830: 319) in his description of the genus *Rutilia*.

"Australia possesses a rich and varied tachinid fauna, most of which is still undescribed."
— first line of Preamble in Crosskey (1973: 4).

"Arguably the best hilltop in the world is Mount Moffatt in Queensland, Australia."
— caption to fig. 32 in Skevington (2008: 1801).

Tachinids were not generally well represented among the first insects collected from foreign lands, but in Australia there exists a tribe that is almost entirely confined to the Australasian Region, the Rutiliini, of considerable diversity and sometimes dazzling metallic colouration. It is thus not surprising that the first tachinid to be described from Australia was a rutiliine, named by the famed Danish entomologist and former student of Linnaeus, J.C. Fabricius. It was described as *Musca retusa* Fabricius (1775: 775) (now *Rutilia retusa*), based

Wallace have been carried through to the present day with little change. The impact of these works is seen throughout biology and is especially noticeable in the treatments of faunas and floras. Within Diptera, for instance, this is seen in the current "regional" catalogues; the *Catalog of the Diptera of the Australasian and Oceanian Regions* (Evenhuis 1989 and online) being the relevant one here, and more particularly the Tachinidae chapter by Cantrell & Crosskey (1989).

Australian Tachinidae

We knew our time would be limited so we chose to visit only Australia within the Australasian Region. It was our good fortune that the Tachinidae of Australia had been recently catalogued as part of the Australian Faunal Directory (AFD) and is available online (<http://www.biodiversity.org.au/afd/taxa/TACHINIDAE>). This inventory was based largely on the conspectus of Crosskey (1973b) and catalogue of Cantrell & Crosskey (1989) and then updated with the addition of literature published since the latter. According to the Statistics page for Tachinidae on the AFD website, the described fauna presently stands at 145 genera and 519 species (plus a few unrecognized species). This is about 100 species more than catalogued by Crosskey (1973b).

If one were to take the number of valid species of Australian Tachinidae as a close approximation of the true fauna, then birds would well outnumber tachinids in Australia. The truth is much different. Many taxonomists have dabbled in the tachinids of Australia but few have specialized on them. There have been a few significant revisions (e.g., Crosskey 1973a, Cantrell 1984, Barraclough 1992, Colless 2012), but on the whole the fauna is both under-studied and under-sampled. [Note to would-be tachinid systematists: new species abound in Australia both in collections and in nature!]

The one saving grace for anyone venturing into the tachinids of Australia is Crosskey's (1973b) *A conspectus of the Tachinidae (Diptera) of Australia, including keys to the supraspecific taxa and taxonomic and host catalogues*. Without this we would be lost. It provides keys to subfamilies, tribes and genera, a discussion and description of each subfamily and tribe, host data, and a complete catalogue of names and types. It does, however, have serious drawbacks for the modern user because of its now out-dated classification and the inadequacy of the named and unnamed material available to Crosskey at the time it was written. For us attempting to identify our Australian material, keying specimens in Crosskey (1973b) is proving a challenge.

Let us return to the question of how many species of Tachinidae are in Australia. The first estimate was made by Crosskey (1973b). He examined specimens in various museums and noted the abundance of undescribed species. He concluded the described fauna "represents only a small proportion of the species" and suggested "that when fully worked out the Australian Tachinidae will muster some 1500–2000 species" (Crosskey 1973b: 4). One of us (JEOH) collected in Australia in October 2002 and was impressed by the huge number of species he was able to collect in just

a few days, especially in Carnarvon National Park in Queensland. He and two colleagues collected on three hilltops in three days in Carnarvon and caught 1116 specimens representing 167 morphospecies (O'Hara *et al.* 2004). Surely Crosskey (1973b) was right about the high number of undescribed species. Using admittedly scanty data from Carnarvon, O'Hara *et al.* (2004) estimated that "460 species of Tachinidae for Carnarvon N.P. is reasonable and perhaps conservative" (p. 9) and suggested "the total Tachinidae fauna of Australia to be roughly in the order of 3500–4000 species" (p. 10).

Australian Expedition, November 28 – December 18, 2013

The joint destination for the four of us in 2013 was eastern Australia. We decided early on to concentrate on collecting in national parks, since these contain among the best undisturbed habitats on the continent and have good access. Our time was limited so we chose a route through eastern New South Wales and southern Queensland that would include coastal and inland sites and habitats ranging from sand dunes to eucalypt forests to wet and dry rainforests (Fig. 1). We also planned to split up our team, with Pierfilippo and Jim arriving first and collecting in New South Wales, followed by the four of us collecting together in Queensland, and then John and Isaac collecting for a few days north of Brisbane after the departure of Pierfilippo and Jim. We documented our intentions in permit applications to the New South Wales and Queensland governments and were successful in obtaining permits for most of the parks we wanted to visit. With collecting permits arranged, we were then able to secure the necessary export permits to take specimens out of the country. As is usual with permits of this sort, any holotypes that might be designated from material we collected will (i.e., must) be deposited in an Australian institution.

The major stops along our route are shown in Fig. 3 and are numbered chronologically. They are reviewed briefly below and accompanied by some images of places and tachinids. More specific information about localities and taxa collected are given on the [webpage](#) about this trip.

1. Myall Lakes National Park, 29.xi.–1.xii.2013 (PC & JEOH)

This park is situated about 200 kilometres north of Sydney and comprises a patchwork of 47,500 hectares of lakes, coastal sand dunes, wetlands, eucalypt forest,

and wet and dry rainforest. We collected along the coast at such places as Dark Point and Hawks Nest (both consisting of dunes), Robinsons Fire Trail (eucalypt forest), Mungo Brush Road (rainforest). At an inland site, we collected under The Grandis, a giant flooded gum tree thought to be the tallest tree in New South Wales (a remnant of old-growth forest). Of special interest, and a place to which we returned three times, was O’Sullivan’s Gap along Wootton Way (a.k.a. the Old Pacific Highway). In addition to tachinids, we sought and found the “McAlpine’s fly” (Kutty *et al.* 2010), an enigmatic fly about 2 mm in length that strongly resembles a muscid except for robust legs and a stance in which the wings are held slightly apart (although not always) as do sev-

eral oestroids. In the same place Pierfilippo captured a female of *Axinia* sp. (Rhinophoridae) in a pan trap for a study on rhinophorids he is pursuing with Thomas Pape (Natural History Museum of Denmark, Copenhagen).

Among the Tachinidae collected at O’Sullivan’s Gap were several males of a species of *Zosteromeigenia* Townsend, a blondeline with particularly well-developed sexual patches ventrolaterally on the 5th abdominal segment (Figs. 13, 14).

2. New England National Park, 2–4.xii.2013 and adjacent Cunnawarra National Park, 4.xii.2013 (PC & JEOH)

This is a magnificent park with large tracts of undisturbed forest within the boundaries of its approximately 72,000 hectares. Situated in the New England Tablelands, it is best known for the precipitous cliffs that line the Great Escarpment. One particularly scenic spot along the cliffs has been developed into Point Lookout with a parking lot, picnic areas, and trails to overlooks. The combination of a drop of over 1000 metres to the valley below and the fact that the Lookout juts out from the irregular line of cliffs may account for it being a superb hilltopping site for a wide variety of Tachinidae. Monty Wood had great success here in late December of 2005 and recommended Point Lookout to us. We had great weather, good collecting (just shy of our expectations), and this proved to be our best site in New South Wales.

Upon arriving at Point Lookout we were greeted by an intense buzzing coming from the bushes alongside the parking lot. To our disappointment, however, we quickly realized that much of the buzzing was produced by flies of the genus *Calliphora* Robineau-Desvoidy (Calliphoridae) (Fig. 4). Interestingly, among the thousands of *Calliphora* we managed to collect some interesting Tachinidae that were impressive in their resemblance to calliphorids in shape and colour and also mimicked the posture of the wings at rest, held along the body rather than slightly apart as is the rule for most tachinids. A pretty smaller-sized *Rutilia* (subgenus *Microrutilia* Townsend) with dark metallic reflections was one of the most abundant tachinid species at Point Lookout (Fig. 5). Along the path leading between overlooks we caught a few long-legged dexiines of the genus *Senostoma* Macquart on tree trunks (Fig. 6).

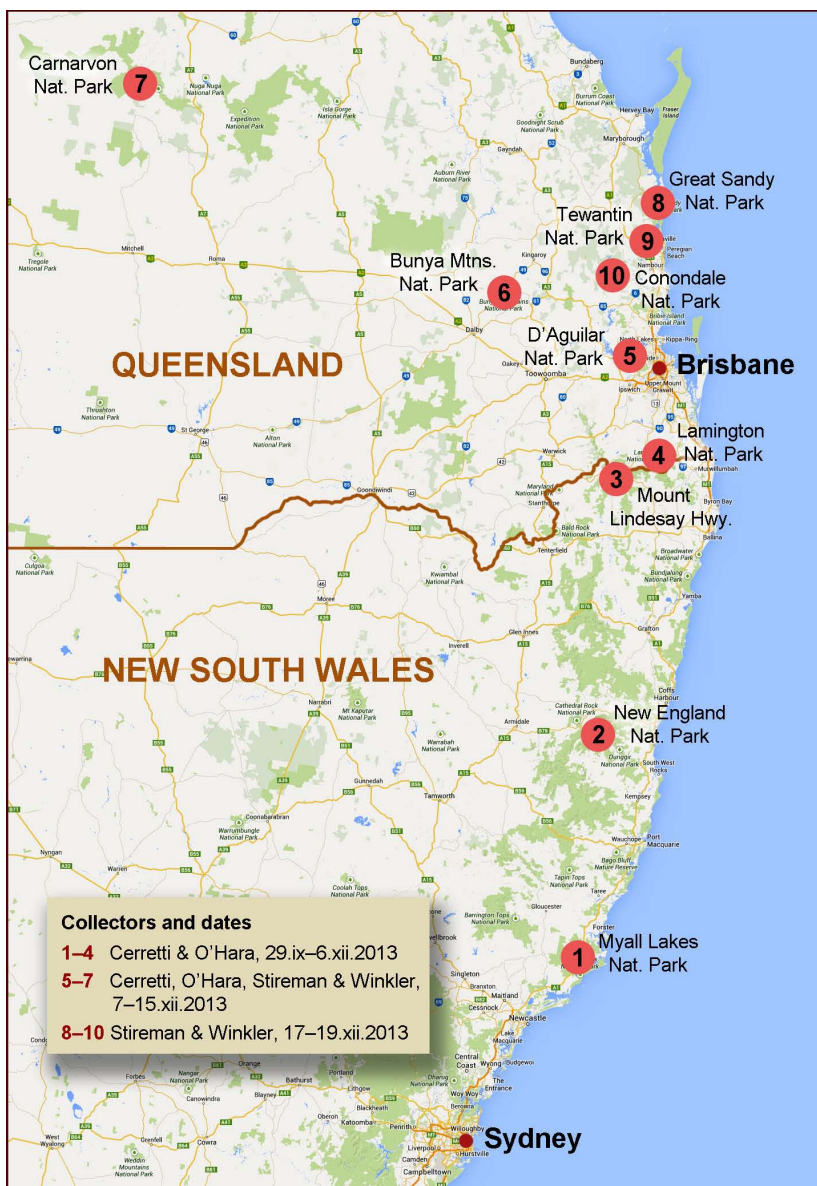


Figure 3. Map of major stops along our route during our collecting trip to eastern Australia.

3. Mount Lindesay Hwy. near Queensland border, 5.xii.2013 (PC & JEOH)

We stopped here for about an hour to look for tachinids along a gated track that followed a slight incline through a eucalypt forest. The track ended at a high point with a double line of fencing running as far as we could see, presumably marking the boundary between New South Wales and Queensland. Our catch was meagre and we did not linger long because we were anxious to press on to our next location.

4. Lamington National Park, 5–6.xii.2013 and O'Reilly's Rainforest Retreat in the middle of the park, 5.xii.2013 (PC & JEOH)

Lamington National Park is divided into the western Green Mountains Section and eastern Binna Burra Section. Both require a significant drive from the nearest town so we prearranged accommodation for one night at the privately-owned O'Reilly's Rainforest Retreat in the Green Mountains Section of the park. We wanted to spend the night in the park so we could collect at light after dark. We were rewarded with a nice collection of a yellow nocturnal species belonging to *Palpostoma* Robineau-Desvoidy, a tachinid that parasitizes adult scarabaeoid beetles. Despite spending the next morning on trails in the rainforest (Fig. 1) and walking along the park road, our collecting was poor.

5. D'Aguilar National Park, 7.xii.2013 (PC, JEOH, JOS & ISW)

D'Aguilar National Park is a narrow strip of parkland straddling the rugged D'Aguilar Range and extends southeastward into the city of Brisbane. Despite its proximity to the city and its well-groomed lookouts and picnic areas, it is still home to extensive tracts of eucalypt forest and rainforest. Pierfilippo and Jim spent the day driving along Mount Nebo Road in the South D'Aguilar Section of the park, stopping to collect at several places along the way (Scrub Road, Jolly's Lookout, Boombana and Westridge Lookout). Meanwhile, John and Isaac stepped off their plane in Brisbane, rented a car, and proceeded to the northern Mount Mee Section of the park. Here they collected at Somerset Lookout, Western Escarpment Forest Drive and Mill Rainforest Walk. The four of us met that evening at a motel in the small town of Kilcoy within a few hours' drive from our next day's destination. It was a moderately successful day.

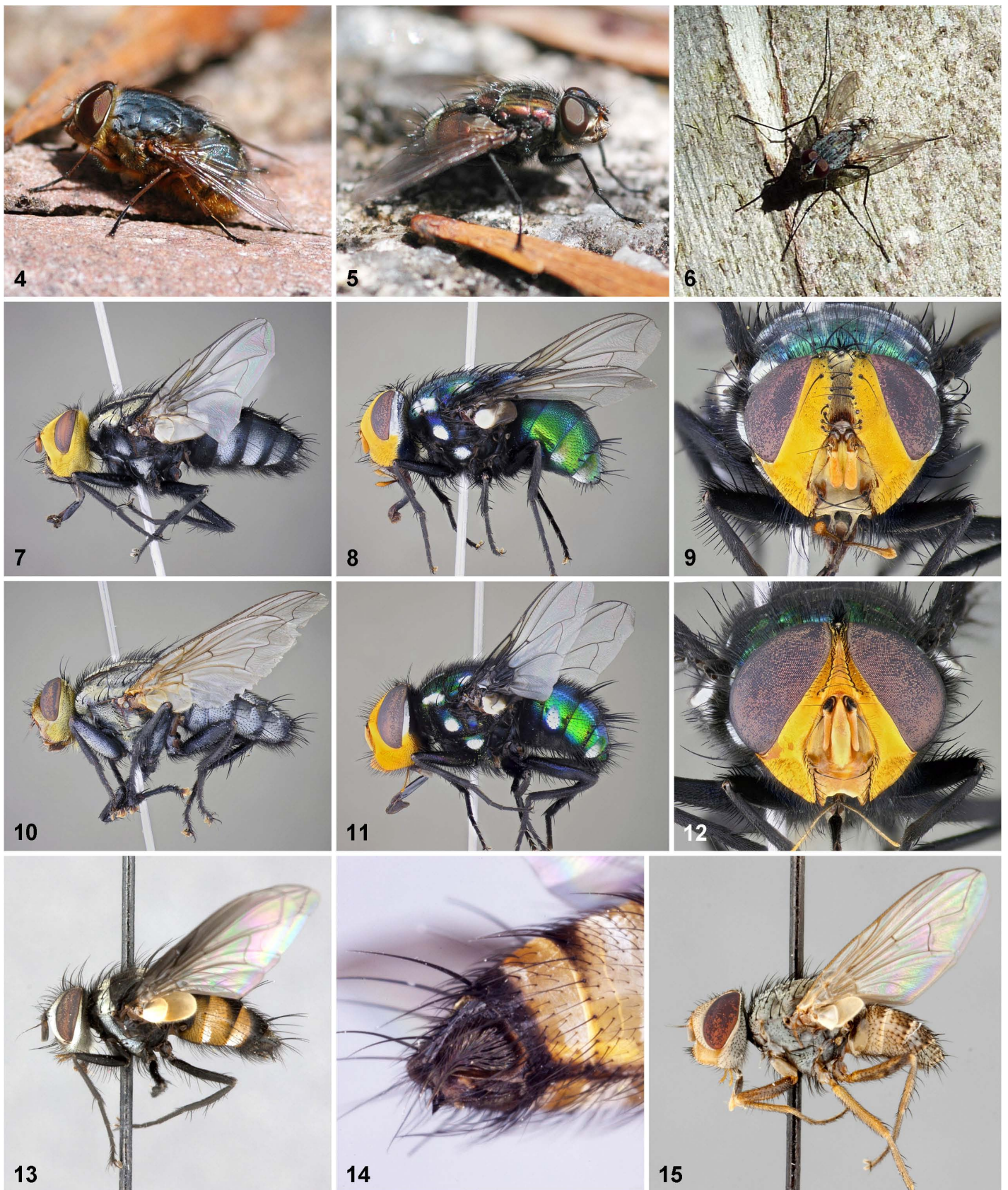
6. Bunya Mountains National Park, 8–9.xii.2013 (PC, JEOH, JOS & ISW)

Bunya Mountains National Park covers about 12,000 hectares and encompasses most of the Bunya Mountains. This isolated portion of the Great Dividing Range is northwest of Brisbane and about 150 kilometres inland from the coast. In addition to its eucalypt and rainforest habitats, this park is especially noted for its tall bunya pines (*Araucaria bidwillii*) with dome-shaped crowns and unusual-looking grass trees (*Xanthorrhoea glauca glauca*). We spent a couple of days here, collecting in a variety of habitats: hilltopping at Mt. Kiangarow among the grass trees, exploring grassland 'balds' rich in rare plants (but seemingly not tachinids), hiking trails through eucalypt forest and rainforest, and taking flies at the lights of our rented cottage on the edge of the park. In all, our efforts resulted in a nice but not spectacular collection of tachinids.

We were fortunate as well to catch several specimens of a remarkable new genus and species of rhinophorid that will soon to be described by Thomas Pape and Pierfilippo. Isaac caught the first one while sweeping on the summit of Mt. Kiangarow. Later, while stopped to talk to a couple of hikers on the trail, John spotted another on the trunk of a sunlit tree. He collected it and a short time later another fly appeared to take the place of the first. John and Jim collected a fly at a time for about 15 minutes, catching in total about ten rhinophorids, all males. These "station taking" males were awaiting females with which to mate. Pierfilippo caught several males and one female on a nearby tree that was also being used for the same purpose by these flies. If the males were competing for the best spots then this would constitute lekking behavior, but although we seldom saw more than one male on the tree trunk at one time we are hesitant to speculate too much about what was going on.

7. Carnarvon National Park, 10–15.xii.2013 (PC, JEOH, JOS & ISW)

Carnarvon National Park is located about 600 kilometres northwest of Brisbane in the Central Queensland Sandstone Belt. The park is both large (almost 300,000 hectares) and ecologically diverse. We were here to visit two of the four sections: the remote Mt. Moffatt Section and the popular Carnarvon Gorge Section. We were especially excited about the former because it is commonly considered the best place in Australia to catch tachinids. This reputation was further enhanced when Jim and others collected here in 2002 (see above



Figures 4–15. Some of the flies we collected in Australia. **4–6.** Point Lookout, New England N.P. **4.** *Calliphora* sp. (Calliphoridae). **5.** *Rutilia (Microrutilia)* sp. (Tachinidae). **6.** *Senostoma* sp. (Tachinidae) on tree trunk in typical, obliquely downward-facing, stance. **7.** *Zita* sp. (Tachinidae), mimic of sarcophagid flies such as the one shown below it, Mt. Moffatt, Carnarvon N.P. **8–9.** Dexiine fly (Tachinidae), mimic of the calliphorid fly shown below it, Carnarvon Gorge, Carnarvon N.P. **8.** Lateral view. **9.** Anterior view of head. **10.** Sarcophagid fly (Sarcophagidae), Mt. Moffatt, Carnarvon N.P. **11–12.** *Amenia* sp. (Calliphoridae), Mt. Allan, Conondale N.P. **11.** Lateral view. **12.** Anterior view of head. **13–14.** Male of *Zosteromeigenia* sp. (Tachinidae), O’Sullivans Gap, Myall Lakes N.P. **13.** Lateral view. **14.** Tip of abdomen in ventrolateral view showing sexual patch within a concave area of tergum 5. **15.** *Eustacomyia* sp. (Tachinidae), Fly Hill, Mt. Moffatt Section of Carnarvon N.P.

and Hansen 2003, O'Hara 2003, O'Hara *et al.* 2004). But before we could discover whether Carnarvon would meet our expectations on this trip, we had to get there. Mt. Moffatt Section is not the sort of place where one can drive in for a quick look around. The entrance is about 120 kilometres to the northwest of the nearest town (Injune, population ca. 1000) and for much of this distance the road is dirt (or mud, if raining). One must plan ahead and carry in all food and upon leaving carry out all trash. These logistical matters only heightened our sense of anticipation as we drove along the minimally marked Mt. Moffatt Road, checking our GPS periodically to ensure we were on the right route.

Once in the park, we proceeded to the 'barracks', a cottage-like building with a kitchen, four bedrooms, a bathroom/laundry area, and a large central room with tables and assorted furniture. The Ranger in Charge at Mt. Moffatt, Greg Keith, had kindly offered us free use of the barracks before we left for Australia. We had camping gear along in case we needed it but camping is not an ideal situation when there are lots of specimens to prepare and a need to keep alcohol-preserved material cool for DNA preservation. There is no accommodation within Mt. Moffatt Section for tourists other than camping areas, and few of these have water. Mt. Moffatt Section does not get a lot of visitors but we were nonetheless surprised to not see a single tourist during our five days here.

We all climbed to the top of 'Fly Hill' the first day after arrival, despite a partly overcast sky. Such weather often makes for poor collecting on a hilltop, but we actually caught a great number of tachinids. This was the same hilltop that was phenomenally rich in tachinids in 2002 (e.g., O'Hara 2003) and still looked much the same in 2013. Interestingly, the summit of Fly Hill is only 100 metres above the ground level of the surrounding eucalypt forest and does not give the impression that it has much to offer (Fig. 16). Perhaps the hill's almost perfect conical shape and its small area at the summit work in its favour.

One of the commoner tachinids we encountered on Fly Hill was a species of *Eustacomyia* Malloch (Fig. 15). These small (5 mm long) rather muscid-like flies flew about the lower fronds of the lone cycad. They, like members of the related genus *Palpostoma* men-

tioned above, parasitize adult scarabaeoid beetles. Near the end of our day's collecting we posed for our only group picture of the trip (Fig. 17).

The second day was supposed to be an ascent of the more formidable Mt. Moffatt, but a completely overcast sky and periodic light rain forced a change in plans. We visited The Tombs area instead and hiked the loop trail, nets in hand, but caught little. That evening we drove to a place where a small stream crosses the road and tried blacklighting, but again with little success.



Figure 16. The summit of Fly Hill in the Mt. Moffatt Section of Carnarvon National Park is barely 100 metres above the surrounding forest but is a mecca for hilltopping tachinids (and tachinidologists). (Photo: J. O'Hara)

Fortunately for us, day three was sunny and Mt. Moffatt was beckoning. Or at least it was for Pierfilippo, John and Isaac; Jim had hilltopped there in 2002 and was anxious to try a hilltop he had spotted to the west of Fly Hill. Mt. Moffatt proved to be a challenging climb, especially just below the summit where a short vertical stretch is hard to avoid. This is not a big mountain, only 730 m above sea level, and it only took about an hour to ascend, but there is no trail and much of the climb is over ankle-busting basalt boulders derived from ancient volcanic eruptions. Apparently there is a "good way" up, but our group did not find it and had to do a little low-grade rock climbing, throwing our nets up ahead during the tricky parts, and thus committing ourselves to the climb. The actual summit is about 150x75 m, almost flat, with tall eucalypt trees and smaller shrubs. It doesn't actually seem like a very good hilltopping site given the heavy tree cover, but as we reached the top and heard the low buzzing of tachinid wings all

thoughts of the treacherous climb vanished. We each patrolled the summit, trying different spots, and collecting tachinids almost as fast as we could get them into our kill jars. After a while, we even started ignoring the beautiful *Rutilia*, which seemed in endless supply. The best spots seemed to be lower sunlit bushes and small trees, but one could collect at least some tachinids almost anywhere on the top of the mountain. A horizontal branch of one standing dead tree on the edge of the top was a hot spot for a species of *Zita* Curran (Parer-



Figure 17. Collectors take a break for a group picture while hilltopping on Fly Hill. Left to right: Jim O’Hara, Pierfilippo Cerretti, Isaac Winkler and John Stireman. (Photo: J. Stireman)

igoniini) as well as the sarcophagids it apparently mimics (cf. Figs.7 and 10). A nondescript tree trunk near the northern edge of the summit was the favoured spot for a species of *Euthera* Loew, and the dappled sunlit branches of a small tree, standing perhaps 3 m in height, was the only spot where we collected what we think is a new genus of Glaurocarini (see Fig. 1h in article by Winkler *et al.* elsewhere in this newsletter). Amidst all this activity a single diminutive fly was spotted running jerkily along on the leaf litter, moving its wings like a sepsid in the shade of a big cactus. Upon capture it was recognized as a species of *Catharosia* Rondani, surely an undescribed species since both the genus and the tribe Catharosiini were previously unrecorded from the Australasian Region, and both are unrecorded from the adjacent Oriental Region. In the afternoon, the “action” began to taper off, and by 3 p.m., hot and weary from all the net-swinging, we decided to head back to the barracks to examine our catch. On our way we discov-

ered an even more perilous route for our descent. We are still in the process of sorting and identifying this material, and though it does not quite match the record collecting from Fly Hill of O’Hara *et al.* (2004) in 2002 (581 specimens), we caught at least 570 specimens between us, making it one of the best days collecting tachinids that we have ever had.

The hill that Jim had chosen in lieu of Mt. Moffatt was not as well-shaped as it had appeared from a distance. Reaching the summit and not seeing the wealth of tachinids he had been expecting, Jim switched to Fly Hill for the rest of the day and had his best collecting of the trip (Fig. 18).

The next day was our last in Mt. Moffatt Section. John stayed back in barracks to finish preparing his specimens from the day before while the rest of us drove up to the Consuelo Tableland in the northern part of the park. We had a couple of exciting encounters along the way: a spectacular and highly venomous eastern brown snake (*Pseudonaja textilis*) was warming up in a sunny spot on the road (Fig. 19), and three dingoes drinking from a puddle were briefly sighted before they disappeared into the low grass. We stopped to collect at a couple of spots before reaching our final destination, the lush Mahogany Forest. The area was blanketed in thick waist-high grass, with scattered palms and bushes under the tall open mahogany forest. Sweeping was

very effective here but we could not stay long because we wanted to reach the Carnarvon Gorge Section by early evening. We were actually only a few kilometres from the head of Carnarvon Gorge while in the Mahogany Forest but by road we were more than five hours away. We would have to drive southeast to Injune, then north along the main road, and finally west to follow the secondary road to the Gorge.

We had called Kieran Hoey, Ranger in Charge at Carnarvon Gorge Section, a few days earlier to ask whether we could use the barracks at the Gorge for a couple of nights. This he readily agreed to and we were able to move in as soon as we arrived. We prepared our specimens collected that morning from the Consuelo Tableland, and the next morning set off to collect within the breathtakingly scenic (and correspondingly popular) Carnarvon Gorge. Jim and Isaac spent the day hiking deep into the Gorge and collecting along the main trail, stopping along the way to see the spectacular aboriginal

rock art at the ‘Art Gallery’ in a side canyon. Pierfilippo and John went first to Boolimba Bluff before also collecting along the Gorge trail. They had hoped Boolimba Bluff would be perfect for hilltopping but it proved disappointingly unattractive to tachinids. We caught some taxa we had not seen before but on the whole our single day in the Gorge did not yield many tachinids. We cannot say that the eucalypt forest in the Mt. Moffatt Section has a greater diversity of tachinids than the rich habitats of the Gorge, but the hilltops in the former are better for collecting than Boolimba Bluff and paths through the Gorge.

Early the next day Pierfilippo and Jim left on their long drive back to Brisbane. They would spend the following day at the Queensland Museum and fly out from Brisbane and back to Italy and Canada the day after. Meanwhile, John and Isaac proceeded on to their next destination.

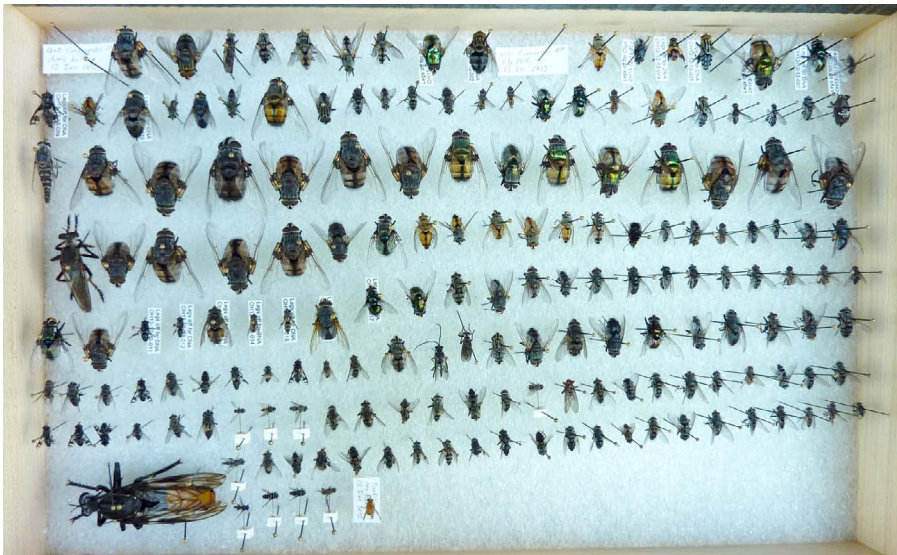


Figure 18. Specimens collected by Jim on 13 December 2013, consisting mostly of tachinids from Fly Hill. (Photo: J. O’Hara)

8. Great Sandy National Park (JOS & ISW)

As Jim and Pierfilippo headed back to Brisbane, Isaac and John drove east to the coast to Tin Can Bay, where we lodged in a nice motel, hardly more than a stone’s throw from the beach, near the northern end of Great Sandy National Park. This coastal park of sand dunes, scrubby woodland and rainforest consists of two sections, the Fraser Island Section (at 56,000 ha, apparently the world’s largest sand island and a very popular tourist destination) and the mainland Coloola Section (over 18,000 ha, and part of the larger 61,750 ha Coloola Recreation Area), which we visited. The coastal forest and “sandblows” were impressive and beautiful

(Fig. 20), but yielded few tachinids. Therefore, after a 5 km or so walk, we decided to try the Bymien Picnic Area, a more inland rainforest area. The forest was impressive, with large buttressed trees and strangling figs reminiscent of forest we had seen in the Neotropics. One plant we were especially struck by was a vining bamboo-like plant (*Flagellaria indica*), which reached at least 10 m up into the canopy by attaching itself to other plants with stiff, tightly coiled leaf tips. Despite intermittent showers and our relatively late arrival, we managed to collect a few tachinids in sunlit tree fall gaps and along trails.

9. Tewantin National Park, Mt. Tinbeerwah (JOS & ISW)

Mt. Tinbeerwah has a good reputation among tachinid collectors in Queensland for several reasons: first, it is close to Brisbane, second, you can drive

nearly to the top (one has to walk only a kilometer or so to the summit), and third, because there are lots of tachinids there! The summit of Mt. Tinbeerwah is primarily solid rock, with low vegetation in a few places with sufficient soil, and a few areas of short, shrubby trees. The observation tower that sits on the peak has great views of the surrounding valleys and hills and is a popular spot for sightseers. The day that we (John and Isaac) visited was not ideal, with some cloudiness and howling winds, yet we still were able to collect a fairly diverse array of tachinids, including some nice *Rutilia* and several taxa of Parerigonini. The best collecting was not on the observation tower itself as we had heard, but in the lower rocky areas around the tower – perhaps because of the fierce winds. We can only imagine how good this spot might be for collecting on a sunny, still morning.

Our favorite specimens from this spot were of an unidentified genus of Dexiini that are remarkable mimics of the distinctive co-occurring calliphorid genus *Amenia* Robineau-Desvoidy (cf. Figs. 8, 9, 11, 12), having metallic green coloration with white pollinose spots and a yellow head. Species of several different Australian tachinid genera mimic *Amenia*, including *Rutilia* subgenera *Ameniamima* Crosskey and *Graphostylum* Macquart and, to a lesser degree, the ernestiine genus *Chlorotachina* Townsend, which we also caught here. As with the sarcophagid-mimicking *Zita*, the uncanny similarity of these tachinids to *Amenia* begs the ques-

tion of why would a tachinid benefit from looking like a calliphorid (assuming that this is the direction of the mimicry, which we believe is likely)? One possibility, suggested to us by Monty Wood, is that many female calliphorids and sarcophagids may be able to cause myiasis if eaten by, say, a nestling bird. Thus, birds or other visual predators may avoid these taxa, and anything that closely resembles them. We don't have space to fully ponder this question here, but we plan to examine the issue more thoroughly in a future article.

10. Conondale National Park (JOS & ISW)

After leaving Mt. Tinbeerwah, we traveled slightly inland to try collecting in Conondale National Park, a moderate-sized (35,500 ha) mountain park encompassing the Conondale Mountain Range, somewhat similar



Figure 19. An eastern brown snake (*Pseudonaja textilis*) slithers to safety after being disturbed on the dirt road to the Consuelo Tableland in Carnarvon National Park. This is ranked as the world's second most venomous snake in some listings and is responsible for more snakebite deaths in Australia than any other snake.

in size and vegetation to Bunya Mountains National Park (even boasting the characteristic bunya pines of the latter). The park was very pleasant and scenic, with clear cool streams, diverse forests, and rounded mountain tops. Here, we decided to make use of the sleeping bags and tents we brought by camping for two nights in the Booloumba Creek campground. The kookaburras were accustomed to people and regularly visited the campground looking for handouts. The "bushies" (bush turkeys) were even more brazen, and one slyly snuck up and stole John's morning sausage as it was cooling next to the fire. We placed pan traps near the creek and tried blacklighting at the campground (which was swamped

by mayflies and caddisflies due to the proximity of the creek), but our main collecting event was on the top of Mt. Allan. A 7 km or so hike took us to the top of this local peak, which was fairly large and broadly rounded. Although ringed by trees, in the center of the summit there was a clearing where vegetation had been replaced with a large fire tower. Unfortunately the fire tower was under repairs and access was closed. The collecting was nothing like Mt. Moffat, but there were tachinids here and there, and we spent several hours patrolling key bushes and grassy hillocks along the top. Perhaps our best find was *Myiotrixia prosopina* Brauer & Bergenstamm (see Fig. 1g in article by Winkler *et al.* elsewhere in this newsletter), individuals of which were perching on a utility pole near the top. They were so un-tachinid-like in appearance (e.g., upright "push-up" posture, wings completely folded over the back), that we just assumed they were muscids and only collected a few specimens. Only later did we realize that they were a completely new tribe of tachinids for us (*Myiotrixini*)!

Acknowledgements

We owe a debt of gratitude to a number of people for making our expedition possible and successful. Our permit application for collecting in national parks in Queensland were endorsed by James Wallman (University of Wollongong, Wollongong) and Monty Wood (Canadian National Collection of Insects, Ottawa [CNC]). We received tips on where to collect in eastern Australia, in addition to various road and park maps, from Monty Wood, Brad Sinclair (Canadian Food Inspection Agency and CNC, Ottawa) and Jeff Skevington (CNC). Dan Bickel (Australian Museum, Sydney [AMS]) provided advice about collecting in Australia and hosted

Jim and Pierfilippo's visit to the AMS collection on their first day in Australia. Chris Lambkin (Queensland Museum, Brisbane [QM]) kindly hosted Jim and Pierfilippo's visit to the QM on their last full day in-country, and did the same for John and Isaac three days later. Special thanks are extended to Greg Keith (Ranger in Charge, Mt. Moffatt Section, Carnarvon National Park) for allowing us to stay at the barracks in the Mt. Moffatt Section for five days. Both Greg and Brent Tangey (Resource Ranger, Queensland Parks and Wildlife Service, Roma) made us feel welcome in the park and facilitated our efforts to catch tachinids in whatever way they could. Kieran Hoey (Ranger in Charge, Carnar-



Figure 20. View of Carlo Sandblow in the aptly named Great Sandy National Park.

von Gorge Section, Carnarvon National Park) kindly allowed us to stay at the barracks in Carnarvon Gorge Section for a couple of nights. Kelvin Quinn (Ranger in Charge, Bunya Mountains National Park) provided maps and helpful advice prior to our visit to Bunya Mountains National Park. Support for this expedition from U.S. NSF DEB-1146269 is gratefully acknowledged.

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A new range extension for *Erythromelana distincta* Inclan (Tachinidae)

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The blondeline genus *Erythromelana* Townsend is widely distributed in the Neotropical Region, being recorded from southern Mexico to northern Argentina. The genus can be recognized within Central America using the keys of Wood (1985) and Wood & Zumbado (2010). Fourteen species, 11 of them newly described, were recognized in the recent revision of the genus by Inclan & Stireman (2013). The species of interest here, *E. distincta* Inclan (Fig. 1), can be recognized from all other *Erythromelana* species by its black and yellow abdominal coloration and the presence of setae on the dorsum of vein R_1 . *Erythromelana distincta* was described from 38 specimens ranging from Costa Rica to southern Brazil; more specifically, it was recorded from Costa Rica, Venezuela, Ecuador, Peru and Brazil (red dots in Fig. 2). It was reported to occur at low to mid elevations (Napo, Ecuador, 250 m; Puntarenas, Costa Rica, 1600 m).

In a recent visit to the Texas A&M University Insect Collection (College Station, Texas), I found a single specimen of *E. distincta* from Mexico. The specimen was collected at the Biological Station "Los Cedros" in Gomez Farias, Tamaulipas (blue dot in Fig. 2). The single label of this specimen reads: "Mexico: Tamps. Est. Biol./ Los Cedros, Gomez Farias/ 350 m, VII-27-30-1993/ J. B. Woodley & K. Wilse/ 93/022, yellow pan trap" (slash lines indicating line breaks). This is the only specimen of *E. distincta* known from Mexico and represents the most northern record of the species. Additionally, this is the first specimen of this species collected by a yellow pan trap.

Acknowledgements

I am grateful to John Stireman (Wright State University, Dayton, Ohio, United States) for providing the image of *E. distincta*.



Figure 1. Lateral view of a female *Erythromelana distincta* Inclan.

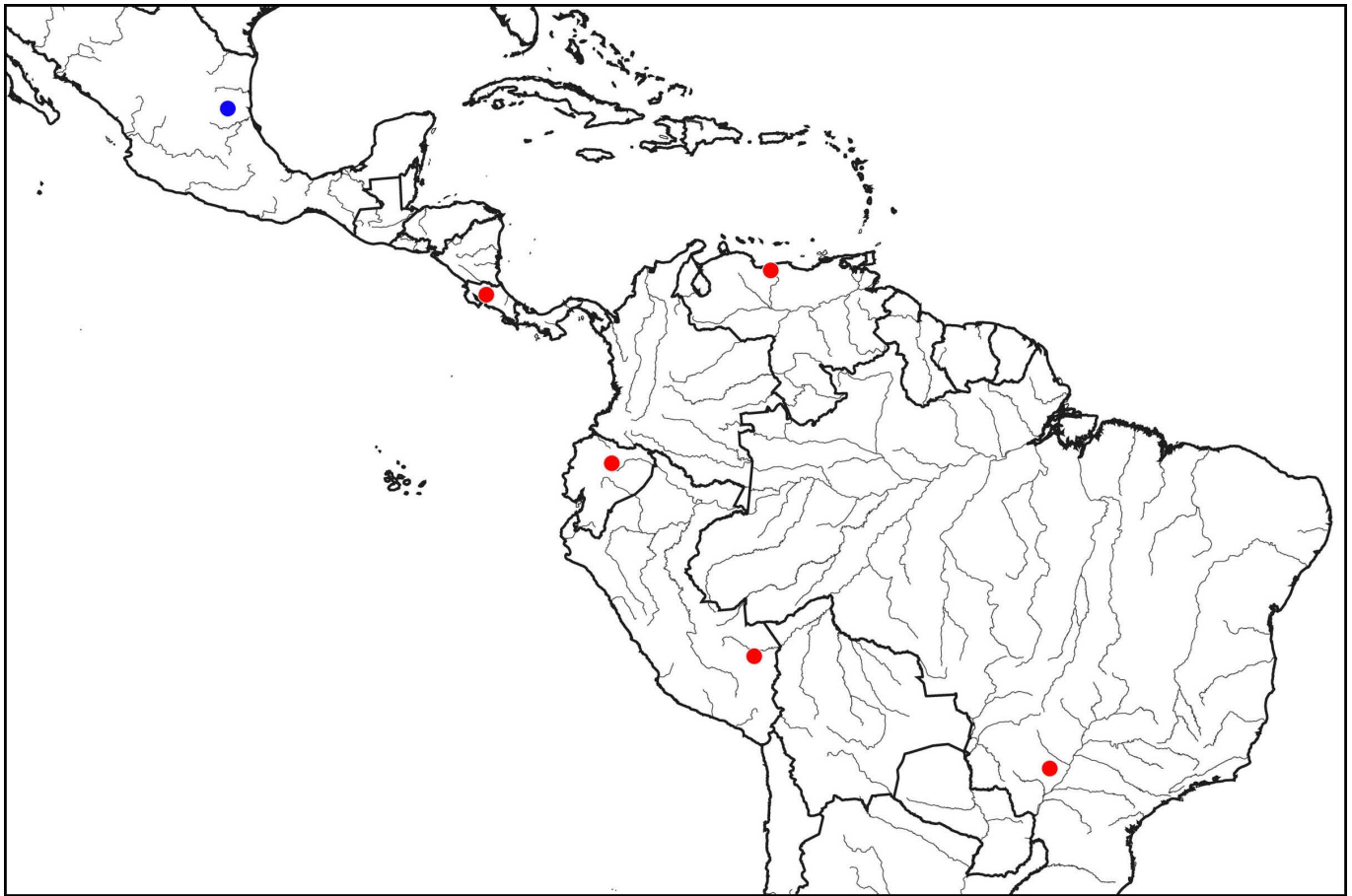


Figure 2. Known distribution of *Erythromelana distincta* Inclan. Red dots indicate previously known locality records and the blue dot indicates the new record from Mexico.

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Figure 1. Hamburg Trail in Ramsey Canyon, Huachuca Mountains, Arizona, United States. The two species newly recorded from America north of Mexico, *Stomatodexia* sp. and *Calolydella summatis* Reinhard, were found here.

New tachinid records for the United States and Canada

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INTRODUCTION

The Tachinid fauna of America north of Mexico was catalogued nearly a decade ago by O'Hara & Wood (2004). This work superseded the long-standing catalogue of Sabrosky & Arnaud (1965) and brought the tachinid classification of the region more in line with that of the Palaearctic Region (Herting 1984; Herting & Dely-Draskovits 1993). Despite this advance in the classification of the tachinids of America north of Mexico, the actual fauna of the region at the species level is not especially well known. Most genera are in need of revision and there are many new species in collections awaiting description. By way of example, I recently

reviewed the tachinid fauna of the Gila National Forest in New Mexico (USA) and recognized 241 morphospecies based on nearly 3000 specimens (O'Hara 2012b). I could not match one-third of the morphospecies with described species and concluded most of them represent new species. Not all of America north of Mexico has such a high percentage of undescribed tachinids, but throughout the region there are new species, and even in the northeast where tachinids are better known, the state of knowledge is far behind that of Europe. There, tachinidologists have been more active over the past 200+ years and have described most of the species.

Another aspect of knowing the fauna of America north of Mexico is keeping track of significant changes to recorded distributions of valid genera and species. This is of special interest to me because I maintain a

database of the tachinids of the region. Four of the more noteworthy new records are reported in this article. They consist of two new records for the region and two new records for Canada. One of the former is a genus new to America north of Mexico (i.e., *Stomatodexia*) and this record will be reflected in the next version of *World genera of the Tachinidae (Diptera) and their regional occurrence* (see O'Hara 2012a for the current version).

Acronyms used below: CNC, Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, Canada; USNM, National Museum of Natural History [formerly United States National Museum], Smithsonian Institution, Washington, DC, USA.

NEW GENUS RECORD FOR AMERICA NORTH OF MEXICO

Stomatodexia Brauer & Bergenstamm, 1889 (Tachininae, Leskiini)

Fig. 2

Stomatodexia Brauer & Bergenstamm, 1889: 125 [also 1890: 57]. Type species: *Stomoxys cothurnata* Wiedemann, 1830, by monotypy.

Guimarães (1971) listed seven species of *Stomatodexia* ranging from Brazil to Mexico. Of these, three were treated as “unrecognized” (i.e., *nomina dubia*) and another from Jamaica (*S. tinctisquamae* Curran) was earlier excluded from the genus by Townsend (1939) but was not placed elsewhere. Wood & Zumbado (2010) did not record the genus from Costa Rica.

There are specimens in the CNC of a *Stomatodexia* species from Durango (Mexico) and Arizona (United States, Fig. 1). It is treated here as “*Stomatodexia* sp.” pending further study of the genus. A revision of the genus, including examination of the types of the nominal species assigned to it (especially the two described from Mexico, *S. maculifera* (Bigot) and *S. similigena* van der Wulp), is needed before the species recorded here from Durango and Arizona can be determined as new or already described.

The CNC specimens of *Stomatodexia* sp. were originally thought to be a species of *Leskia* Robineau-Desvoidy until identified as *Stomatodexia* by Enio Nunez (Brazil) during a visit to the CNC in 2004. This reassignment was too late for *Stomatodexia* to be included in the catalogue by O'Hara & Wood (2004) and

then went unnoticed until I caught several specimens of *Stomatodexia* sp. in Arizona in 2013.

There are 18 specimens of *Stomatodexia* sp. in the CNC from several localities in the state of Durango, Mexico. This species is further known from the following specimens from Arizona (all in CNC), and these records form the basis for this new record of *Stomatodexia* from America north of Mexico:

1 male: USA, Arizona, Santa Catalina Mountains, mile 10, Bear Canyon [within Sabino Canyon], 2.vii.1958, F. Werner.

1 male: USA, Arizona, Huachuca Mountains, Ramsey Canyon, 5200' [1585 m], Malaise trap, 24.v.1967, R.F. Sternitzky.

1 male: USA, Arizona, Huachuca Mountains, Ida Canyon, 7000' [2133 m] [probably in error and closer to 6100', 1860 m], 8.viii.1999, J.O. Stireman III.

2 males: USA, Arizona, Huachuca Mountains, Ida Canyon, 31°23.1'N 110°19.6'W, ca. 6100' [1860 m], 8–9.viii.1999, J.E. O'Hara. One of these was photographed for the [Tachimage Gallery](#) (Tachimages 00499 [Fig. 2], 00500).

2 males: USA, Arizona, Huachuca Mountains, Ramsey Canyon, Hamburg Trail, 31°26.3'N 110°19.2'W, ca. 6300' [1920 m], 11.viii.1999, J.E. O'Hara.



Figure 2. *Stomatodexia* sp. from Ida Canyon, Huachuca Mountains, Arizona, United States.

3 males: USA, Arizona, Huachuca Mountains, Ramsey Canyon, Hamburg Trail, 31°26.2'N 110°19.2'W, ca. 6200' [1890 m], 9–10.viii.2013, J.E. O'Hara. The right legs of one of these are preserved in 95% ethanol for possible future molecular study (specimen code OH10-08-13-004).

Stomatodexia sp. keys to *Leskia* Robineau-Desvoidy in Wood (1987) and Wood & Zumbado (2010). The two genera differ in part by the relative lengths of the two notopleural setae: the anterior seta is longer in *Stomatodexia* spp., whereas the two setae are subequal in length in *Leskia* spp. (D.M. Wood, pers. comm.).

NEW SPECIES RECORD FOR AMERICA NORTH OF MEXICO

Calolydella summatis Reinhard, 1975 (Exoristinae, Blondeliini)

Fig. 3

Calolydella summatis Reinhard, 1975: 1158. Holotype male (CNC, examined). Type locality: Mexico, Durango, El Salto, 8000 ft [2440 m].

The CNC has 14 males and females of *C. summatis* from the state of Durango, Mexico, mostly belonging to the type series. One of these was photographed for the [TachImage Gallery](#) (Tachimages 00503 [Fig. 3, right], 00504 [Fig. 3, left]).

There are five specimens of *C. summatis* in CNC from America north of Mexico, all from Ramsey Canyon in the Huachuca Mountains of southern Arizona. The earliest was collected in a Malaise trap by R.F. Sternitzky on 11.iv.1967 at 5200 ft [1585 m]. The next two were collected by B.V. Brown (Natural History Museum of Los Angeles County, Los Angeles), also in Malaise traps, on 2–13.viii.1986 and 22.vi.1987 at 1700 m. These specimens from Ramsey Canyon were either overlooked during the preparation of O'Hara & Wood (2004) or were identified later. The new record for America north of Mexico reported here came to light when I collected and identified the following two specimens in 2013:

1 male: USA, Arizona, Huachuca Mountains, Ramsey Canyon, Hamburg Trail, 31°26.3'N 110°19.2'W, ca.



Figure 3. *Calolydella summatis* Reinhard from 14 mi. SW. El Salto, Durango, Mexico. Left, dorsal view. Right, lateral view.

6300' [1920 m], 30.v.2013, J.E. O'Hara. The right legs are preserved in 95% ethanol for possible future molecular study (specimen code OH30-05-13-005).

1 male: same data but collected on 1.vi.2013. Right legs preserved in 95% ethanol (specimen code OH01-06-13-006).

There are in CNC many new species of *Calolydella* from Costa Rica reared from caterpillars in Area de Conservación Guanacaste (see Janzen & Hallwachs 2009) or collected as adults by D.M. Wood.

NEW GENUS RECORD FOR CANADA

Istocheta Rondani, 1859 (Exoristinae, Blondeliini)

Figs. 4–6

Istocheta Rondani, 1859: 151, 171. Type species: *Istocheta frontosa* Rondani, 1859 (as “Sp. Typ. nova *Frontalis* Mihi”, incorrect original spelling, see O'Hara *et al.* 2011: 101) (= *Phorocera cinerea* Macquart, 1850), by original designation.

Istocheta aldrichi (Mesnil, 1953)

Centeter cinerea Aldrich, 1923: 4 (junior secondary homonym of *Phorocera cinerea* Macquart, 1850 and *Metopia cinerea* Perris, 1852). Holotype male (USNM). Type locality: Japan, Honshū, reared at Marioka.

Hyperecteina aldrichi Mesnil, 1953: 50 (*nomen novum* for *Centeter cinerea* Aldrich, 1923).

Istocheta aldrichi is native to the eastern Palaearctic Region (Herting & Dely-Draskovits 1993) and is either native to, or was introduced to, Taiwan in the Oriental Region (O'Hara *et al.* 2009). It is a natural parasitoid of adults of the Japanese beetle, *Popillia japonica* Newman, in Japan. The Japanese beetle was first discovered in the United States near Riverton, New Jersey, in 1916. There, in its new surroundings and free of its natural enemies, it proliferated to almost unimaginable numbers. Clausen *et al.* (1927: 2) illustrated the seriousness of the infestation with this quote from a report by L.B. Smith:

“During July, 1923, in an orchard of one hundred fifty-six 10-year-old Redbird peach trees, thirteen 16-gallon tubfuls of beetles were shaken

from the trees and collected early one morning, in somewhat less than two hours. The next morning the beetles were apparently as numerous on these trees as before.”

After intense study of the parasitoids of the Japanese beetle in Japan and related beetles in South Korea, *I. aldrichi* was selected for importation to the United States as a promising biological control agent (Clausen *et al.* 1927: 2). It became established and spread throughout the eastern states from New York and Massachusetts to the District of Columbia (Sarbrosky & Arnaud 1965). No reports of *I. aldrichi* from outside this range were found by O'Hara & Wood (2004), but an overlooked online article (Klein 1998) mentions *I. aldrichi* from North Carolina. BugGuide (<http://bugguide.net>) currently has reports and images of what are assumed to be *I. aldrichi* eggs on Japanese beetles from Maine and New Hampshire. The distribution of the Japanese beetle is closely monitored and is presently recorded from Atlantic Canada (except Newfoundland) to Georgia and westward to Ontario, Minnesota, Nebraska to Texas (Canadian Food Inspection Agency 2012). Eradication programs are attempting to stop the spread of the Japanese beetle to new states.

The presence of *I. aldrichi*-like eggs on the pronota of Japanese beetles is a strong indication of *I. aldrichi* parasitism but is not definitive proof. One cannot discount the possibility, however remote, that a related blondeliine tachinid is responsible, especially



Figure 4. *Istocheta aldrichi* (Mesnil) from Nepean, Ontario, Canada.

outside the known range of *I. aldrichi*. Thus, when parasitized Japanese beetles appeared in my backyard in 2013 (Fig. 5), I set up a Malaise trap and periodically checked vegetation in an effort to verify the presence of *I. aldrichi*. This ad hoc recovery program resulted in a single specimen of *I. aldrichi* (Fig. 4) swept from a leaf of a raspberry plant near feeding Japanese beetles. No *I. aldrichi* were caught in the Malaise trap during six weeks of operation. Label data of the single adult *I. aldrichi* are as follows:

1 female: Canada, Ontario, Nepean [part of greater Ottawa], [street address omitted], 45°19.0'N 75°43.2'W, 20.vii.2013, 90 m, J.E. O'Hara. This specimen was photographed for the [TachImage Gallery](#) (Tachimages 00494 [Fig. 4], 00495).

The captured specimen was identified as *I. aldrichi* by comparison with a specimen from Japan and two specimens reared from Japanese beetles at the laboratory in Riverton, New Jersey (see Clausen *et al.* 1927).

I did not carefully study the parasitized beetles in my backyard, but on two occasions I counted the number with and without eggs on their pronota. A count on 23 July 2013 found 10 of 30 beetles with one or more eggs on the pronota (33%). A count on 26 July 2013 found 5 of 32 beetles with one or more eggs on the pronota (16%).

The sex ratio of parasitized beetles was determined by sexing 32 parasitized beetles collected at random during July 2013. These were easily separated



Figure 5. Japanese beetle with tachinid egg (red arrow) attached to pronotum; on raspberry, Nepean, Ontario, Canada.

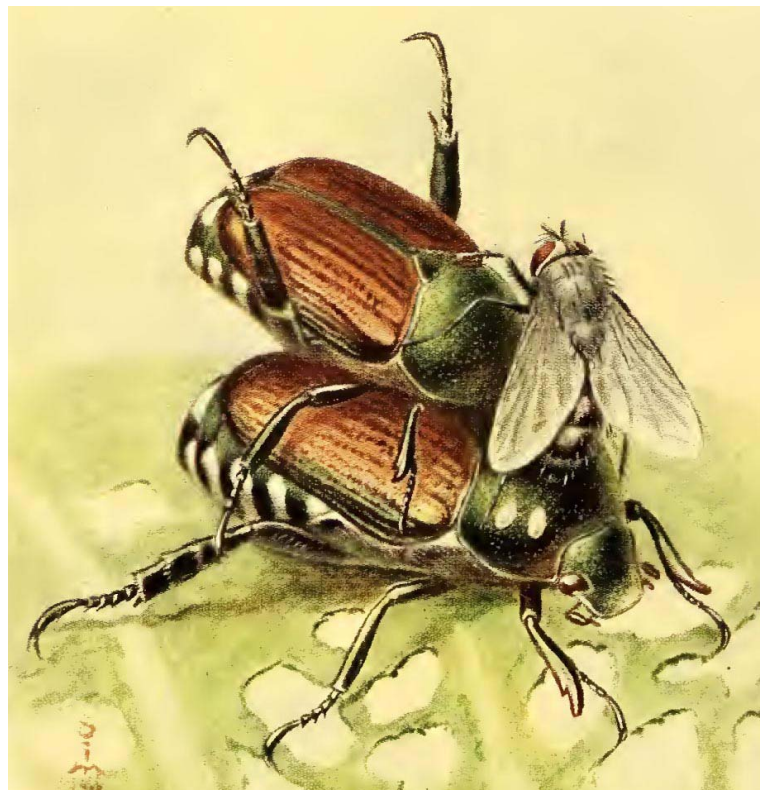


Figure 6. *Istochea aldrichi* ovipositing on lower (female) Japanese beetle of mating pair (from Clausen *et al.* 1927).

into males and females using front leg differences as described and illustrated by Vail *et al.* (2002). Of the 32 beetles, 6 were males and 26 were females. This propensity for ovipositing on females was also noted by Grenier & Liljestrom (1991). The reason for this behavior is not what one might expect and was discovered by the keen observations of Clausen *et al.* (1927). These authors found that beetles of both sexes have good defensive strategies for evading female *I. aldrichi* but are vulnerable when mating. They described the fly's mode of attack as follows (Clausen *et al.* 1927: 15; see Fig. 6):

“The manner of oviposition is very unusual in that it leads to the placement of the egg on a restricted portion of the host body. In case the beetles attacked are feeding singly upon the foliage they take alarm immediately a fly alights in the vicinity, and a closer approach leads them to drop to the ground. For this reason oviposition normally takes place upon mating pairs, since these do not take alarm so readily. The female fly may stand about on the leaf for some time, apparently watching the beetles, after which she makes a dash for the pair, running diagonally across the thorax of the female and pausing only for an instant to place an egg thereon. About 98 per cent of all eggs laid are so placed and, under normal conditions such as prevail at Koiwai [Honshū, Japan], about 85 to 96 per cent are upon female beetles.”

NEW SPECIES RECORD FOR CANADA

Siphosturmia confusa Reinhard, 1931 (Exoristinae, Eryciini)

Fig. 7

Siphosturmia confusa Reinhard, 1931: 6. Holotype male (USNM; paratypes in CNC examined). Type locality: USA, Texas, College Station.

Two Canadian records of *S. confusa* were discovered in CNC while identifying a recently collected Arizona specimen of this species. *Siphosturmia confusa* had been recorded from “California to Texas” by O’Hara & Wood (2004) and is newly recorded from Canada based on the following specimens:

2 males: Canada, Alberta, Tolman Bridge Recreation Area, 17 km east of Trochu, 16–18.vii.1989, J.E. O’Hara. One male was collected with a hand net and the other by Malaise trap. The former was photographed for the [TachImage Gallery](#) (Tachimages 00501 [Fig. 7], 00502).

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Figure 7. *Siphosturmia confusa* Reinhard from Tolman Bridge Recreation Area, Alberta, Canada.

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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.

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