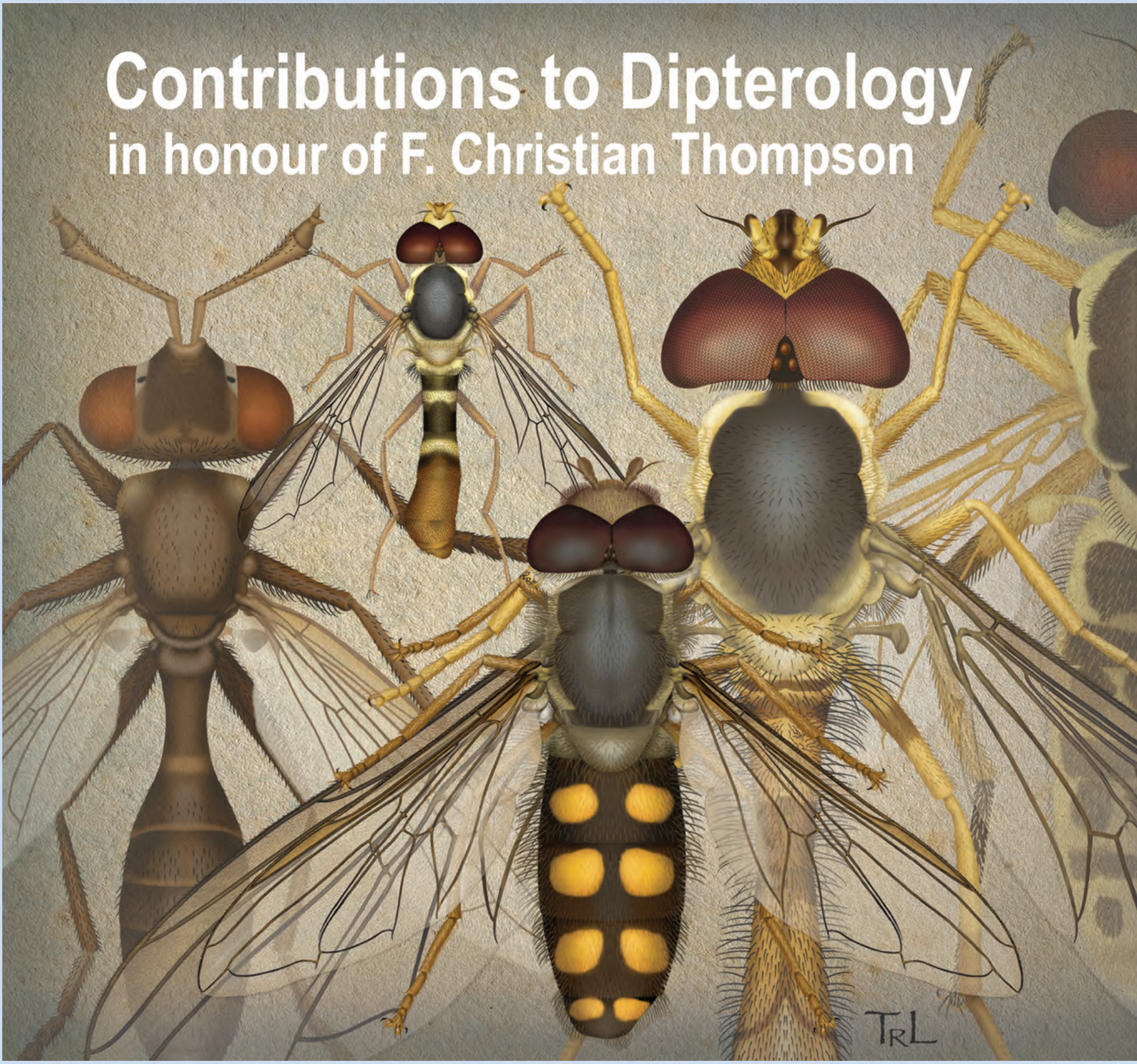
Contributions to Dipterology
in honour of F. Christian Thompson



STUDIA DIPTEROLOGICA

Supplement 23

Edited by Kurt Jordaens, Ximo Mengual,
and Jeffrey H. Skevington

AMPYX-VERLAG

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Supplement

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The signet in the title picture shows a frontal view of a male of *Campsicnemus magius* (Loew). This halophilic long-legged fly (Dolichopodidae) occurs in the salt flats around Halle (Saale). It was described by Loew after specimens from Sicily (Syracuse) in 1845 in the Stettiner entomologische Zeitung 6: 392–394 as *Medeterus magius*. In terms of coloring and leg design, the males of this species exhibit the most magnificent and complicated variation of any living *Campsicnemus* species. It symbolizes the beauty of the Diptera in a special way and has therefore been selected as the signet of the journal Studia dipterologica and the Supplementum series.

Cover design of volume 23 by Taina Litwak with her illustrations painted for the publications of F. C. Thompson. From left to right: *Tropidomyia bimaculata* Williston, *Antillus ascitus* Vockeroth, *Claraplumula latifacies* Shannon, *Rhinoprosopa aenea* (Hull), and *Toxomerus schlingeri* Thompson & Thompson.

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Contributions to Dipterology in honour of F. Christian Thompson

[Beiträge zur Dipterologie
zu Ehren von
F. Christian Thompson]

edited by

Kurt Jordaens

Ximo Mengual

Jeffrey H. Skevington

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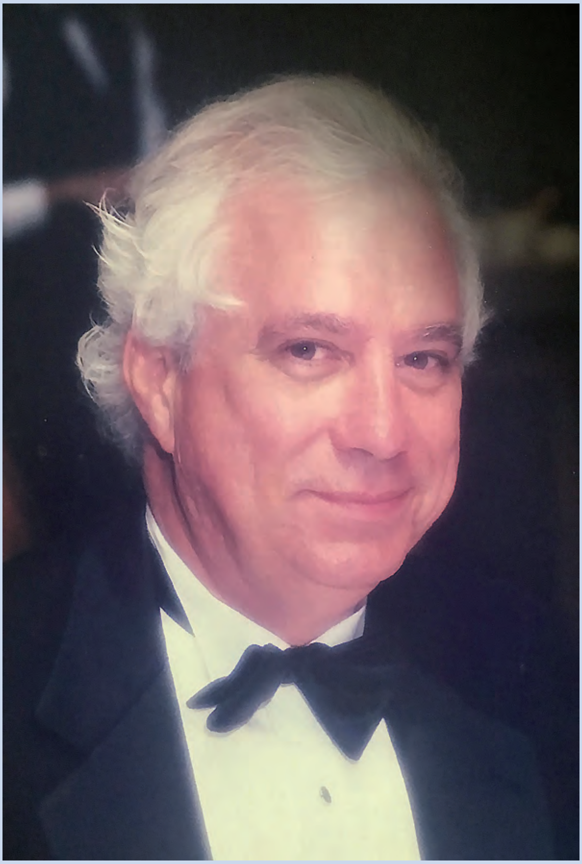

Frederic Christian Thompson
(1944–2021)

Preface

F. Christian THOMPSON or Chris, as most of us knew him, made a seminal contribution to the taxonomy of Syrphidae. Sadly, Chris passed away in February 2021 and in response *Studia dipterologica* kindly agreed to publish this special issue in his memory. The issue contains 18 contributions all of which are original work by colleagues who have enjoyed the privilege of collaborating with Chris and who wish to express their appreciation with selected contributions from their research.

The volume starts with a detailed overview of Chris's life and career by Neal EVENHUIS, Thomas PAPE and Adrian PONT (9–18), followed by an historical overview of *Systema Dipterorum*, the online database for Diptera names created by Chris, by the same authors (19–30). The second set of papers starts with the legacy of Chris's work at the National Museum of Natural History (USNM) by Torsten DIKOW (31–41), followed by contributions on the impact of Chris in several biogeographical areas. Ximo MENGUAL summarizes Chris's influence and legacy to Neotropical dipterology (43–52), and Kurt JORDAENS and Marc DE MEYER relate his major contributions to the Syrphidae of the Afrotropical Region (53–67). Next, Jeff SKEVINGTON, Andrew YOUNG and Chris (77–102) describe three of the 18 new species the authors recognized in the recent "*Field Guide to the Flower Flies of Northeastern North America*". One of the best known unpublished works of Chris is the "Conspectus on the Nearctic flower flies (Diptera: Syrphidae)", which proves invaluable to our understanding of the flower flies of the area. Inspired by this, Wouter VAN STEENIS provides a contribution on the flower flies of Nebraska (103–145), and Thalles PEREIRA highlights Chris's contribution to the study of Alaskan Diptera and discusses his work at the University of Alaska Museum Insect Collection (69–76). Chris had many unfinished and unpublished papers. Two of these are here finished and published; the first by Christopher BERGH, Paul MAREK, Brent STUART, Jeff SKEVINGTON & Chris THOMPSON is on the identity of *Neocnemodon calcarata* (147–163), and the second by Gunilla STÅHLS, Graham ROTHERAY & Chris himself deals with the intra-tribal relationships of Volucellini (Syrphidae) (237–254).

Five papers in this supplement describe various new dipteran species, with one new species named after Chris in each: Vlad BLAGODEROV describes two new species of *Lygistorrhina* (Keroplatidae) (175–187); Norm WOODLEY revises the Neotropical genus *Pseudocyphomyia* (Stratiomyidae) with the description of two new species (189–198); Dan BICKEL describes four new Australasian species of *Nepalomyia* (Dolichopodidae) and a new genus of long-legged flies from the Solomon Islands (199–218); Li SHI, Miao LIU & ZhiWei WANG describe a new species in the genus *Homoneura* (Lauxaniidae) from China (219–226); and Ximo MENGUAL and Anatolij BARKALOV describe a new species of *Cheilosia* (Syrphidae) from the high mountains of India (227–235). In addition, John MIDGLEY, Terence BELLINGAN and Kurt JORDAENS describe the female of the flower fly *Spheginobaccha pamela* (255–263), and Jason Pollock and Martin Hauser survey the Syrphidae as prey of Asilidae in eastern New Mexico and western Texas (165–174). The special volume ends with a contribution from Jeroen van Steenis (265–277) on the ICZN code-compliant authorship for nominal species and genera-group names of Diptera (Insecta), with special reference to Meigen (1822) on the "*Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten*". Chris had a penchant for the rules of zoological nomenclature and all of its peculiarities, and he was an ICZN Commissioner and a member of the editorial board for the Fourth Edition of the ICZN Code (see Evenhuis et al. this volume). We are sure Chris would have loved this contribution.

Besides these contributions, we have compiled the publications of Chris and listed them at the end of this supplement (279–295), together with some images of Chris and colleagues (297–308).

Such a special volume takes much organization and preparation and we need to thank a number of people for their efforts. First, we thank Andreas Stark, the key person between us and the publisher Ampyx-Verlag, for his enthusiasm and hard work to get the special volume printed and published. We are indebted to the reviewers for their time and help to bring this project to fruition, and we are very grateful to the authors for their superb work and research. Thanks also to Taina Litwak for the amazing front cover of the volume. Our special thanks to the S. W. Williston Diptera Research Fund for supporting the publication of this Studia dipterologica Supplement and to Torsten Dikow for coordinating the donation, and to the Royal Museum for Central Africa also for funding this volume dedicated to Chris.

Enjoy reading!

Kurt Jordaens, Ximo Mengual and Jeff Skevington

Shoes too big to fill:
Frederic Christian THOMPSON (1944–2021)

Neal L. EVENHUIS[1], Thomas PAPE[2] and Adrian C. PONT[3]

[1] Honolulu, U.S.A. [2] Copenhagen, Denmark [3] Oxford, U.K.

In February 2021 we lost one of the truly greats. Frederic* Christian THOMPSON ["Chris" to all who knew him] may not have been the most prolific of Diptera taxonomists in numbers of papers or numbers of new taxa, but he was nevertheless a formidable giant in many ways. He was instrumental in helping many fledgling dipterists make a start by helping fund their travel to meetings and visits to collections to assist with their studies. In addition, he and his wife Betty made their home a "home away from home" for many dipterists visiting the Washington, D.C. area. Chris was a visionary in bioinformatics long before the term ever existed. He had an exceptional mind for logic, a necessity for writing code for and developing the structure of databases, and this allowed him to create and put into place some of the database procedures we use today in specimen, taxonomic, bibliographical, and nomenclatural databasing. His penchant for the rules of zoological nomenclature and all of their peculiarities led him to become an ICZN Commissioner and a member of the editorial board for the Fourth Edition of the ICZN Code. He had a deep understanding of the necessity for proper bibliographical research as well as a love of dipterological and entomological history and possessed one of the largest personal libraries of Diptera books and reprints ever compiled. This deep knowledge of dipterological history, bibliography, and zoological nomenclature combined to form the major underpinning to what was to become his lasting legacy: the database of all the scientific names of the world's flies—*Systema Dipterorum*. When we look at all of his scientific accomplishments, the various products of his vision, and the students he mentored and supported, who have gone on to become some of the world's leading dipterists, he does indeed leave shoes too big to fill.

Early years and schooling

Chris was born in Boston, Massachusetts, on 24 April 1944 (Fig. 1), the second son of Paul Christian THOMPSON (1902–1983), a businessman involved in the manufacturing of paper and plastic packaging, and Elinor Bunn THOMPSON (née Elinor Howard BUNN) (1916–2014), an assistant to the Dean at Harvard Divinity School in Cambridge, Massachusetts, and editor of the school's publications. Chris's two siblings (still surviving) are his older brother, Paul Brooks THOMPSON, and younger sister, Dr. Tracy Ann THOMPSON. Chris was interested in his genealogical forebears and a family tree in his personal files showed that branches of his Danish and Scandinavian heritage could be proudly traced back to the Vikings. His grandparents on his father's side (Frederick Kristian THOMPSON and Else NIELSEN) emigrated from Mors, Denmark to the United States, arriving in April 1900, and settling in Palmer, Massachusetts.

Although born in Boston, Chris's family lived for many years in Wellesley Hills, Massachusetts, a few miles west of Boston, where Chris was a student at Wellesley Junior and High Schools. Chris had a childhood interest in the outdoors and, with his older brother Paul, was a camp councilor in the early 1960s at Camp Mowglis in New Hampshire, a youth summer

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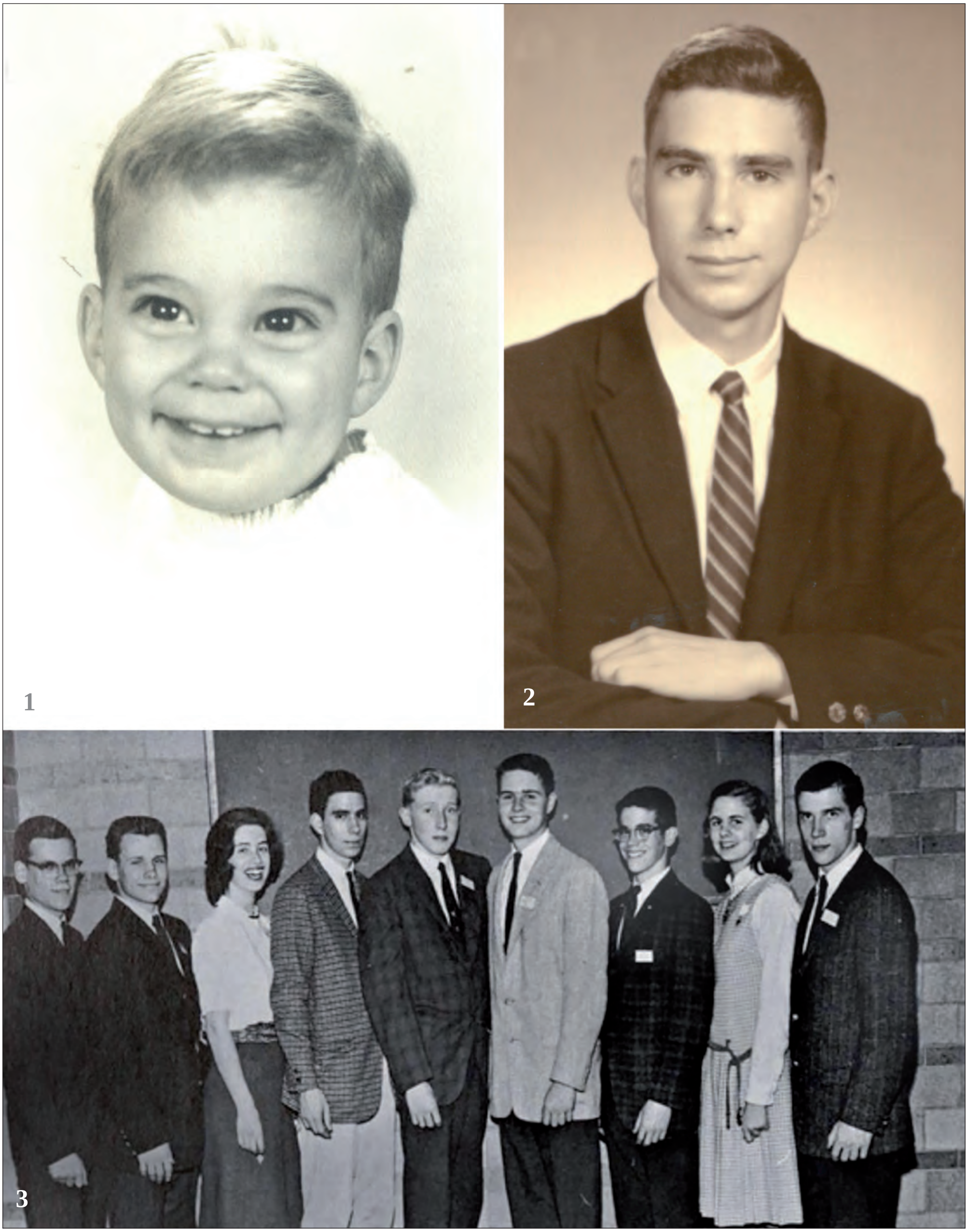
* Chris's given name is spelled as "Frederik" on his birth certificate, but his subsequent legal documents and his own personal preference spell it as "Frederic". It is misspelled as "Frederick" in many places.



Figs 1–3: – **1**: Chris THOMPSON at one year; – **2**: Wellesley High School graduation portrait; – **3**: Wellesley Science Club Science Fair winners, 1960.

camp. But it was a teacher at Wellesley High School, Douglas SANDERS, a strong promoter of bird studies, who was the major influence in developing Chris's interest in that area of biology. A number of students banded together under the tutelage of SANDERS and became known as the "Wellesley Boys", some of whom went on to much acclaim in birding (FREELAND 2005). Although active in birding since he was 12, Chris listed entomology as his favorite extra-curricular subject in an application to Harvard University, with ornithology second (see further below). Chris was active in science and a member of the Wisewell Science Club at Wellesley and won Honorable Mention at the school's science fair as a sophomore (Fig. 3).

University years

Before Chris graduated from Wellesley in June 1962 (Fig. 2) he had applied to a number of colleges to continue his studies. His mother wanted him to apply to Harvard University so she could drive him to school as she went to work at the nearby Harvard Divinity School. Chris started to fill out the 6-page application form to Harvard but never finished (leaving blank a required page where applicants were asked to write a 200–300-word essay describing themselves). Instead, much to the dismay of his mother, Chris went to the University of Massachusetts at Amherst (UMass), some 90 miles to the west, residing in the dormitories there. It is curious that Chris opted for the more entomologically leaning University of Massachusetts over Harvard where the famed ornithologist Dr. Ernst MAYR was a professor.

While an undergraduate at the University of Massachusetts, Chris excelled in his entomology classes and the path of his professional career was set. During his undergraduate years at UMass studying entomology, he became involved in the Fernald Entomology Club, formed in 1925 to "further the study of insects". Although it was formed mainly for graduate students, it also accepted undergraduates and faculty, and Chris served as its secretary.

Charles P. ALEXANDER (Fig. 4) was at UMass when Chris was a student there but could not act in any official capacity on Chris's behalf as he had already been retired since 1959. However, there is no doubt that "C.P." (Chris always referred to him as "Alex") had an influence on Chris and, at some point, Chris became interested in syrphid taxonomy as evidenced in a 1965 entomology seminar syllabus that lists Chris giving a presentation on "Problems in syrphid taxonomy" in November. Indeed, his first published paper was in 1965 on a new Neotropical *Lepidosis* CURRAN (THOMPSON 1965). He published one more publication on syrphids while an undergraduate (THOMPSON 1966).

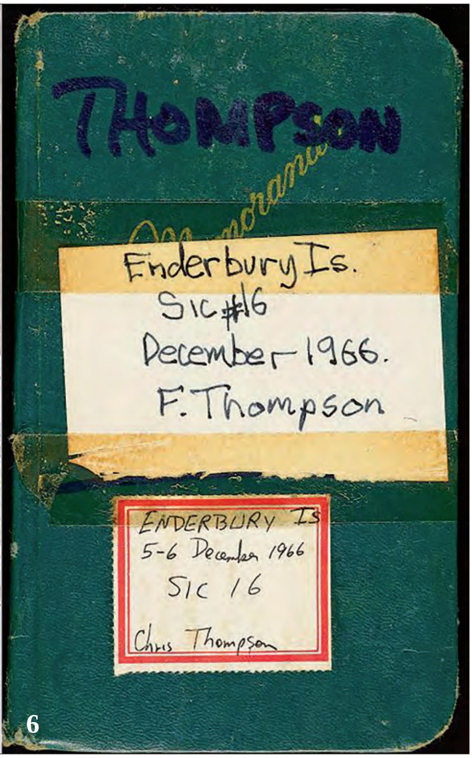
These undergraduate years also were formative in establishing his views on phylogenetics and the tools to analyze the classification of taxa, views that would follow Chris throughout his career. In that November 1965 seminar, Chris outlined the types of analyses used to classify organisms and made the statement "Numerical Taxonomy is the greatest threat to Science today". Chris was a follower of Hennigian phylogenetics and not a proponent of methods whereby classifications were based on similarity (numerical taxonomy) rather than shared derived characters. With the advent of molecular analyses, Chris kept to his Hennigian roots and had a continual disdain for the software used to classify taxa in these analyses, since the algorithms used were based on maximum likelihood (similarity) and not shared derived characters (Hennigian phylogenetics).

Chris graduated from the University of Massachusetts with a Bachelor of Science Degree in entomology in June 1966 and soon after obtained a small contract with the Massachusetts Department of Agriculture to investigate a problem of the Greenhead (*Tabanus nigrovittatus* MACQUART) in Essex County.

Pacific Ocean Biological Survey Program

Just before graduating from UMass, a notice for an opening for a medical entomologist appeared at the University's Department of Entomology. The Smithsonian Institution was looking for applicants for their Pacific Ocean Biological Survey Program (POBSP). The POBSP was a multi-disciplinary project begun in 1963, but for many years during and after its completion was shrouded in mystery and rumor. Working under a contract from the U.S. Army, the Smithsonian employed a vast number of scientists to survey the distribution and movement of sea birds in the Pacific. But the involvement of the Army brought rumors of the project being used as a "screen" for efforts to locate a site for chemical and biological warfare activities (ANONYMOUS 1969). The claims were denied by Smithsonian Secretary S. Dillon RIPLEY, but there still might have been some concern about participants being exposed unwittingly to radioactivity since some of the islands surveyed had been involved in various nuclear tests by the U.S. and other countries (e.g., Fig. 5 shows a buff young Chris on Malden Island during the POBSP survey standing next to a vat with a hazard symbol. Malden Island had been used by the British for three aerial thermonuclear bomb tests a mere 10 years earlier). Adhering to a signed agreement of confidentiality, Chris was mum about such matters when asked, but he kept clippings and articles related to the controversy as well as information leading to published results of vessels and personnel that may have been exposed to chemical or biological warfare testing by the U.S. Department of Defense (Project 112). For example, two of the research vessels used in the POBSP and upon which Chris was stationed as they traveled from island to island, the *U.S.S. Granville*, and *U.S.S. Eastman*, were simultaneously conducting tests for Project 112. So, despite denials by Smithsonian officials, the subject was very much on his own "radar", as it were.

The person the Smithsonian was looking for was an assistant entomologist with training and experience in the collection, general identification, and ecology of medically important arthropods. With both birding and entomological experience Chris applied and was accepted.



Figs 4–6: – **4**: Left to right: Charles P. ALEXANDER, Nelson PAPAVERO and Chris THOMPSON at University of Massachusetts, 1966; – **5**: Chris THOMPSON in Malden Island as a scientist on the Smithsonian's Pacific Ocean Biological Survey Program (POBSP), 1967; – **6**: One of Chris's field notebooks from the POBSP.

After being sent a number of summaries of previous expeditions of the program to familiarize himself with procedures and logistics, he arrived in mid-August 1966 at the project's "base camp" in Honolulu, Hawai‘i: the Hawaiian King Hotel in Waikiki. He was sent out with other scientists on the Southern Island Cruise (SIC) #15 on 7 September 1966, traveling from Hawai‘i to Johnston Island, and south to Howland, Baker, and the Phoenix Islands. Chris was on four SICs (15, 16, 17, and 18) as well as two surveys of the Leeward Hawaiian Islands and islets off O‘ahu. Most of the work on the SICs was banding sooty terns and collecting ectoparasites. Chris kept detailed field notebooks for each island (e.g., Fig. 6) and even kept maps of a couple of the trips. Work apparently never stopped. Even during the long intervals at sea traveling from island to island, nocturnal and diurnal watches were conducted each day and numbers and species of sea birds noted.

Not only was being an avid birder a benefit to Chris on this project, but he also began to compile a life list of islands, like those of bird species, in order to keep track of all the islands in the Pacific he had visited. This island list was one he endeavored to fill after the project's completion by traveling on vacation cruises to various Pacific isles, which he did with his wife Betty. In the Hawaiian Islands, he lacked only Ni‘ihau and Kure. He had planned to come to Hawai‘i to mark off those last two islands, but the COVID-19 pandemic unfortunately halted those plans.

Doctoral studies

Although the project itself ended in 1970, Chris's one-year POBSP contract ended in August 1967, at which time he went back to school at the University of Massachusetts to obtain a PhD. Prof. John F. Hanson, a Plecoptera specialist, was his major advisor. Chris once again was involved in the Fernald Club, gave seminars, and helped with graduate courses as a teaching assistant.

Chris's thesis was a "Contribution to a generic revision of the Neotropical Milesiinae (Diptera: Syrphidae)"; and it had a frightening history. One night, Chris parked his car and left his only copy of the thesis inside in an attaché case. Upon returning to his car, he found it had been broken into and the attaché case stolen! He went home totally dejected. He thought the worst and that he would have to write the thesis all over again. But the family came to his rescue. They could not believe any thief would be interested in a thesis on flies. They went back to the area where he had parked his car and soon found the attaché case by the side of a road, but empty. Not giving up, they continued to search and eventually found the thesis, with all the pages soaked, in a storm drain nearby. They took all the pages home and dried them on the wash line and his thesis was saved. The final copy was accepted and signed by his committee members with their titles typed below the signature lines, but one more signature without a typed title was also there—that of Charles P. Alexander.

The Fernald Club remembered Chris in 1992 when they dedicated an issue of their *Fernald Club Yearbook* to him. Normally, such dedications were restricted to professors or alumni in the process of retiring, but they made an exception for Chris and dedicated it to him while "at the peak of his professional career" (Peters 1992).

Military service

The Vietnam War was taking place while Chris was a student at UMass. His employment on the POBSP was not a guarantee to exempt him from being drafted into the military by the U.S. Selective Service System, but it did give him a temporary 2-A rating. However, going back to school and not keeping a full course load had the ultimate result of his receiving a letter from "Uncle Sam" informing him of his 1-A rating and ultimate induction into the U.S. Army. Chris gave himself a bit more time by requesting a postponement of his induction; and just in case the postponement request was denied, Chris had applied for the U.S. Army Reserve. While on the POBSP, he had networked with a number of military personnel, one of whom was Lt. Colonel Wesley Nowell (who happened to be a dipterist himself, specializing on dixids). Those military colleagues suggested he apply to the Army Reserve. He did so in January 1968, and asked to be appointed as Captain (which was possible for personnel having obtained a PhD). However, the application was rejected (possibly because he had not yet finished his thesis). In any case, his request to the Selective Service for postponement of induction was accepted, and Chris was able to finish his thesis and graduate from UMass in June 1969. As anticipated, a few months later, in October 1969, he was inducted into the U.S. Army and entered basic training at Fort Dix, New Jersey. After the completion of basic training (Fig. 7), he began his service as medical entomologist at Fort Meade, Maryland. His duties there were to identify mosquitoes collected by military medical service personnel in Vietnam and adjacent countries. Chris served at Fort Meade from January 1970 to August 1971.

Taxonomic research

Soon after finishing his required 2-year tour of duty with the U.S. Army, Chris tried to find work, but applications for assistantships, teaching positions, and even "re-upping" in the U.S. Armed Forces proved fruitless. He applied to dozens and dozens of U.S. and foreign institutions and universities in hopes of obtaining a position but was met with rejection letters (he kept all of them, no doubt to remind himself that success comes from perseverance). With supporting letters from Charles P. Alexander and others, and due to the kindness of dipterist Pedro Wygodzinsky, who vouched for Chris, he eventually obtained a Fellowship at the American Museum of Natural History (AMNH) in 1972. With a 2-year job secured, he moved to New York, rented an apartment there on 15th Street, and married Betty Jean Lacy, whom he met while both were working at Fort Meade. Chris's work on the taxonomy of syrphids began in earnest and Betty was at his side assisting him with various details in preparing manuscripts and joining him on the many trips they took together in their 49 years of marriage, including collecting with him on some of the trips. During this time at AMNH, Chris attended meetings, networked further with colleagues, and published 10 papers.

Soon after his Fellowship at AMNH ended, Chris obtained a position as Research Entomologist with the U.S. Department of Agriculture, Agriculture Research Service, Systematic Entomology Laboratory (SEL), located at the Smithsonian, which he held until his retirement from SEL in 2008. Being at SEL afforded Chris the time and funds to do research, attend conferences, and visit collections at home and abroad (Fig. 8). That, combined with access to the vast libraries of the Smithsonian, Library of Congress, and National Agricultural Library, gave him arguably unrivaled resources to conduct his taxonomic research. His 35 years with USDA SEL resulted in more than 120 published papers and CD-ROM media; most of these papers were devoted to the taxonomy and biosystematics of syrphid flies [see Evenhuis et al. (2023) for more details].

Bioinformatics

In the early 1980s Chris, influenced by the tephritid database project led by Dick Foote (cf. Hodges & Foote 1982), quickly recognized the potential of personal computers [having purchased one for himself at considerable personal expense well before others had them] and various software packages in assisting with collection management and databasing and, after taking enough computer courses at night school to get a degree (Peters 1992), he became the designated Automated Data Processing person at SEL. He recommended computers and software for SEL staff to use and gave a number of seminars to USDA staff and outside the USDA at conferences, as well as authoring a number of papers and notes (e.g., Thompson 1990), all to promote the wide use of computers and software for nomenclature, taxonomy, specimen and collection management in what was later to be termed "bioinformatics". A few selected examples of his forward-thinking include the following: in 1987 he gave his first presentation (at a local Virginia insect workshop) on the Biosystematic Information program of the USDA SEL; at a meeting of the Entomology Collections Network in 1990 he presented a talk on data standards for automatic data processing in systematic entomology; at ECN meetings in 1992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Figs 7–9: – **7**. PFC Chris Thompson after basic training; – **8**: Visiting the British Museum (Natural History), 1970s. Left to right: Brian Cogan, Tony Hutson, Kenneth G. V. Smith, Chris Thompson. Photo: A. Pont; – **9**: Thompson home, Ponte Vedra, Florida.

and 1993 he gave talks on barcodes for specimen data management; and he gave a talk on the value of electronic publishing in "delivering the goods to the public" at an annual Entomological Society of America meeting in 1996.

The speed and breadth of the communication of scientific results via electronic publishing intrigued Chris and he went out and bought a CD-ROM bulk writing machine, not one that copied CDs one-by-one, but one that created multiple CDs simultaneously (so as to be ICZN Code-compliant in publishing). Some of the first CDs he created were called the Diptera Data Dissemination Disk (DDDD). Two volumes were published (1999 and 2004) and each contained a wealth of Diptera information including a world Tephritidae catalog, a world dipterists directory, and the first iterations of the Biosystematic Database of World Diptera (BDWD) [see Evenhuis et al. (2023) for a detailed history of BDWD and its successor, *Systema Dipterorum*].

Chris also realized that the internet would be critical for the dissemination of material not just to a few (as with CD-ROM disks) but to the whole world and he created the "Diptera World-Wide Web Site" with directories to dipterists, inventories, an early web portal and search feature for a world Diptera database, and included an element called a "species page", a feature that was later to be the signature one for E. O. Wilson's *Encyclopedia of Life* online project.

Mentoring, bibliography, and philanthropy

Chris and Betty did not have children, so all young dipterists coming to Washington, D.C. became their "adopted children" of sorts. Two of us (NLE and TP) were among the many recipients of Chris's largesse in assisting with funding various things like travel, housing, etc. Chris enjoyed mentoring. And enjoyed it so much, it seems that almost everything became a "teaching moment" (inside and outside of the workplace). And like most children and their parents, the kids would grow older and wiser, but those teaching moments always persisted, sometimes to the point of seeming to be condescending. But the intent was to make sure his "kids" never made a mistake.

Having no children also created some disposable income that he put to good use by acquiring any book he could on Diptera taxonomy. He began early on by cashing in on an opportunity to acquire a portion of the Verrall-Collin library of books and reprints that had been purchased by E. C. Zimmerman. A weevil specialist and former Bishop Museum entomologist, "Zimmie" was also a book collector and had a side-business of purchasing books and reprints from the estates of recently deceased entomologists, then turning around and selling portions of those to various people and institutions. The Bishop Museum's entomology reprint collection was built on the foundation of the C. T. Greene reprint collection, which Zimmie personally purchased and then sold to J. Linsley Gressitt, the chair of the department, in the 1950s. A similar thing happened to the Diptera reprints of the Verrall-Collin library. Zimmie made the purchase in the U.K. in the early 1970s and took it back to Australia with him. He sold most of the books to the Australian National Library in Canberra and offered Chris the "dregs" of the reprints that were left. This was still a substantial amount of material and Chris jumped at the opportunity. With that foundation for his new personal library, Chris then filled in as many "gaps" as he could with reprints dealing with Syrphidae, and eventually purchased as many books (antiquarian and new) as he could on Diptera taxonomy as a whole. The book purchasing beyond Syrphidae began in earnest with the initiation of the BDWD. This was done in order to have originals at hand to make sure the data entered into the database was accurate. His library slowly grew into one of the largest and most complete Diptera taxonomy libraries anywhere except possibly the Natural History Museum in London. After his passing, Steve Gaimari and NLE went to Florida to help Betty organize his many files, books, and loans. Chris left everything to Betty and she has donated a number of his books to the Smithsonian.

Apparently the remaining disposable income was "burning a hole in his pocket", as throughout his career he was generous (almost to a fault) in providing seed money for various endowments, assisting young dipterists with funding for travel to meetings and congresses (e.g., setting up the S. W. Williston Fund at the Smithsonian as well as making personal donations), creating awards to honor dipterists (e.g., the Charles P. Alexander Lifetime Award of the North American Dipterist Society, and the Thomas Say Award of the Entomological Society of America), helping with funding projects and publications he felt were worthy of promotion, and paying for the services of other dipterists who could provide a product he felt was important [e.g., NLE received a short-term contract to provide dates of publication for the works in the Family-Group Names of Diptera volume (Sabrosky 1999) and ACP received funding for the "Systematic Database of *Musca* Names (Diptera)" (Thompson & Pont, 1994) and his translation into English of the "Wiedemann prefaces" (the front matter of the Wiedemann and Meigen works); this last translation can be found on the *Systema Dipterorum* website under "Documents"].

Retirement and travel

After 35 years of working for the U.S. government, Chris retired from the USDA SEL in 2008 but continued working, this time with more of a focus on Syrphidae as he had shed the government responsibilities that otherwise took up so much of his time. He initially worked from his Kingstowne, Virginia, home having moved there from Arlington, Virginia. But Betty saw that still being in and around the D.C. environs was stressful and coerced him to get out of the area. In 2014 they ended up moving into a newly built home in Ponte Vedra, Florida (Fig. 9), where Chris engaged contractors to build for him a three-room second story that was to be his office and library. Finally, he was away from the D.C. biopolitics and far enough away to concentrate on his work. Chris was overly ambitious about what he could do and had plans for many works—too many—resulting in most unfortunately never seeing completion. When Steve Gaimari and NLE went to Florida to help sort out his files, it became clear that Chris intended literally dozens upon dozens of manuscripts to be published. There were folders for almost every genus of flower flies, most with a template first page with a title that read "A new species of ______ from _____ (Diptera: Syrphidae)" and "send proofs to [and Chris's home address]". Other larger folders were intended reviews or annotated catalogs like "A conspectus of _____ from ____ (Diptera: Syrphidae)". These, and associated computer backups, have all been boxed and will be available for someone to finish, if possible.

But all was not work for Chris. Betty and Chris were avid world travelers. Chris had already visited a number of countries as part of his job, and had attended meetings all over the globe, usually without Betty. However, upon retirement, they made a concerted effort to travel together as much as possible, especially enjoying ship cruises. [The portrait used as the frontispiece of this volume is one taken of him in his dinner jacket while on board one of these cruises.] That old checklist of Pacific Islands Chris had made while on the POBSP was pulled out and the two of them boarded cruises that took them to a number of Pacific Islands that Chris had not yet checked off. And when they got back home, there were maps on the walls at home that received new pushpins to mark the new islands and cities they had visited.

As mentioned above, plans to come to Hawai‘i to check off the last two islands he had not yet visited (Ni‘ihau and Kure) were postponed because of the COVID-19 pandemic in 2019–2020. Then, in late 2020 Chris was diagnosed with pancreatic cancer and all dreams and plans of traveling came to a halt. He was hospitalized in January 2021, but remained optimistic that he could get better. But that was not to be. He passed away on 4 February 2021 and news quickly traveled worldwide of his passing — by means of the internet which, as he knew, would disseminate information faster than anything else.

Acknowledgments

NLE thanks Betty THOMPSON for allowing access to personal files belonging to Chris and for helping fill in the gaps of knowledge in this personal account of his life, and Paul THOMPSON for interesting discussions of Chris's childhood and pre-college years. Patrick O'GRADY is thanked for assistance with literature requests. Al NORRBOM read an early draft of the manuscript and is thanked for his suggestions, which helped improve it. Wayne MATHIS and Norm WOODLEY are thanked for reviewing the submitted manuscript and helping improve the accuracy.

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The lasting legacy of F. Christian THOMPSON: *Systema Dipterorum*

[Das bleibende Vermächtnis von F. Christian THOMPSON: *Systema Dipterorum*]

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Abstract

The *Systema Dipterorum* is one of the largest databases currently maintained for the taxonomy and nomenclature of a single order of insects. Conceived, and maintained for most of its duration, by one man (Chris THOMPSON), it currently contains more than 237,000 records for species-group, genus-group, and family-group names of Diptera plus more than 37,300 associated references. We here review its initial conception, development, and evolution to what it is today, and discuss possibilities for its future.

Key words: Database, Diptera, history, nomenclature

Zusammenfassung

Das *Systema Dipterorum* ist eine der größten Datenbanken, die derzeit für die Taxonomie und Nomenklatur einer einzelnen Insektenordnung geführt wird. Es wurde von einer Person, nämlich Chris THOMPSON, konzipiert und während des größten Teils seines Bestehens gepflegt und enthält derzeit mehr als 237.000 Datensätze für Artengruppen-, Gattungsgruppen- und Familiengruppennamen von Diptera sowie mehr als 37.300 zugehörige Referenzen. Wir überblicken hier die anfängliche Konzeption und Entwicklung sowie den heutigen Stand der Datenbank und diskutieren Möglichkeiten der zukünftigen Entwicklung.

Stichwörter: Datenbank, Diptera, Geschichte, Nomenklatur

Past *

Organizing natural history collections with the use of computers dates to the 1960s. At the Smithsonian, an ADP (Automated Data Processing) Committee was set up in 1963 as a sort of brainstorming and advocacy group (SQUIRES 1966). In the 1960s, personal computers had not yet arrived on the scene, so ideas were developed on how to use powerful mainframes to manage data.

By the time Chris THOMPSON became employed by the Systematic Entomology Laboratory (SEL), USDA (many of whose staff were housed at the Smithsonian's Natural History Museum) in the early 1970s, a number of people, including Ron HODGES, Dick FOOTE, Robert POOLE, and Dug MILLER, were interested or involved in projects cataloging various taxa and wanted SEL to do more. Chris pushed for establishing data standards across all the databasing efforts and got SEL to use the Wang OIS (Office Information System) for all of the databasing and cataloging. Staff had access to terminals that shared information across the SEL network and stored everything on large 30-cm (ca. 12 inches) 10 MB storage disks. Once PCs were more readily available, more powerful, and could store larger amounts of data on much smaller hard drives, SEL abandoned the Wang OIS, and went for PCs. Chris obtained

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* A brief history of the Biosystematic Database of World Diptera until 2008 was given in THOMPSON (2010). This article relies much on that short note but goes into more detail in a number of areas.

the FileMaker database software for his PC and redesigned the SEL Diptera database he was to use the rest of his life.

Using ADP to produce catalogs

In October 1982, at the same time a reprinted version of the original 1965 North American Diptera Catalog was being produced by the Smithsonian, a formal proposal to produce a revised "Nearctic Diptera Checklist" was submitted by Chris to USDA. By using the Wang OIS computer system and its proprietary database software, along with a standard set of fields and protocols, Chris estimated the time to completion would be one year. The USDA expressed interest in the project, along with other similar projects such as a Coleoptera Checklist. In addition to these projects, in 1984, at the International Congress of Entomology in Hamburg, Lloyd Knutson and Chris publicly announced that a series of fascicles for a Biosystematic Database of World Diptera (BDWD) would be produced by USDA. While still in the planning process for these fascicles, Chris requested a number of specialists to complete family chapters for the Nearctic Checklist and began coordinating the world database.

Unfortunately, USDA eventually rejected the proposal to fund the Nearctic checklist. However, it did approve funds for a project using the new technology toward producing a world catalog and computer-based identification system for pest Tephritidae. With all the information in one database (names, hosts, distributions, authors, and references) Chris took the opportunity to dovetail the BDWD into this and concurrent data entry for these projects began in earnest.

Chris spent a great deal of time coordinating the efforts toward production of the Tephritidae catalog and identification system, but at the same time was still updating and improving the Nearctic checklist. Lloyd and Chris's plan to expand these efforts into a world database was logical in ultimately saving time and effort. The data entry for the Nearctic Checklist and that for the world Tephritidae catalog easily provided a substantial amount of data (names, distributions, and literature) that he could use in expanding a database to the entire world. Chris continued to work on his list of specialists who could vet the world Diptera data being entered and set up an initial steering committee. Over the years, the steering committee was eventually finalized as comprising Chris and the authors of this article.

A World Diptera Database starts to take hold

The vision of Lloyd and Chris in 1984 of producing fascicles from a master Biosystematic Database of World Diptera saw fruition in 1994. The first product in this series was that of all *Musca* names, which was co-authored by Chris and ACP (Thompson & Pont 1994) and entitled "Systematic Database of *Musca* Names (Diptera)". The second of these fascicles, the world tephritid catalog, was published as part of the "Fruit Fly Expert Identification System and Systematic Information Database" (Thompson 1999). A third product[**] stemming from BDWD was the "A World Catalog of the Stratiomyidae (Insecta: Diptera)" (Woodley 2001). But the world Diptera catalog would be the first one to get the 1984-dubbed "Biosystematic" prefix: it would be named the "Biosystematic Database of World Diptera" (BDWD) and it became a formal project of USDA-SEL's Biosystematic Information on Terrestrial Arthropoda

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[**] The work of Sabrosky (1999) in cataloging the family-group names of Diptera was initially refused by Chris as being a part of these BDWD fascicles because it was created without following the data standards he required for the fascicles. Eventually, it was "adopted" into the BDWD "family" as it dealt with all of the Diptera family-group names and leaving it out would look odd. But a number of world catalogs produced after 1999 and outside of the BDWD protocol and editorship were not recognized by Chris as of BDWD "quality" and it took some time before information from them was added to the database by him.

(BIOTA) program in September 1993. News of the database spread quickly and led to articles promoting it (e.g., PENNISI 1994):

> "F. Christian THOMPSON is helping compile a "telephone directory" of all the world's insects. His volume of the directory, which deals only with the 100,000 or so species of flies—a small percentage of the world's millions of species—will include the scientific name of the insects, the name of the person who first described it, and where and when the species was discovered. It will also give the name and phone number of an authority on that species and detail its classification. Within the next year, THOMPSON hopes to have complete information for North American flies. "Then," he says smiling, "we'll go for the world"."

Building the BDWD database was conducted in planned phases. The first phase was raw data entry from the existing regional Diptera catalogs and world fossil Diptera catalog. By the fall of 1993, when the BDWD was a project of BIOTA, data from the Nearctic (STONE et al. 1965) and Australasian/Oceanian (EVENHUIS 1989) catalogs had been entered as well as data for world catalogs of Syrphidae, Tephritidae, Phoridae, Drosophilidae, and Simuliidae from various published sources. The remaining work for the first phase would be to enter data from the other regional catalogs—Neotropical (PAPAVERO 1966–1987), Oriental (DELFINADO & HARDY 1973–1977), and Afrotropical (CROSSKEY 1980)—and the world fossil Diptera catalog (EVENHUIS 1994). Initially, Chris worked with NLE to draft a proposal to the U.S. National Science Foundation to assist with funding the data entry. Robert POOLE, who was already entering vast amounts of Nearctic insect data into what would become his *Nomina Insecta Nearctica* series (the Diptera and Lepidoptera names in Vol. 3; POOLE & GENTILI 1996), was dubbed to help with the project if NSF funded the proposal. Unfortunately, NSF funding did not happen. Elaine JAMISON, data entry specialist for the USDA who was the super-accurate heavy-lifter for data entry for many of the names from the regional Diptera catalogs, continued her work entering records; and Chris eventually took on more of a data entry role as time went on. Over the ensuing years, Chris was able to obtain external funding from the Smithsonian, GBIF, Species2000, 4D4Life, and the SCHLINGER Foundation, which allowed the services of Jennifer FAIRMAN (graphics, website), Irina BRAKE (2005–2006, 2011–2012), Owen LONSDALE (2007–2009), and Ximo MENGUAL (2009–2011); but the vast majority of data entry in the following years would be done almost daily by the now-retired Chris during long evenings at home.

The second phase included harvesting new nominal taxa from the literature published since those catalogs and updating records where there were new synonymies or changed generic combinations, or other relevant nomenclatural acts. This was done primarily by Chris, with the help of Irina and Owen. While trying to get all the articles from which to enter names and new nomenclatural acts proved difficult if not impossible, Chris had made arrangements with Nigel ROBINSON at *Zoological Record* (ZR) and would periodically get a CD of the abstracted and detailed Diptera section of ZR from which to enter new data. There was also easy access to newly published works via the library at the Smithsonian's National Museum of Natural History and the nearby National Agricultural Library. Having access to them, one of us (NLE) supplied Chris with *Zootaxa* articles as soon as they were published.

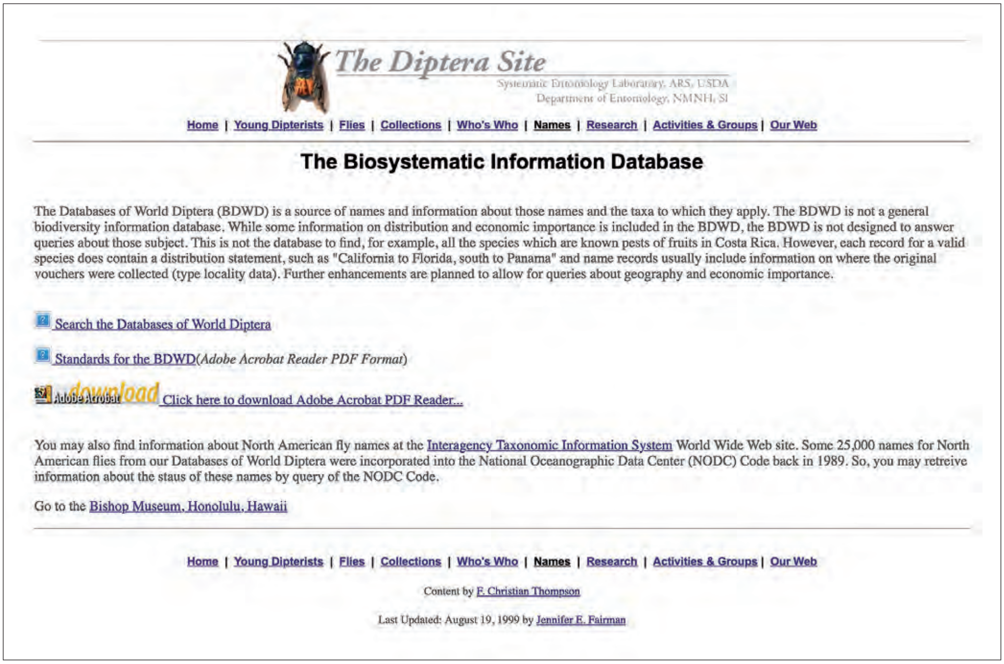
The third and final phase was vetting the data via specialists. The first two families achieving that goal (as a result of work toward their respective world catalogs) were the Tephritidae and Stratiomyidae. It was easy to ensure that data and verification standards were followed for these families since both projects were headed by staff of USDA-SEL. Vetting other families in the same way was more difficult, mainly because Chris did not have as much control over the process for families being vetted by non-USDA staff. However, the importance of vetting was critical to the success of the accuracy of the database, e.g., which was elucidated by Chris in a letter he wrote to NLE on 11 Oct 1994 with regard to helping Curt Sabrosky finish his family-group names work:

> "The most boring part in Science is verification. There is no recognition in verifying what was already discovered, but until at least one worker verifies, the discovery is only an unsubstantiated hypothesis! In Nomenclature, the same is true. Most workers are only interested in the new taxa, new synonyms, new combinations, etc., not even verification of details of previous work. Hence, most workers merely copy from other sources the essential nomenclatural data. While verification is obviously less significant, etc., as less creativity, insight, etc. is needed, careful and accurate verification is recognized. While Loew belittled the work of Hagen in building a bibliography of entomology, today Hagen's name and work has a greater recognition than Loew! We want our's to be likewise trusted."

Despite the difficulties in finding a team of active specialists willing to assist, Chris persevered with wanting phase three to be a reality and recruited a steering committee of dipterists to help in coordinating the vetting process and suggesting a list of those who could help with the results.

Over the years, that steering committee of Chris, Neal, Thomas, and Adrian developed standards and procedures as well as fine-tuned the specialist list for vetting; and looked to a hopeful future for the database with funding to properly staff and maintain it. The last major meeting of the steering committee took place in April 2008 at Chris's Kingstowne, Virginia home (Fig. 1). At the time, it was still called BDWD, and Chris was still employed by the USDA. But little known to us then, many things were due to change in just a few months.

Fig. 1: BDWD Steering Committee meeting at Kingstowne, Virginia, April 2008. Left to right: Adrian Pont, Neal Evenhuis, Chris Thompson. Photo: Thomas Pape.



The Biosystematic Information Database

The Databases of World Diptera (BDWD) is a source of names and information about those names and the taxa to which they apply. The BDWD is not a general biodiversity information database. While some information on distribution and economic importance is included in the BDWD, the BDWD is not designed to answer queries about those subject. This is not the database to find, for example, all the species which are known pests of fruits in Costa Rica. However, each record for a valid species does contain a distribution statement, such as "California to Florida, south to Panama" and name records usually include information on where the original vouchers were collected (type locality data). Further enhancements are planned to allow for queries about geography and economic importance.

Search the Databases of World Diptera

Standards for the BDWD(*Adobe Acrobat Reader PDF Format*)

Click here to download Adobe Acrobat PDF Reader...

You may also find information about North American fly names at the Interagency Taxonomic Information System World Wide Web site. Some 25,000 names for North American flies from our Databases of World Diptera were incorporated into the National Oceanographic Data Center (NODC) Code back in 1989. So, you may retreive information about the staus of these names by query of the NODC Code.

Go to the Bishop Museum, Honolulu, Hawaii

Content by F. Christian Thompson

Last Updated: August 19, 1999 by Jennifer E. Fairman

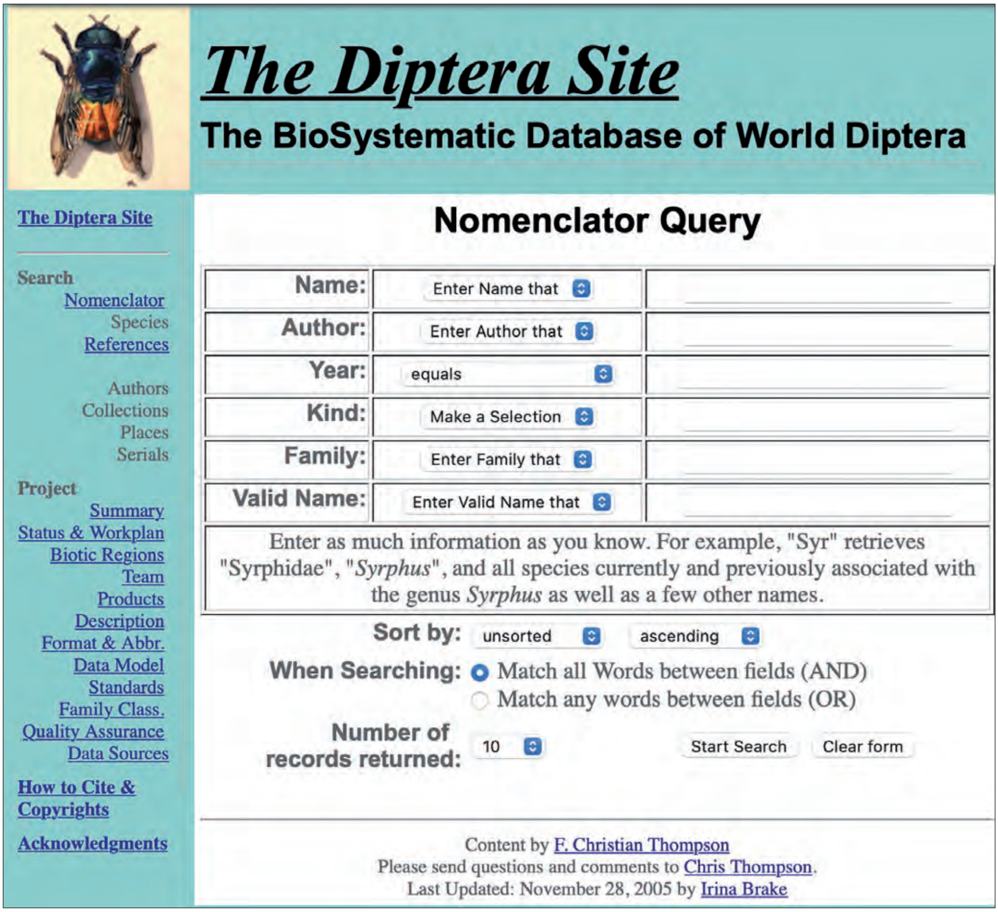
Fig. 2: Screenshot of The Diptera Site (BDWD) in August 1999.

The Web

The early 1990s, the midst of the initial phase, saw the advent of the World Wide Web. Chris again quickly realized the potential for its use in disseminating data widely and created the first website devoted to one order of insects. He simply called it *The Diptera Site* (Figs. 2, 3). It was here, in June 1997, that the BDWD was first made "public." Having BDWD online allowed it to reach a large number of user scientists who had access to the web. The initial website was designed by scientific illustrator Jennifer FAIRMAN and won awards for its design. Chris at the same time developed a species page [for the syrphid *Allograpta obliqua* (SAY)], which was the first of its kind and many years later would be the signature feature of the E. O. WILSON-inspired *Encyclopedia of Life*, the website of which is currently hosted by the Smithsonian.

Initially, the Diptera website was hosted by the USDA (http://www.sel.barc.usda.gov/Diptera/names/) where it remained until 2009. When Chris retired from USDA in the summer of 2008, it soon became evident that he could not take the BDWD with him: the USDA retained the copyright on the name Biosystematic Database of World Diptera, if not the data therein. The USDA's website eventually shut down and there was a gap of time where the database was not online.

Then in 2010, there came a name change and a new home for the database. Chris had in the early 2000s purchased the domain name www.Diptera.org. From about 2001 to 2009, when one typed in the address http://www.Diptera.org, it would get redirected to the USDA server where the BDWD was hosted. Now that Chris was no longer a USDA employee, he decided to use his domain and place it elsewhere. Thomas PAPE at the Natural History Museum in Denmark agreed to host a redesigned website (Fig. 4) (the design of which remains the same today), and the name of the database was changed to *Systema Dipterorum*, the name reflecting FABRICIUS's 1805 "*Systema Antliatorum*". The website first appeared on 10 August 2010,



Nomenclator Query

Name: Enter Name that
Author: Enter Author that
Year: equals
Kind: Make a Selection
Family: Enter Family that
Valid Name: Enter Valid Name that

Enter as much information as you know. For example, "Syr" retrieves "Syrphidae", "*Syrphus*", and all species currently and previously associated with the genus *Syrphus* as well as a few other names.

Sort by: unsorted ascending

When Searching: ● Match all Words between fields (AND)
○ Match any words between fields (OR)

Number of records returned: 10

Content by F. Christian Thompson
Please send questions and comments to Chris Thompson.
Last Updated: November 28, 2005 by Irina Brake

Fig. 3: Screenshot of The Diptera Site (BDWD) in November 2005.

conveniently coinciding with the 7th International Congress of Dipterology, San José, Costa Rica (8–13 August 2010), and remained in operation until 2016 when Chris, after becoming increasingly dissatisfied with providing the nomenclatural data in *Systema Dipterorum* for free, took the site down for personal reasons.

After a number of emails back and forth and meetings between Neal and Chris and Richard PYLE in Hawai‘i, Chris eventually handed over the management of the database to both Thomas PAPE and Neal EVENHUIS in June 2018, with an official announcement soon after in *Fly Times* (THOMPSON 2018). Transfer of the domain name had some technical problems, and the database was initially hosted by the Bishop Museum on the same server as for ZooBank, but separate from it and linked through Diptera.dk. The transfer of ownership of the domain was finally completed in early 2020 and the database is once again accessible at www.Diptera.org.

CD-ROMs

Posting updated versions of BDWD on the web was one medium for disseminating information about names, but there was one more medium (other than printing) that Chris had envisioned not only to be able to reach many users but also to allow them to have volumes of information on their desktop computer: this was via CD-ROM disks. Chris was in cor-

The Project

Two-winged insects or Diptera comprise 12% of the planetary biota, and the Systema Dipterorum is an authoritative source for their names. Systema Dipterorum contains all names proposed for extant and extinct Diptera and it is a source for information about those names. The two main components of Systema Dipterorum are the Nomenclator and the References database.

By providing authoritative information about dipteran names, Systema Dipterorum is the necessary framework for organizing, interpreting and integrating current and future data, information and knowledge about two-winged insects.

Supporting organisations

Natural History Museum of Denmark: http://snm.ku.dk/

Smithsonian Institution (SI): http://www.si.edu/

Global Biodiversity Information Facility (GBIF): http://www.gbif.org/

Species2000: http://www.sp2000.org/

Content by F. Christian Thompson and Thomas Pape
Please send questions and comments to Chris Thompson or Thomas Pape
Served from the Natural History Museum of Denmark, University of Copenhagen - Web Design: Nikolas Ioannou, ZMUC - Photos: © S.A. Marshall

Fig. 4: Screenshot of the Copenhagen-hosted database renamed as *Systema Dipterorum* (SD) Version 1.0 in August 2010.

respondence with Bill ESCHMEYER after Bill's *Catalog of Fishes* came out in a 3-volume set plus CD-ROM; and Chris wanted to know the costs of producing the work and if there was an efficient way to get such information out by publishing via CD-ROM. He wrote to Bill in an email of 24 February 2003:

> "I am publishing printed versions at the family level for authors who are interested in sharing printing costs, but the whole BDWD will never be printed as a single or series of volumes like your fish book. At best there will be CD-ROM versions of the database. I have now over 250,000 name records, just too many to justify a printed version."

Chris's CD-ROM idea had taken hold almost 5 years earlier though. Lloyd KNUTSON and Chris had promised delegates at the Hamburg International Congress of Entomology to deliver published fascicles of world Diptera. The 1985 (third) edition of the ICZN Code allowed for CD-ROM as a medium after 1984 and "if" the work met the criteria of multiple identical copies issued simultaneously (and gave this information in words) and included a statement by the author that any new name or nomenclatural act within it is intended for permanent, public, scientific record. Chris believed that just copying a computer file onto a CD-ROM and copying CDs one at a time did not comply with the Code. So, Chris went out and purchased a CD-ROM writer and labeler. In December 1995, he sent out the first Beta 1.0 release (labeled the Diptera Data Demo Disk) to a few dipterists and Beta 2.1 was released in March 1997 (the

Fig. 5: Case covers for DDDD CD-ROMs. Left: Volume 1 (1998), right: Volume 2 (2001). Note: That is not a lens flare on the volume 2 case. It is part of the design.

contents of the disk is dated February 1997. In December 1998 the first CD-ROM product of the BDWD project was issued under the auspices of the North American Dipterists Society: the Diptera Data Dissemination Disk (DDDD) Volume 1, with ISSN number: 1521-0014 (Fig. 5, left). It contained a dipterists's resource directory, a working copy of the world Tephritidae database, MEDHOST Version 1.0 (a bibliography of host plants of the Mediterranean Fruit Fly), a working copy of the BDWD, a working copy of family-group names in Diptera, a key to mosquito genera of the world, the USNM Diptera collections inventory, and the html files of the Diptera website (which could be launched from the disk—if one did not yet have access to the web).

A second volume of the DDDD was issued in 2001 (Fig. 5, right) and contained updated versions of files in volume 1 plus the stiletto fly website, the MANDALA 5.3 database, the systematic database of *Thereva* names, the Tachinidae resources website, a revised version (database) of Arnaud's Host-Parasite Catalog of North American Tachinidae, a host database for *Anastrepha* Schiner and *Toxotrypana* Gerstaecker (Tephritidae), and an update to the tephritid names database. For reasons unknown, but it may have just been because Chris was juggling too many projects at once, the CD-ROM idea did not proceed after volume 2 of the DDDD.

Myia

In 1979 Paul H. Arnaud, Jr. created the journal *Myia*, devoted to works dealing with Diptera. The first volume (Arnaud 1979) dealt with the Diptera types in the California Academy of Sciences. Successive volumes were published, dealing mainly with biographically-themed works focused on important dipterists, until the journal suspended publication in 1994. Chris made an agreement for a few more volumes to be finished by Paul, but volume 8 and those after would contain products of the Biosystematic Database of World Diptera. The first of these to appear (vol. 9) was the world Tephritidae catalog (Norrbom et al. 1999) (Fig. 6, left) and the next (vol. 10) the family-group names catalog (Sabrosky 1999). A few years later, the world Stratiomyidae catalog came out (Woodley 2001), and after a 10-year gap, the last volume (12) appeared (Brake & Thompson 2011) (Fig. 6, right), which contained a number of world catalogs as well as other information deriving from the *Systema Dipterorum* database. Other volumes had since long been planned by Chris, including his world catalog of Syrphidae.

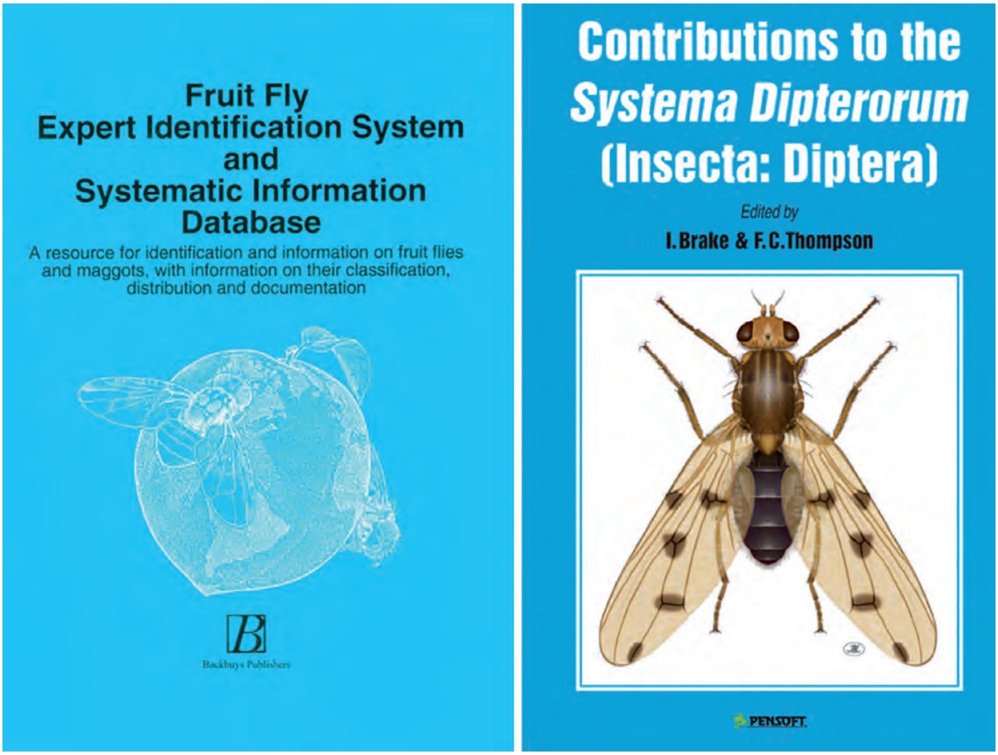


Fig. 6: *Myia* volume covers. Left: *Myia* 9 (1999); right: *Myia* 12 (2011).

Statistics over the years

From time to time, Chris published statistics of the database; either for internal USDA promotion or externally to let the user community know where things stood. Table 1 gives a summary of how SD has progressed over the years based on what data we could find with regard to valid extant species numbers. Very early numbers for every year could not be found but those that were found in yearly summary reports reflect the totals of the various regional catalogs since that was the goal of the first phase.

Present

The current database structure of *Systema Dipterorum* (version 3.11 as of this writing) has not changed much since Chris designed it and decided which fields should be displayed on the web. A few new fields have been added such as UUIDs that are automatically generated for every record of names and references and a few fields that were never used have been deleted. But the overall data structure and relationships have not been touched.

In version 3.11 (November 2022) (Evenhuis & Pape 2022) there are currently 242,556 fly names (extant and fossil) entered into SD (213,740 species-group, 24,158 genus-group, and 4658 family-group names). Of these, 172,703 species-group (168,079 extant), 12,681 genus-group, and 472 family-group names are considered taxonomically valid. The number of references entered is 39,024 and 83 % of the species-group names are linked to those references.

Table 1: Summary of valid extant species-group names in SD over time. The asterisk (*) indicates a decrease due to removal of duplicate entries.

Year	BDWD/SD	Version	Extant spp.
1992	–	–	30,363
1993	BDWD	–	45,994
1995	BDWD	–	62,181
1997	BDWD	–	78,567
2000	BDWD	1.0	105,396
2001	BDWD	2.0	
2002	BDWD	4.0	
2004	BDWD	6.1	144,383
2005	BDWD	7.5	149,199
2006	BDWD	8.5	150,292
2007	BDWD	9.5	
2008	BDWD	10.5	156,698
2009	BDWD	10.5	
2010	SD	1.0	158,438
2011	SD	1.1	
2012	SD	1.2	
2013	SD	1.5	
2018	SD	2.0	156,446*
2019	SD	2.1	156,206*
2019	SD	2.2	156,311
2019	SD	2.3	155,439*
2019	SD	2.4	155,470
2020	SD	2.5	156,496
2020	SD	2.6	157,859
2020	SD	2.7	158,662
2020	SD	2.8	158,871
2020	SD	2.9	159,212
2021	SD	2.10	160,180
2021	SD	3.0	160,739
2021	SD	3.1	161,077
2021	SD	3.2	161,635
2021	SD	3.3	162,308
2021	SD	3.4	164,425
2021	SD	3.5	165,268
2022	SD	3.6	165,923
2022	SD	3.7	166,688
2022	SD	3.8	166,859
2022	SD	3.9	167,489
2022	SD	3.10	167,805
2022	SD	3.11	168,079

Future

Chris had always touted his database as one belonging to the community. Although implementation of direct user input was not achieved during his life, the intention was always to set up the database, in such a way, that the community could take it over and maintain it while adhering to strict and explicit quality assessment. We still adhere to his vision. We envision a web portal in which updates can be made on the fly of new names and literature as well as updating both nomenclature and taxonomy by making changes, and correcting errors, with explicit reference to published authority sources.

We also envision the future for SD to be a sort of one-stop shopping website, where clicking on a name that has been searched may call up links to, e.g., nomenclatural registry in ZooBank, original description through the Biodiversity Heritage Library, taxonomic treatments from PLAZI, images from MorphBank, occurrence data through GBIF, molecular sequence data from GenBank, BINS from Barcode of Life, and additional data from many other sources.

All this takes time, money, and people. We have a little time, but far from enough, and we are still looking for the other two coefficients to that formula.

Acknowledgements

NLE thanks Betty Thompson for allowing access to Chris's files and correspondence relating to BDWD. Thanks to Owen Lonsdale for his remembrances of the SD project. Al Norrbom kindly reviewed an early draft and made valuable comments, corrections, and additions, all of which have greatly helped improve the accuracy of the paper.

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Chris THOMPSON at the USNM

[Chris THOMPSON am United States National Museum]

Torsten DIKOW

Washington, D.C., U.S.A.

Abstract

This manuscript aims to provide an insight into Chris THOMPSON's work at the USNM by touching on a few key points and interests he developed while at the Smithsonian. I overlapped with Chris at the USNM for only a few years (2012–2019) but met him the first time when I was a research intern with my predecessor as Smithsonian dipterist Wayne MATHIS in 2000. The following text should not be seen as an exhaustive list of Chris's work at the USNM, but focuses on select observations I think are of wider interest to the dipterological and entomological community.

Key words: Diptera, Syrphidae, collection curation, digitization, Smithsonian, WILLISTON Fund

Zusammenfassung

Vorliegender Beitrag gibt einen Einblick in Chris THOMPSONS Arbeit am USNM, indem es auf einige Schlüsselpunkte und Interessen eingeht, die er während seiner Zeit am Smithsonian entwickelt hat. Ich habe nur wenige Jahre (2012–2019) mit Chris am USNM überschnitten, traf ihn aber das erste Mal, als ich im Jahr 2000 ein Forschungspraktikant bei meinem Vorgänger, dem Smithsonian Dipterist Wayne MATHIS, war. Die Ausarbeitung ist nicht vollständig. Sie konzentriert sich auf ausgewählte Themenbereiche, die aus meiner Sicht für die dipterologische und entomologische Gemeinschaft von größerem Interesse sind.

Stichwörter: Diptera, Syrphidae, Sammlungskuration, Digitalisierung, Smithsonian, WILLISTON Fund

USNM Diptera collection

The Smithsonian Diptera collection is housed in the Department of Entomology of the National Museum of Natural History (NMNH). The official abbreviation for citing this museum as a repository is USNM (referring to the former United States National Museum). The collection is administered by the Smithsonian Institution, but four separate U.S. government agencies provide research and curatorial staff, i.e., the Smithsonian (SI); the Systematic Entomology Laboratory (SEL) of the Agricultural Research Service, U.S. Department of Agriculture; the National Identification Service (NIS) of the Animal & Plant Health Inspection Service, U.S. Department of Agriculture; and the Walter Reed Biosystematic Unit (WRBU) of the Walter Reed Army Institute of Research, U.S. Department of Defense. The NIS, SI, and SEL dipterists and main collection are located at the NMNH in downtown Washington, D.C. The WRBU dipterists and collection of medically important fly families as well as Chironomidae, Limoniidae, and Tipulidae are situated a few miles southeast of Washington, D.C. at the Museum Support Center (MSC) in Suitland, Maryland.

Chris THOMPSON started as a researcher and curator in the Systematic Entomology Laboratory (SEL) in 1974 and was employed there until his retirement in 2008. After retirement, Chris kept the same schedule of working in his office and the collection every day until he moved with his wife Betty to Florida in 2014. He continued to visit the USNM for a long weekend or a week at a time three to four times a year until the SARS-CoV-2 pandemic made access impossible in March 2020. Figures 1–4 show Chris, colleagues, and visitors at the USNM at different times of his career.

Chris became curator of the USNM Syrphidae collection starting with his SEL appointment in 1974. He oversaw and managed a much larger part of the Diptera collection though, totaling at various times of his career some 26 families from Nematocera (Anisopodidae, Axymyiidae, Bibionidae, Bolitophilidae, Diadocidiidae, Ditomyiidae, Hesperinidae, Keroplatidae, Lygistorrhinidae, Mycetophilidae, Pachyneuridae, Perissommatidae, and Rangomaramidae), to Asiloidea (Asilidae), to Phoroidea (Ironomyiidae, Lonchopteridae, Opetiidae, Phoridae, Platypezidae, Pipunculidae), to Syrphidae, to Conopidae, to acalyptrate taxa (Braulidae, Mormotomyiidae), and finally Calyptratae (Anthomyiidae, Scathophagidae).

Chris employed modern tools in collection curation such as utilizing a custom FileMaker Pro database to print header labels for the unit tray that houses all or some specimens of a particular species. In contrast to the majority of USNM curators, Chris did not insert new header labels directly into the unit tray (wedged between the foam and tray top), but placed them on the outside, on the top of the unit tray with written information visible above the tray (Figs 5–6). An example of such a printed, but not yet folded header label is shown in Fig. 6 (left) with the solid line being for folding the bottom part upward to place it underneath the unit tray and the dotted line for cutting the length of the entire card. This style of header label allows lifting the unit tray out of the drawer without needing to touch the unit tray itself and causing potential damage to specimens. One can also see that other information was directly included on the header label such as subfamily and tribe. A disadvantage of this approach is that the unit tray and header label can get disassociated and information lost.

Fig. 1: The USNM Diptera unit staff in 1978 and some visitors. Chris THOMPSON is back row 4th from right. Others: front row left to right: Sunthorn SIRIVANAKARN, Bill WIRTH, Alan STONE, Curt SABROSKY, George STEYSKAL, Ray GAGNÉ, Dick FOOTE; back row from left: Ed PEYTON, Lloyd KNUTSON, Bill GROGAN, Ron WARD, Laurene VAN WIE, Don MESSERSMITH, Chris THOMPSON, Holly WILLIAMS, Michael FARAN, Wayne MATHIS. Photo: Victor KRANTZ, Smithsonian Institution.

Fig. 2: USNM Diptera unit in 2005. Chris THOMPSON is back row on left. Others: front row left to right: Holly WILLIAMS, Wayne MATHIS, Diane MATHIS, Lucrecia RODRIGUEZ; middle row left to right: Gary OUELLETTE, Masahiro SUEYOSHI, Allen NORRBOM; back row left to right: Chris THOMPSON, Ray GAGNÉ, Irina BRAKE with son Leon, Peter BRAKE, Norm WOODLEY. Photo: L. RODRIGUEZ, 18 November 2015.

Chris was instrumental in establishing unique specimen identifiers (a.k.a. 'barcodes') in the Diptera and insect collection at the USNM (Fig. 6, center, see also below). He purchased the first batch of unique specimen identifier labels that used 'USDA SEL' as the institutional acronym/depository (Fig. 6, right). Since the collection belongs to the Smithsonian, the Smithsonian Entomology Chair immediately requested a change to represent each specimen by USNMENT followed by an eight-digit number, which formed what was then called a Darwin-Core Triplet of institutionCode (= USNM), collectionCode (= ENT), and catalogNumber (e.g., 01234567). This USNMENT number series started at 20,000 and an example of an early 'barcode' label is attached to the holotype of *Xylota analis* WILLISTON, 1887 (USNMENT00022004, see http://n2t.net/ark:/65665/305fcf129-118c-448c-8c71-2218b7b6e92f). These early labels use a triple stack code-128 barcode, which is small and printed on a roll from which one can easily detach single labels (see Fig. 6, center). These labels are still found in the collection, but modern barcode scanners cannot read the triple stack barcodes anymore. However, the unique identifier with the USNMENT number is printed on the label so that it is accessible, and the department has several refurbished barcode scanners that can read all three types of barcodes used at the USNM. To this day, the numbering convention continues although the modern labels look quite different and use a 2D matrix barcode as can be seen in the holotype of *Citrogramma chola* GHORPADÉ, 1994 (USNMENT01818022, see http://n2t.net/ark:/65665/3ab7e359e-f127-4b51-a88b-5c89741601c3).

Chris together with Wayne MATHIS, the Smithsonian dipterist between 1976 and 2011, developed the idea of a species inventory. Under their leadership, the Diptera unit utilized vol-

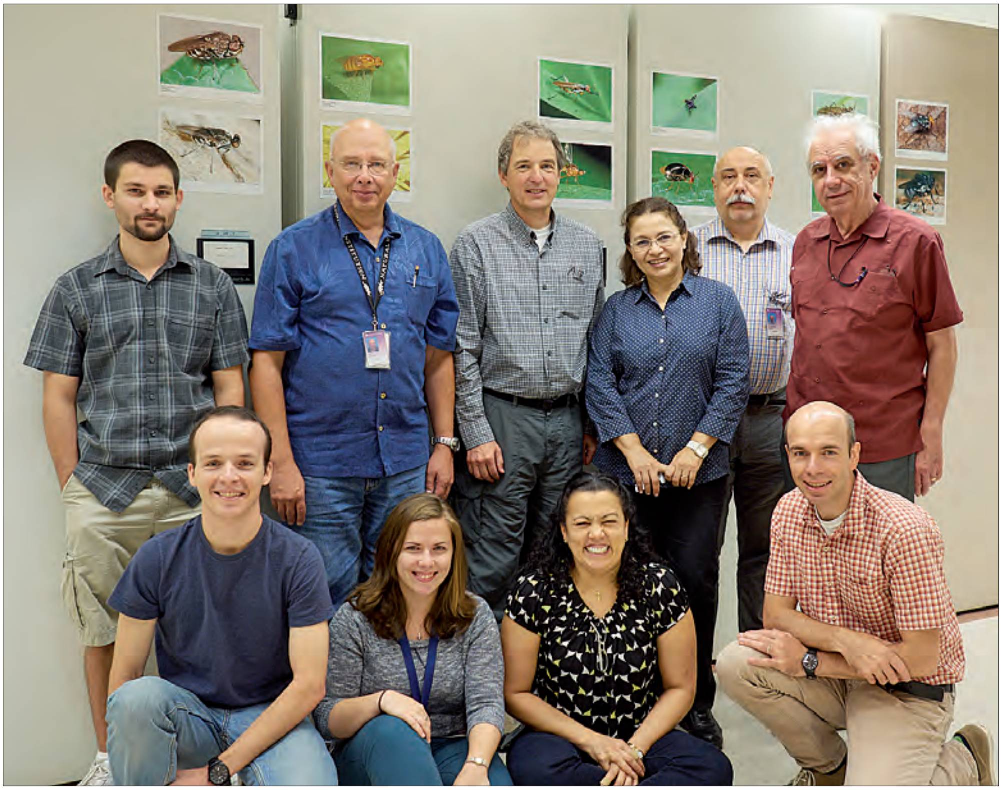


Fig. 3: USNM Diptera unit with visitors in 2013. Chris THOMPSON is back row on right. Others: front row left to right: Diego FACHIN, Erin KOLSKI, Lucrecia RODRIGUEZ, Torsten DIKOW; back row left to right: Chris COHEN, Wayne MATHIS, Allen NORRBOM, Rosaly ALE-ROCHA, Tadeusz ZARTWANICKI, Chris THOMPSON. Photo: T. DIKOW, 17 September 2013.

unteers and contractors to capture the species names present in the collection and it became the first such species inventory for a large insect taxon at the USNM. With additional funding from the Smithsonian, this inventory was updated by one contractor between 2013–2015 resulting in a comprehensive list and account of all species in the collection. It also includes the number of pinned specimens, the countries where these specimens have been collected in, and for the U.S.A. and Canada additionally the states/provinces. While other species inventories are accessible on the USNM collections portal, such as aquatic insects, for example, the Diptera species inventory is not yet publicly accessible, but will hopefully be searchable on the portal soon.

The USNM provides the opportunity for established curators at other natural history museums to take over the curatorial obligations of entire insect families at their home institution. Chris was influential in developing the program and getting the Diptera community involved. The first of these USNM Off-site Collections Enhancement Program loans were the Bombyliidae and Mythicomyiidae collections to Neal EVENHUIS at the Bernice Pauahi Bishop Museum (BPBM) in Honolulu, HI in 1990. Other Diptera taxa are the Celyphidae, Chamaemyiidae, and Lauxaniidae at the California State Collection of Arthropods (CSCA) in Sacramento, CA under the curatorial supervision of Steve GAIMARI (established in 2002), and Pipunculidae at the Canadian National Collection of Insects, Arachnids and Nematodes (CNC) in Ottawa, ON curated by Jeffrey H. SKEVINGTON (established in 2012).

Fig. 4: USNM Diptera unit with visitors in 2015. Chris THOMPSON is back row 4th from right. Others: front row left to right: Tatiana SEPULVEDA, Kevin MORAN, Erin KOLSKI; back row left to right: Marcoandre SAVARIS, Silvana LAMPERT, Mauren TURCATEL, Luciane MARINONI, Mark SCHUTZE, Wayne MATHIS, Chris THOMPSON, Diego SOUZA, Allen NORRBOM, Torsten DIKOW. Photo: T. DIKOW, 5 May 2015.

USNM Syrphidae collection

Chris was eager to both curate the Syrphidae collection and utilize it in his research. His research resulted in 25 new Syrphidae genera and 165 new species (data from Systema Dipterorum as of 20 May 2022, http://www.diptera.org) of which 40 species are represented by holotypes in the USNM. Chris organized the collection by subfamily followed by tribe and then alphabetically by genus. He borrowed primary type specimens, other interesting specimens, or the entire holdings of Syrphidae from other museums and university collections for study. Unfortunately, these specimens were, at least in part, physically placed in the main USNM collection in the same unit tray of the respective species. Because not all instances of specimens from other museums are documented properly, for example through a label indicating the original owning museum collection, without subject-matter expertise it is a complex task to decipher which specimens are borrowed and which belong to the USNM (the same method of non-USNM specimen placement was also done in the Chloropidae, Tephritidae and several other families by earlier USNM Diptera curators). Fortunately, through members of the Syrphidae community such as Jeffrey H. SKEVINGTON and Kevin MORAN, the USNM has received support for returning borrowed specimens to the correct owning institutions in August 2022 and future visits by Jeffrey H. SKEVINGTON are planned.

Chris invested personal funds to pay contractors to photograph the USNM primary type specimens of Syrphidae, USNM Syrphidae specimens used in his research, and type specimens he had on loan from other institutions. The majority of the USNM specimen photos were not added to the institutional database (EMu) and therefore have not been made accessible online. Since I joined the USNM and assumed the official responsibilities of the Syrphidae collection in 2012, I asked Chris repeatedly to review the primary type database, which originated in the 1960s along with the physical movement of all Diptera primary types into a special collection housed alongside the main collection. The task was to highlight any types that represented yet unpublished manuscript names, did not belong to the USNM, or locate specimens that for some reason had not been placed in the type collection yet. Unfortunately, Chris was busy with so many other projects that he didn't review this list, which included some 554 records of Syrphidae primary types. Systema Dipterorum lists 523 primary types of Syrphidae that should be deposited at the USNM based on a review of the published literature. Many of these primary types have been photographed under Chris's oversight over the years.

However, the SI Diptera team made an effort to fill the gaps and we are now able to share photographs of 521 Syrphidae types on the USNM collections portal (https://collections.nmnh.si.edu/search/ento/, Type search tab) from where they are downloadable in full resolution. All images of specimens from the Smithsonian Institution are in the public domain (Creative Commons license CC0) and therefore can be used and published in manuscripts, shared with colleagues and online, or made openly accessible otherwise. Acknowledging that the specimen is from the USNM and Smithsonian Institution with its unique specimen identifier (USNMENTXXXXXXXX) would be greatly appreciated. The photos can also be accessed on the Smithsonian Open-Access Portal (https://www.si.edu/openaccess) from where they can be downloaded more straightforwardly. Searching for the USNMENT identifier or original species name (original generic combination) will suffice to locate the record.

In addition to photos of Syrphidae species, Taina Litwak, a SEL illustrator, was commissioned on many occasions to digitally draw Syrphidae species published in Chris's manuscripts. Some of these illustrations have been reproduced in this issue.

Chris developed many projects throughout his career using the existing collection at the USNM to better understand regional faunas. Two projects, the Syrphidae/Diptera of Plummer's Island and DelMarVa come to mind. Plummer's Island (38°58'11" N 077°10'35" W) is an island in the Potomac River, which separates Maryland and Washington, D.C. from Virginia. It has been sampled extensively for fauna and flora by the Washington Biologist's Field Club since 1899 and is referred to as "the most thoroughly studied island in North America" (see https://en.wikipedia.org/wiki/Plummers_Island). DelMarVa represents the Delmarva Peninsula composed of Delaware as well as the eastern parts of Maryland and Virginia between the Atlantic Ocean and the Chesapeake Bay and is only a short drive east of Washington, D.C. (see https://en.wikipedia.org/wiki/Delmarva_Peninsula). There are numerous specimens in the Syrphidae collection and a few other families that have been 'barcoded' (received a unique specimen identifier, see above) or hand-written labels are placed inside the unit tray indicating that specimens originate from these two places. Chris surveyed the collection for these localities and was setting the specimens up for future study and he likely captured the occurrence data in a custom FileMaker Pro database. However, no scientific publication on Syrphidae resulted from the analysis of the specimens from Plummer's Island and DelMarVa, and no specimen data were entered into the museum-wide EMu database; the few records of Syrphidae from Plummer's Island available from the USNM at GBIF (https://www.gbif.org) originated from a 2019 conservation-focused data capture project.

Natural history museum specimen data

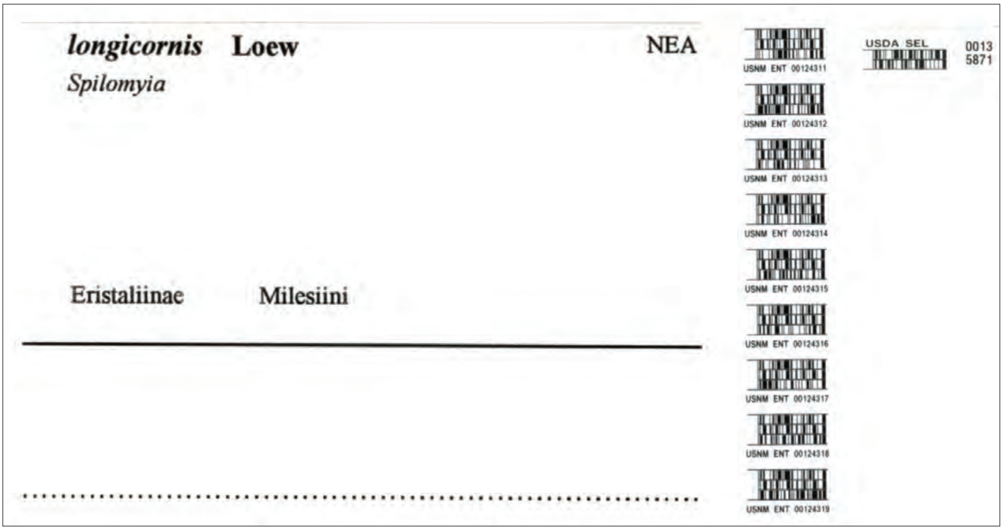
Evenhuis et al. (2023) provide an overview of Chris's forward-thinking approach to species data capture that resulted in the invaluable Systema Dipterorum portal. Chris was deeply

Fig. 5: The unit tray containing all specimens of *Palpada bistellata* HULL, 1935 showing the header label placed outside at the top of the unit tray with the species name and zoogeographic region visible. This additional height allows for lifting the tray and moving it out of the drawer.

interested in developing new tools for entomological data management and was invited to organize a workshop on and produce a data standard for Systematic Entomology entitled, “Automatic Data Processing for Systematic Entomology: Promises and Problems, a report for the Entomological Collections Network” (1 December 1990, Baton Rouge, LA) as well as speak on “Electronic publishing: Delivering the goods to the public” (Entomological Society of America, “Computer and software tools for improving and speeding biodiversity studies” symposium, 11 December 1996, Louisville, KY).

Chris also developed a poster in the USNM Diptera collection on “Digitizing and Disseminating Diptera Diversity (D^4)” (Fig. 7) in the mid-2000s. This poster provides a forward-looking approach to specimen-level data capture using unique specimen identifiers and utilizing the digital data record as well as external data and media to aggregate a species page on the Encyclopedia of Life (EoL, https://eol.org) from where the information is accessible to the dipterological community and the public-at-large.

This is one initiative to share species and specimen data today, but Chris, in my understanding, did not put resources into the specimen-level data capture toward the institutional database (EMu in the case of the USNM) although his custom database might have the specimen data available. As becomes clear also when looking at Bionomia (see below), very few USNM Syrphidae specimens have been data-captured, added to EMu, and made available to the Global Biodiversity Information Facility (GBIF, https://www.gbif.org) for use by all scientists and the public. As of December 2022, of the 96,000 Syrphidae specimens in the USNM collection, only 3348 specimen-level records are accessible at GBIF (see https://www.gbif.org/occurrence/map?dataset_key=821cc27a-e3bb-4bc5-ac34-89ada245069d&taxon_key=6920),



longicornis **Loew** NEA

Spilomyia

Eristaliinae Milesiini

USNM ENT 00124311

USNM ENT 00124312

USNM ENT 00124313

USNM ENT 00124314

USNM ENT 00124315

USNM ENT 00124316

USNM ENT 00124317

USNM ENT 00124318

USNM ENT 00124319

USDA SEL 0013 5871

Fig. 6: Left: A printed but unused unit tray header label from Chris's database. Center: A set of early 'barcode' labels initiated by Chris THOMPSON (triple-stack code 128 with perforation between each label for easy detachment and use). Right: A 'USDA SEL' unique specimen identifier label (acronym never officially used at USNM).

which include all primary type specimens with photos and the majority of the other specimen records that were added in the past several years through digitization projects in-house. The hope is to obtain access to Chris's specimen-level database to add the digital data to EMu and make them accessible online, but so far only an older copy has been located (circa 2011) with some 3000 USNM specimens.

Smithsonian

Although Chris was an SEL employee, he was very much involved in Smithsonian issues. His employer, the U.S. Department of Agriculture (USDA) is a federal government agency while the Smithsonian (called a quasi-official entity and not officially part of the executive branch of the U.S. government) is not entirely federally funded and therefore might have some less-stringent protocols. For example, establishing a research endowment for Diptera (see WILLISTON Fund below) was certainly not possible within USDA but easily accomplished within the Smithsonian Institution where this endowment fund is being held for perpetuity. Likewise, Chris was a generous supporter of the Smithsonian Natural History Library. He served on the NMNH library committee as a strong advocate for the print collection and contributed annually to the Entomology library until his retirement. He and his wife Betty set up an endowment fund to help sustain natural history serial subscriptions [see https://library.si.edu/donate/endowments/serials-acquisition-and-preservation] and several of his rare books were also donated to the Smithsonian library recently (see EVENHUIS et al. 2023).

Chris also made regular 'rounds' to Smithsonian administrators and was asked to contribute to departmental and museum-wide initiatives. He also received a permanent appointment as Research Associate from then Smithsonian Secretary S. Dillon RIPLEY in 1981 (Fig. 8).

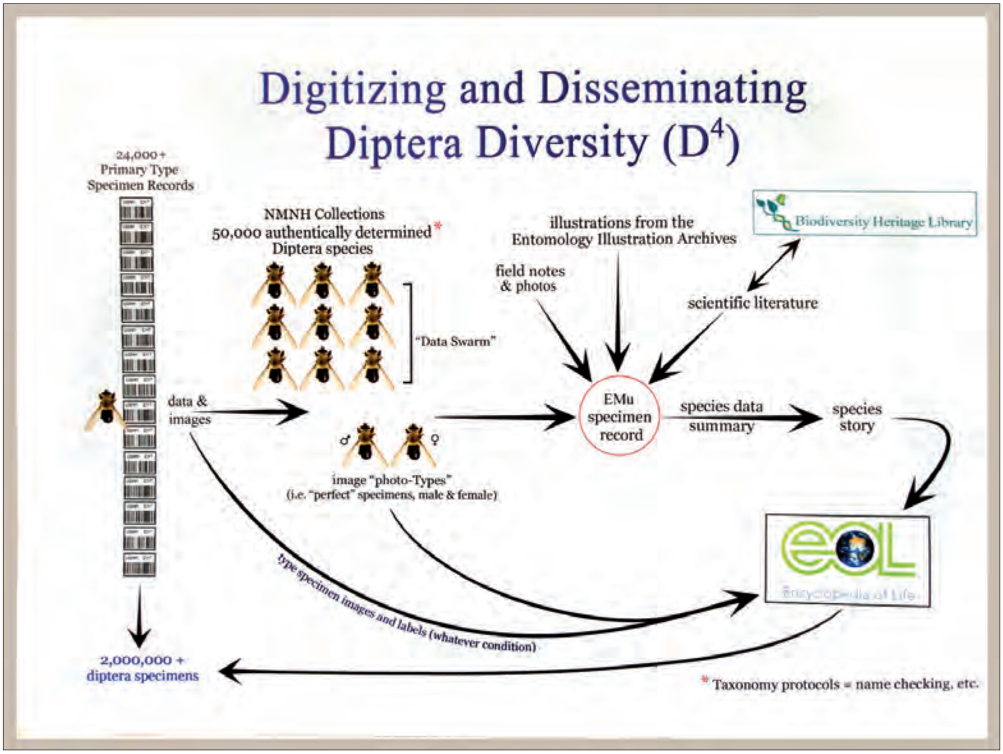
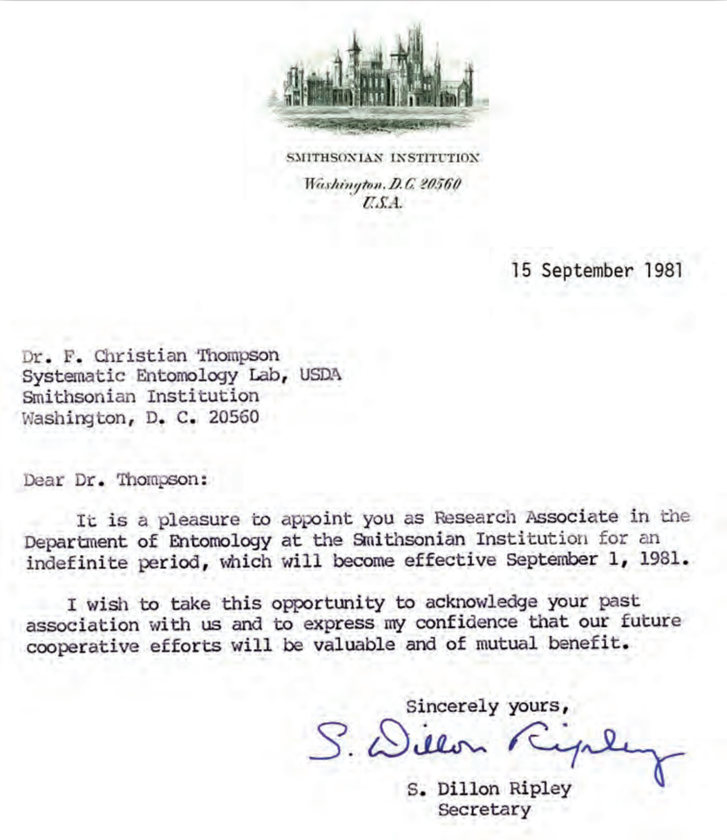


Fig. 7: Poster on "Digitizing and Disseminating Diptera Diversity (D4)" developed by Chris THOMPSON in the mid-2000s and posted on the wall of the Diptera collection.

WILLISTON Diptera Research Fund

Chris THOMPSON was a great supporter of dipterists coming through the Washington, D.C. area (see EVENHUIS et al. 2023), but also reached out to the international community. The S. W. WILLISTON Diptera Research Fund (Fig. 9) was initiated by Chris in the mid-1970s and has grown to its current size primarily through his contributions. It is the only endowment in the NMNH Department of Entomology that is publicly announced and invites applications from outside the department. Chris was very deliberate when setting this endowment fund up so that it can only be used for "the increase and diffusion of knowledge about Diptera".

Samuel Wendell WILLISTON (1851–1918, https://en.wikipedia.org/wiki/Samuel_Wendell_Williston) was a distinguished biologist who made significant contributions to paleontology, entomology, medicine, and education. He was the first native dipterist in the U.S.A., the first to produce generic monographs of Nearctic Diptera as well as three editions of the Manual of North American Diptera, the first to curate and study the Diptera of the USNM, and the first to contribute to that collection (his types of Nearctic Syrphidae). It was only fitting that Chris named this endowment fund to honor the contributions WILLISTON made to the USNM Diptera collection and dipterology in general. Until 2012, Chris served on the WILLISTON endowment fund committee and has overseen the financial support of many dipterists young and old. The fund remains active and supports the travel of graduate students to the International Congresses of Dipterology (http://www.nadsdiptera.org/ICD/ICDhome.htm), to the USNM for collections-based research, and more recently for students and naturalists to participate in



SMITHSONIAN INSTITUTION
Washington, D.C. 20560
U.S.A.

15 September 1981

Dr. F. Christian Thompson
Systematic Entomology Lab, USDA
Smithsonian Institution
Washington, D. C. 20560

Dear Dr. Thompson:

It is a pleasure to appoint you as Research Associate in the Department of Entomology at the Smithsonian Institution for an indefinite period, which will become effective September 1, 1981.

I wish to take this opportunity to acknowledge your past association with us and to express my confidence that our future cooperative efforts will be valuable and of mutual benefit.

Sincerely yours,

S. Dillon Ripley

S. Dillon Ripley
Secretary

Fig. 8: Letter from former Smithsonian Secretary S. Dillon RIPLEY granting a permanent Research Associate appointment to Chris THOMPSON.

FlySchool. The fund has also supported field-work for taxonomic or systematic research, especially for attending the North American Dipterists Society (http://dipterists.org) bi-annual field meetings. The fund web-site (http://bit.ly/WillistonFund) is kept up-to-date with an annual proposal call on December 1st.

Bionomia

Bionomia (https://bionomia.net/) is an analysis tool summarizing specimen data from the Global Biodiversity Information Facility (GBIF) and attributing them to people. These attributions focus on specimens collected by and identified by an individual and provide a great overview of the impact a scientist has had in the field, especially in natural history museum settings and field-collecting. The aggregated data are based on digitized specimen records from museums around the world that have been uploaded to GBIF and therefore provide only a snapshot of the digitally accessible records at a given time. Many more specimens, especially insects, await data capture in museum collections before they can be shared through GBIF for open access by the scientific community and the public at large. The Bionomia record for Chris THOMPSON can be accessed at https://bionomia.net/Q22111516. Currently (as of 2 December 2022), the available digital data include 2248 specimens from 19 countries collected and 26,784 specimens from 45 countries identified by Chris. From the USNM, 820 specimens are included (“deposited at”) which represent only a very small percentage of the

S.W.
Williston
Diptera Research Fund

Fig. 9: Williston Diptera Research Fund logo. Design by Burgert Muller in 2017.

collection and ongoing digitization efforts on the Diptera collection will increase this number considerably. This Bionomia record also provides a glimpse at Chris's field-work in which he was very often accompanied by his wife Betty who is, when label data are captured, included as a co-collector such as this specimen of *Anu una* Thompson, 2008 from New Zealand (USNMENT00035218, http://n2t.net/ark:/65665/30641e417-f048-4907-9b4d-0bc101b6c121).

In summary, Chris Thompson has contributed in many ways to the Diptera collection at the USNM, other initiatives at the National Museum of Natural History and Smithsonian in general, served on committees and supported the Smithsonian library, and utilized the collection and infrastructure for his research and developing Systema Dipterorum.

Acknowledgments

I would like to thank my Diptera colleagues at the USNM, Ray Gagné, Allen Norrbom, and Norm Woodley, for critically reading a manuscript draft and suggesting improvements; Richard Greene (Smithsonian Natural History Library) and Dave Furth (Smithsonian Entomology Collections Manager, retired) for providing background information; and Neal Evenhuis (Bernice P. Bishop Museum, Honolulu, HI) for sharing his biography of Chris before publication.

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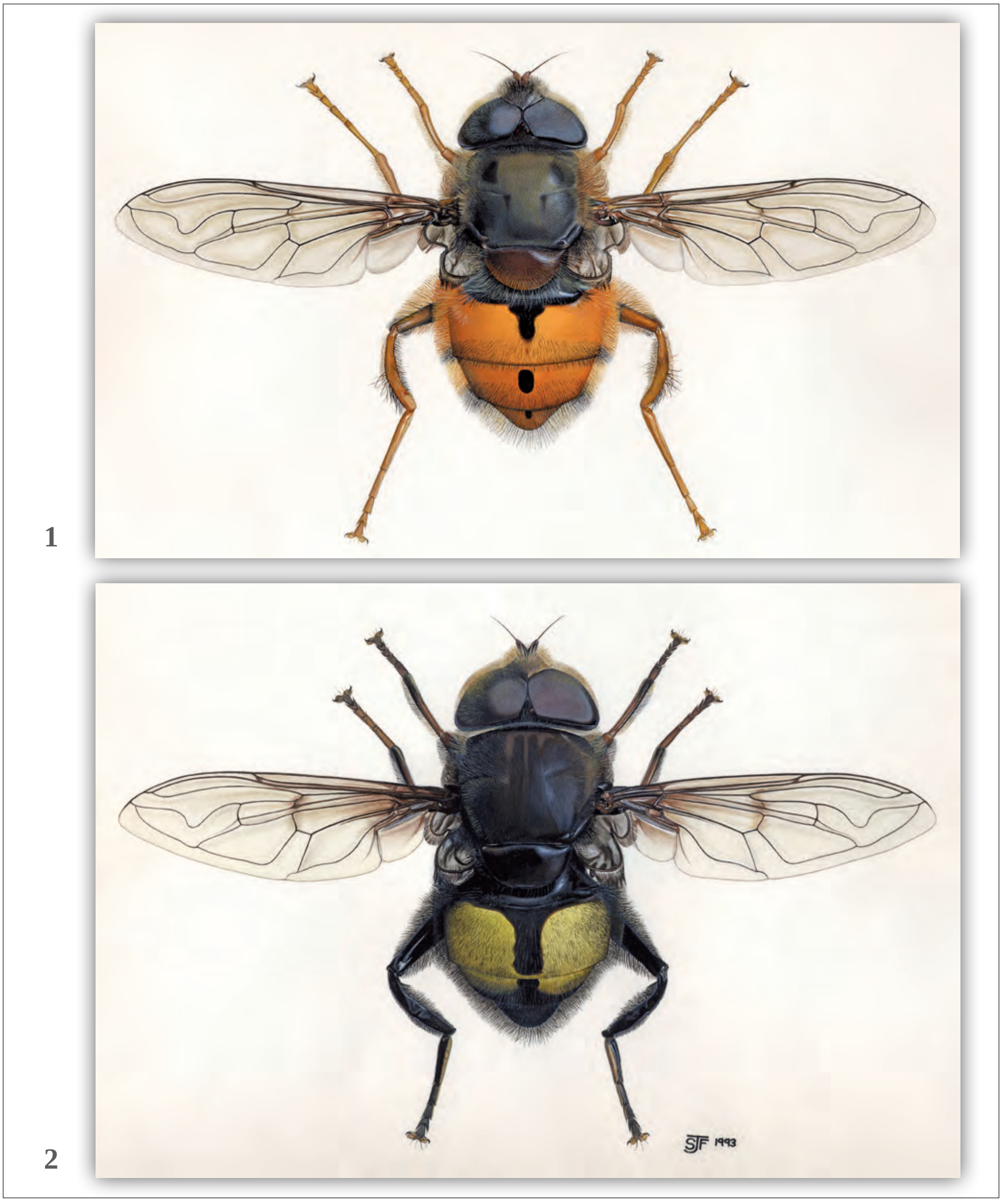
Selected species described by F. Christian Thompson. I.

Ximo Mengual

In his revision of the *Eristalis* of Americas south of the United States, Thompson (1997) named two new species after the co-founders of Microsoft Corp. [namely Paul Allen and William (Bill) Gates, III] in recognition of their contribution to the PC revolution. The drawings of *Eristalis alleni* and *Eristalis gatesi* were done by Steven Falk and Chris Thompson paid for them 'at my expense', in another gesture of his generosity. Chris was a computer enthusiast, but ironically, he hated Microsoft Word and kept using Corel WordPerfect until the last day. Among friends, Chris revealed that his aim with naming these two species from Costa Rica was to bring attention to the Microsoft co-founders and try to get some funding from them, something that he regretted never happened.



Figs 1, 2: Selected species described by F. Christian Thompson. – **1**: *Eristalis alleni* Thompson, 1997; – **2**: *Eristalis gatesi* Thompson, 1997. From the original publication.

F. Christian THOMPSON (1944–2021): his influence and legacy to Neotropical dipterology

[F. Christian THOMPSON (1944–2021): Sein Einfluss und sein Vermächtnis in Hinblick auf die Dipterologie der Neotropis]

Ximo MENGUAL

Bonn, Germany

Abstract

The most influential publications of F. Christian THOMPSON on Neotropical Syrphidae are discussed, including his invaluable synthetic work to propose new broader generic concepts for Neotropical taxa. I also provide some insights into his character and some of my personal experiences with him.

Keywords: Diptera, Syrphidae, flower flies, hover flies, taxonomy, Neotropical Region, Neotropics, personal reflections

Zusammenfassung

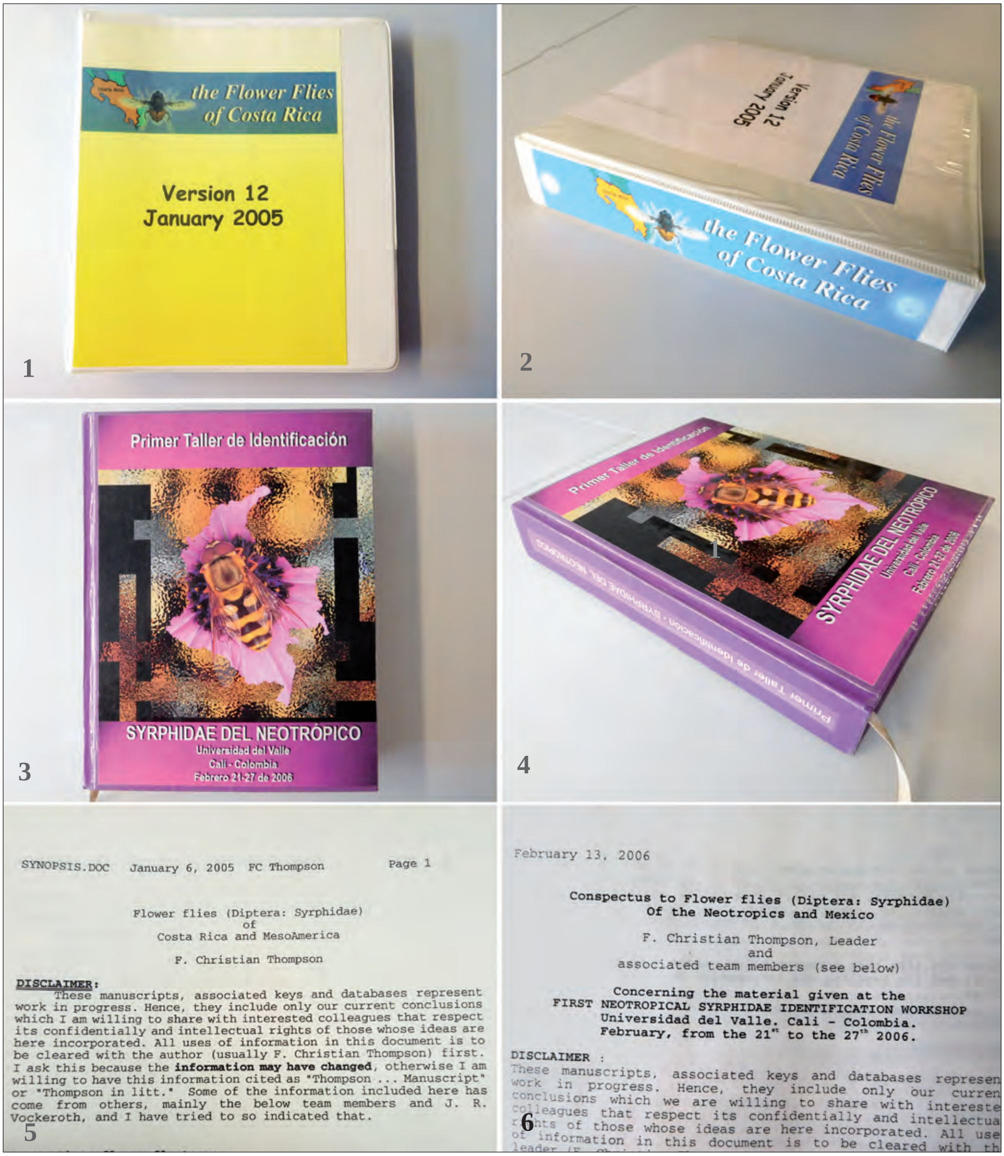
Die einflussreichsten Veröffentlichungen von F. Christian THOMPSON über neotropische Schwebfliegen werden einschließlich seiner unschätzbaren synthetischen Arbeit diskutiert. Sie fokussierten auch darauf, neue und breitere generische Konzepte für neotropische Taxa vorzuschlagen. Es werden auch ganz persönliche Einblicke in sein Wesen und Erfahrungen mit Chris THOMPSON mitgeteilt.

Stichwörter: Diptera, Syrphidae, Schwebfliegen, Taxonomie, neotropische Region, Neotropis, persönliche Erlebnisse

My beginnings with Chris

I first met F. Christian THOMPSON (Chris) back in 2003, during the II International Symposium on Syrphidae in Alicante (Spain). I was a recent graduate student, who helped to organize the symposium, and I was a bit shy to introduce myself to such a world-renowned researcher. That was never a problem for Chris, who liked to get to know the new students and their research, and we exchanged a few words during those days. I still vividly remember his closing talk and the shocked audience after one of his most memorable comments regarding professional and amateur dipterologists; he was the only professional syrphidologist in the symposium following his argument. Chris never held back on his opinions, and they were often very controversial.

Two years later, in January 2005, I met Chris again for a two-week field expedition in Costa Rica. This was not the first visit of Chris to this beautiful MesoAmerican country. In November 1991, almost paired with the creation of the INBio (Instituto Nacional de la Biodiversidad), Chris sent a commitment letter formalizing his intention to study the flower flies of Costa Rica. Since then, Chris visited Costa Rica on several occasions within the framework of the Costa Rican National Biodiversity Inventory. During his trips, Chris worked with Manuel ZUMBADO (INBio) and collaborated with Paul HANSON (Universidad de Costa Rica) and Dan JANZEN (University of Pennsylvania and Area de Conservación Guanacaste) to accumulate a vast knowledge of the syrphid fauna of MesoAmerica. In our joint trip of 2005, we spent our days while in San José at the Instituto Nacional de Biodiversidad (INBio) preparing for field work in several areas along the west coast of the country. In the first day, Chris gave us a copy of his "Flower flies of Costa Rica and MesoAmerica" (Figs 1, 2, 5), a compendium of manuscript identification keys, conspectuses and gathered information, including an early



SYNOPSIS.DOC January 6, 2005 FC Thompson Page 1

Flower flies (Diptera: Syrphidae)
of
Costa Rica and MesoAmerica

F. Christian Thompson

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These manuscripts, associated keys and databases represent work in progress. Hence, they include only our current conclusions which I am willing to share with interested colleagues that respect its confidentially and intellectual rights of those whose ideas are here incorporated. All uses of information in this document is to be cleared with the author (usually F. Christian Thompson) first. I ask this because the **information may have changed**, otherwise I am willing to have this information cited as "Thompson ... Manuscript" or "Thompson in litt." Some of the information included here has come from others, mainly the below team members and J. R. Vockeroth, and I have tried to so indicated that.

February 13, 2006

Conspectus to Flower flies (Diptera: Syrphidae)
Of the Neotropics and Mexico

F. Christian Thompson, Leader
and
associated team members (see below)

Concerning the material given at the
FIRST NEOTROPICAL SYRPHIDAE IDENTIFICATION WORKSHOP
Universidad del Valle. Cali - Colombia.
February, from the 21st to the 27th 2006.

DISCLAIMER :
These manuscripts, associated keys and databases represen
work in progress. Hence, they include only our curren
conclusions which we are willing to share with intereste
colleagues that respect its confidentially and intellectua
rights of those whose ideas are here incorporated. All use
of information in this document is to be cleared with th

Figs 1–6: Manuscript material provided by F. Christian THOMPSON for the taxonomical identification of Neotropical Syrphidae. – **1**, **2**: Folder of his "Flower flies of Costa Rica and MesoAmerica", version 12 from January 2005; – **3**, **4**: Bound volume for the "Primer taller de identificación de Syrphidae (Diptera) del Neotrópico", regularly cited as THOMPSON (2006); – **5**: First page of the "Flower flies of Costa Rica and MesoAmerica", version 12; – **6**: First page of the volume "Primer taller de identificación de Syrphidae (Diptera) del Neotrópico".

version of the chapter dedicated to Syrphidae for the *Manual of Central American Diptera*, finally published a few years later (Thompson et al. 2010). In the field, I never saw such a selective collector before – Chris knew the genus and most of the species before having them in his net – and he was definitively faster than us (a group of five, with the oldest member more than 20 years younger than Chris) walking through the cloud forest. One morning in the Cerro de la Muerte, over 3000 m a.s.l., he saw a robust female of what could be a new species of *Mallota* Meigen, and the whole team spent a couple of hours in that area of 50 square meters trying to catch that female flower fly. We never did.

During the fall of 2005 I spent two weeks visiting Chris at the National Museum of Natural History (NMNH), Washington, D.C. It was a very helpful stay to work on material collected during 2004 in Madagascar and on our joint expedition in Costa Rica. Those specimens would end up forming the largest part of my PhD, together with the sampled material from Colombia in 2006, again with Chris. During my 2005 visit, I brought to D.C. a couple of males of a new species of *Palpada* Macquart to describe them together with Chris. The material was collected in 2004 on a hilltop close to Cali (Colombia) by my friend Carlos Prieto (also a PhD candidate like me at that time). It was my first new species description and Chris's help was priceless; he not only taught me how to describe a species, but also the steps to follow in any description to agree with the International Code of Zoological Nomenclature. Chris wanted to study the collection of the Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, housed at the time at the Universidad del Valle (Cali, Colombia), and we ended up visiting Colombia next year (2006) with a double goal: to collect more specimens of the new species (finally published in Mengual & Thompson 2008) and to take part in the "Primer taller de identificación de Syrphidae (Diptera) del Neotrópico" organized at the Universidad del Valle. Chris taught the taxonomy and systematics of Neotropical flower flies and shared all his manuscript identification keys for the genera occurring in South America; a kind of updated work from his "Flower flies of Costa Rica and MesoAmerica" from 2005. The organizers (Nancy Carrejo, Carlos Ruiz and Catalina Gutierrez) printed and nicely bound all the immense knowledge gathered by Chris for this event in a limited-edition volume, with fewer than 10 original copies remaining in existence (Figs 3, 4, 6). The printed manuscript work has been extensively used and cited as Thompson (2006) and Thompson *in litt.* by many authors including Chris himself (Restrepo-Ortiz & Carrejo 2009; Mengual et al. 2012, 2018; Morales et al. 2014; Mengual & López García 2015; Thompson & Wyatt 2015; Arcaya & Mengual 2016; Montoya 2016; Sinclair et al. 2016; Arcaya Sánchez et al. 2017; Marín-Armijos et al. 2017; Mengual 2017; Thompson 2017; Medeiros et al. 2019; Ángel Villarreal et al. 2021).

The very positive teaching experience prompted Chris to repeat the identification course two years later in Peru (Figs 7, 8). The "II taller de identificación de Syrphidae (Diptera) del Neotrópico" was organized by the Universidad Nacional Agraria La Molina between June and July 2008, within the collaborative Spanish project AECID A/013484/07, but a very last-minute legal issue left Chris without the possibility to fly to Peru and immediately I became the teacher of the course. The course took place two weeks after my PhD defense, where Chris was the president of my evaluation committee, and the course went well despite the short preparation time I had. Once more, Chris's help was invaluable providing slides and information to prepare the classes and the field expedition. During the minutes following my PhD defense, Chris asked me to apply for a postdoc position funded by The Schlinger Foundation at the NMNH, and I happily moved to Washington, D.C. in January 2009. For two years we worked on the systematics of Syrphidae and, when I was running out of the funds generously provided by The Schlinger Foundation, Chris prompted me to become one of the


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COSTO

TEORIA: USD $ 50.00
(Incluye CD con un extracto de ponencias y separatas)
TEORIA Y PRACTICA: USD $ 150.00
(Incluye manual para la identificación de Syrphidae Neotropicales, separatas y CD del curso).

Las prácticas se desarrollaran con material biológico proporcionado por la institución y los alumnos podrán traer sus propias muestras para identificación.

Depósito a la cuenta de la Fundación para el Desarrollo Agrario:
191-0-031059-0-26, Banco de Crédito del Perú
(Enviar por fax o correo electrónico el recibo del depósito respectivo)

UNIVERSIDAD NACIONAL AGRARIA LA MOLINA
Facultad de Agronomía
BODAS DE ORO DE LA ESCUELA DE POSTGRADO

ESPECIALIDAD DE ENTOMOLOGÍA
ESPECIALIDAD DE MANEJO INTEGRADO DE PLAGAS

CURSO INTERNACIONAL:

Importancia y Biodiversidad de los Sírfidos Neotropicales

II TALLER DE IDENTIFICACIÓN DE SYRPHIDAE (DIPTERA) DEL NEOTRÓPICO
"Del 30 de Junio al 2 de Julio de 2008"


Importancia y Biodiversidad de los Sírfidos Neotropicales

OBJETIVOS
- Presentar la historia evolutiva, sistemática, biodiversidad e importancia aplicada de la familia Syrphidae.
- Identificación de las especies y géneros presentes en Perú y otras regiones del Neotrópico mediante características morfológicas válidas.
- Dotar a los participantes de las herramientas necesarias para la correcta identificación y estudio de sírfidos neotropicales.

CONTENIDO
- La Sistemática en la era digital: BioSystematic Database of World Diptera (BDWD).
- Generalidades sobre la taxonomía, diversidad y distribución de los Syrphidae.
- Morfología de imagos de la familia Syrphidae.
- Generalidades sobre la biología y morfología larval. Importancia en investigación aplicada.
- Historia de la clasificación de la familia Syrphidae.
- Técnicas de estudio, manejo, preparación y conservación de las especies de Syrphidae.
- Identificación, estudio y biodiversidad de las subfamilias de Syrphidae (I): Microdontinae, Syrphinae y Eristalinae.
- Identificación, estudio y biodiversidad de las subfamilias de Syrphidae (II): Eristalinae.

DURACIÓN: 3 DÍAS (30 horas lectivas)
PROGRAMA DEL CURSO

Lunes	30:	Mañana-Tarde (teoría)
Martes	1:	Mañana (teoría); tarde (práctica de Microdontinae, Syrphinae)
Miércoles	2:	Mañana (teoría); tarde (práctica de identificación de de Eristalinae)

EXPOSITORES
- Coordinación y dirección: Dr. F. Christian Thompson, investigador del Systematic Entomology Laboratory (Agricultural Research Service,USDA, Smithsonian Institution, Washington D.C., U.S.A.);
- Colaboradores: Dr. Santos Rojo, Dr. Ximo Mengual, Dra. Celeste Pérez-Bañón, Dra. Ana Isabel Martínez, Grupo de Investigación en Diptera, CIBIO, Universidad de Alicante, Alicante, España.

ORGANIZACIÓN DEL CURSO
- **Universidad Nacional Agraria La Molina:**
  Departamento Académico de Entomología:
  Museo de Entomología "Klaus Raven Büller"
  Escuela de Post Grado
- **Universidad de Alicante:**
  Instituto Universitario CIBIO
  (Centro Iberoamericano de la Biodiversidad)

Patrocinador AECID, Proyecto A/013484/07- Per 27

II TALLER DE IDENTIFICACIÓN DE SYRPHIDAE (DIPTERA) DEL NEOTRÓPICO

Figs 7, 8: Handbill/flyer advertising the "II taller de identificación de Syrphidae (Diptera) del Neotrópico". – **7**: Front and back cover; – **8**: Interior.

first Encyclopedia of Life Rubenstein Fellows (https://Syrphidae.myspecies.info/). During those six months as a Rubenstein Fellow, I learned about Syrphidae taxonomy more than in all the previous years since I graduated, thanks to the enthusiasm and support from Chris.

Years later, I copied the same format of Chris's course to teach the "Curso Internacional Teórico Práctico de Taxonomía y Ecología de Insectos" organized by the Universidad Técnica Particular de Loja (Ecuador) in 2012. And even a third Neotropical syrphid identification workshop was planned in Venezuela, but it never took place due to reasons not related to science.

Neotropical Syrphidae

Since his first publication, the Neotropical flower flies (he always advocated against the term hover flies) remain'ed one of his main research topics. His first work ever published was on a new Neotropical species of *Copestylum* Macquart (Thompson 1965) and was followed by 53 other works where he treated, described and studied Neotropical taxa (see Mengual et al. 2023). My intention is not to review all his publications dealing with Neotropical taxa, but to emphasize what Chris's work on Neotropical Diptera meant for dipterology. Among his publications, there are several works considered as 'masterpieces' to understand the generic concepts that we currently use for Neotropical Syrphidae. The first (in chronological order) of these gems is his PhD work (Thompson 1972), where he revised the subfamily Eristalinae (as Milesiinae), inferred phylogenetic relationships for many tribes and generic groups, and discussed zoogeographical patterns and transitions between South and North American eristalines. In this influential publication, Chris already applied a methodology that would revolutionize the systematics and taxonomy of the New World syrphids: his tendency to arrange different taxa (placed under different names before his work) in larger units or genus concepts. In other words, he was a 'lumper' and not a 'splitter'. Those who knew Chris will remember that he used to divide taxonomists into these two groups, with a remarkable inclination to consider 'splitters' all his European colleagues and 'lumpers' most of the American taxonomists. During the following years, the 'lumping' exercise of Chris and his very good friend John Richard (Dick) Vockeroth made achievable what seemed impossible: to recognize and name the genus of every Neotropical syrphid species. This immense work of synthesis is exemplified in many of his taxonomic revisions, where taxa changed their status, and culminated in the chapter on Syrphidae for the *Catalogue of the Diptera of the Americas South of the United States* (Thompson et al. 1976), the second of Chris's most significant publications on Neotropical flower flies.

In 1974, Chris was hired at the U.S. Department of Agriculture after a two-year fellowship at the American Museum of Natural History, and he came up with a three-year research plan to study the Neotropical syrphids (Evenhuis 2021). The *Catalogue of the Diptera of the Americas South of the United States* (Thompson et al. 1976) was the fruit of this research plan. For each genus and each species, there is information on the type locality, type holding institution, type specimen(s) and geographical distribution. In the era before internet, this kind of publication was more valuable than gold for taxonomists. Among the numerous new combinations, new names (17 authored by Chris) and new synonyms, we find again the same synthesis effort at genus level exemplified in genera like *Allograpta* Osten Sacken (three new synonyms, two brought out of synonymy later), *Arctophila* Schiner (one), *Argentinomyia* Lynch Arribálzaga (two), *Criorhina* Meigen (one), *Leucopodella* Hull (one), *Meromacrus* Rondani (one), *Microdon* Rondani (one), *Ocyptamus* s. l. Macquart (13, with only two kept in synonymy nowadays), *Paramicrodon* de Meijere (one), *Pseudodoros* Becker (one), and *Ubristes* Walker (one). The application of broad taxonomic concepts for these genera allowed a more exhaustive analysis of these taxa by other authors and helped to focus the taxonomic comparison on those species included in the new generic concept. Sometimes they did not get it right and mixed different taxa (e.g., in the case of the synonymy of *Aristosyrphus* CURRAN under *Argentinomyia*), but most of the resulting new generic concepts aggregated large evolutionary lineages under one name. These new genus concepts were tractable, had morphological diagnostic characters, and boosted the taxonomic research on Neotropical Syrphidae by facilitating the study of more manageable and recognizable systematic units.

The next monumental publication was devoted to the syrphid fauna of the West Indies (THOMPSON 1981). In my opinion, Chris had much affection for this publication and often presented it as a good example of a taxonomic revision. In addition to the identification keys, excellent drawings and extensive taxonomic work, the remarks written by Chris were a way of putting his hypotheses and ideas on paper, and he did not skimp on details. The Addendum (THOMPSON 1981: 191–196) contains extremely valuable information that usually would be part of the main text, including the description of a new species and an identification key to the species of *Leucopodella*, with up to five undescribed species. A few years ago, I took responsibility to finish the taxonomic revision of *Leucopodella*, which I am close to accomplishing now; finally, some of these taxa will be described four decades after their discovery. My apologies, Chris, for not being faster.

Another of Chris's publications I consider pivotal in the development of the systematics of Neotropical flower flies is "*A key to the genera of the flower flies ... of the Neotropical Region ...*" (THOMPSON 1999). In the key, Chris wrote the number of described and undescribed species (known to him) for each genus with a small note on distribution or likely mistakes, together with relevant literature. The work is full of nomenclatural acts (five new synonyms, two new combinations, nine new species and two new genera) and includes the only published key to all the Neotropical syrphid genera. In the Introduction, Chris explained his personal way of making dichotomous keys, which I still follow, and he compiled a glossary of taxonomic terms that has become the standard terminology for most syrphid researchers in the last two decades. By compiling and unifying several earlier terminologies, this publication works as a dictionary for *old* and *new* taxonomic terms applied to Diptera, more specifically to Syrphidae. Last time we met in Washington, D.C., Chris was working on a new version of the glossary with additional terms.

Although it is not considered a publication but a manuscript work, his "Conspectus to Flower flies (Diptera: Syrphidae) of the Neotropics and Mexico" (THOMPSON 2006 or THOMPSON *in litt.*) deserves a special mention here (see comments on the previous section). So far, this is the only taxonomic compendium that covers the Neotropical fauna of flower flies in its totality.

The last masterpiece of Chris that deserves attention is the Syrphidae chapter in the *Manual of Central American Diptera* (THOMPSON et al. 2010). The chapter has information about the morphology, biology and systematics of the family Syrphidae and an identification key to the genera of the northern Neotropical Region, based on both adults and larvae. Besides including the most significant literature, the chapter ends with a small summary about each genus. I consider this publication as a summary of the intensive and extensive work done by Chris in Costa Rica.

The history of systematics, nomenclature and taxonomy of Neotropical Syrphidae cannot be understood without Chris's crucial contribution and his synthesis exercise to create larger generic concepts. The taxonomic work before Chris and his good friend Dick (VOCKEROTH 1969), summarized by HULL (1949), was rearranged into larger units or generic concepts. This action made possible to split them again into smaller taxa with the help of molecular

Figs 9–12: F. Christian Thompson at different international congresses and symposia. – **9**: Chris and Betty Thompson at the 7th International Congress of Dipterology in 2010, Costa Rica. Photo: X. Mengual; – **10**: Chris and Tore R. Nielsen at the 5th International Symposium on Syrphidae in 2009, Serbia. Photo: M. Hauser; – **11**: Chris (left), Mírian N. Morales (right) and myself (center) during the field excursion at the 5th International Symposium on Syrphidae in 2009, Serbia. Photo: M. Hauser; – **12**: (Left to right) Axel Ssymank, myself, Chris, Jeffrey H. Skevington and Andrew D. Young at the 8th International Symposium on Syrphidae in 2015, Germany. Photo: A. Schäfer.

data. It was necessary to lump before we could split taxa properly. During the last 15 years, molecular data have been used to decipher the clades within the broad generic concepts suggested by Chris and their relationships. In most cases, old names and old generic concepts reemerged or were redefined (Mengual & Thompson 2011; Thompson 2012; Miranda et al. 2014; Mengual et al. 2018; Miranda et al. 2020, among others). We can say that most (if not all) current researchers working on Neotropical flower flies are somehow disciples of Chris.

Chris was also the first researcher to apply cladistics to infer evolutionary relationships within Syrphidae and the last 'syrphidologist' that had a global perspective and world-wide knowledge on this family of dipterans. However, if we need to value Chris's legacy in Neotropical dipterology, we must not forget the influence and importance of the *BioSystematic Database of World Diptera* (BDWD), now *Systema Dipterorum* (Evenhuis & Pape 2022) (see Evenhuis et al. 2010; Thompson & Pape 2016; Evenhuis et al. 2023). As Evenhuis (2021) says, his passion for computers, names and databasing made him one of the first bioinformaticians even before the term "bioinformatics" was ever coined. Besides Syrphidae, Chris published on Neotropical Calliphoridae (Thompson 1973), Richardiidae (Perez-Gelabert & Thompson 2006), Braulidae (Brown & Thompson 2010), Conopidae (Skevington et al.

2010), Cryptochetidae (MCALPINE & THOMPSON 2010), and Tanypezidae (APIGIAN & THOMPSON 2010). Outside the Neotropics, Chris was one of the authors of the chapter devoted to Syrphidae in all but one of the published Manuals (VOCKEROTH & THOMPSON 1987; THOMPSON & ROTHERAY 1998; THOMPSON et al. 2010) and almost all the Catalogs on Diptera (KNUTSON et al. 1975; THOMPSON et al. 1976; THOMPSON & VOCKEROTH 1989). His contributions went beyond Syrphidae, publishing on 18 other families (Anisopodidae, Anthomyiidae, Bibionidae, Braulidae, Calliphoridae, Conopidae, Cryptochetidae, Culicidae, Lygistorrhinidae, Muscidae, Pipunculidae, Rhagionidae, Richardiidae, Sciomyzidae, Simuliidae, Tabanidae, Tachinidae, and Tanypezidae).

My experience working with Chris during all these years is just an example of two of his many virtues: his enormous generosity and commitment to open science, and his endless willingness to help, especially students. He believed in open data but was simultaneously overly suspicious about people stealing his ideas; an odd and impossible juxtaposition that lead to a lot of conflicts. He constantly took part in the International Symposia on Syrphidae and the International Congresses of Dipterology, where it was common to see Chris talking with colleagues and taking notes (compare Figs 9–12 on previous page). During the last two decades since we met, Chris's knowledge on entomology, taxonomy, nomenclature, science history and bibliography did not stop surprising me every now and then, but in a very natural way like what he was saying now was something that everyone knows by default. His personal library is full of bibliographic treasures and original copies of rare books and editions. I inherited from him the passion for printed copies and followed his example. As Chris told me during my 2005 visit, "information is power" – only by having the relevant bibliographic information are we able to make authoritative taxonomic decisions. My postdoc under his supervision started with another unforgettable sentence from Chris: "All my students got a good job afterwards, and you will not fail me". Oh, well ..., I did my best.

Acknowledgements

I thank Betty THOMPSON for all her support during my visits to Washington, D.C. and for her help in settling down in North Virginia. I also thank Jeffrey H. SKEVINGTON and Gil F. G. MIRANDA for their valuable comments.

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F. Christian THOMPSON's contribution to the taxonomy of Afrotropical Syrphidae (Diptera)

[F. Christian THOMPSONS Beitrag zur Taxonomie
der afrotropischen Syrphidae (Diptera]

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Abstract

F. Christian THOMPSON (1944–2021) made several important taxonomic contributions on Afrotropical hover flies over the last 47 years, including the description of two new genera and ten new species belonging to six genera. Here, we present an overview of these taxonomic contributions and provide pictures of the holotypes and labels of species described by Chris.

Key words: Africa, Afrotropical Region, flower flies, hover flies, taxonomy

Zusammenfassung

F. Christian THOMPSON (1944–2021) hat über eine Zeitspanne von 47 Jahren mehrere wichtige taxonomische Beiträge zu afrotropischen Schwebfliegen geleistet, darunter die Beschreibung von zwei neuen Gattungen und zehn neuen Arten. Letztere gehören sechs verschiedenen Gattungen an. In vorliegendem Beitrag geben wir einen Überblick über diese taxonomisch orientierten Arbeiten. Die Holotypen der Arten werden abgebildet.

Stichwörter: Afrika, Afrotropische Region, Schwebfliegen, Taxonomie

Introduction

Flower flies or hover flies (Diptera, Syrphidae) comprise over 6300 species worldwide (SKEVINGTON et al. 2019). Compared to other biogeographical regions, the hover fly diversity and taxonomy of the Afrotropical Region is poorly studied. This is also reflected in the publications by F. Christian THOMPSON (1944–2021), whose immense and outstanding work is highlighted in detail in this issue, but whose attention to Afrotropical Syrphidae had been limited. Nevertheless, Chris made several important taxonomic contributions on Afrotropical hover flies (or flower flies as he preferred to use himself) over the last 47(!) years, starting with the description of *Spheginobaccha dubia* THOMPSON, 1974 (THOMPSON 1974a), and the discovery of the genus *Myolepta* NEWMAN, 1838 in the Afrotropics alongside the description of three species (THOMPSON 1974b). This continued until the description of *Eristalinus megametapodus* THOMPSON, 2019 (THOMPSON 2019) and *Afroxanthandrus magnificus* THOMPSON, 2019 (GOELDLIN DE TIEFENAU & THOMPSON 2019), which we believe are the last of his published Afrotropical hover fly species descriptions.

The first comprehensive generic revision of Afrotropical Syrphidae was the work of BEZZI (1915) and afterwards a number of generic identification keys, though incomplete and currently largely out of date with respect to the Afrotropics, have subsequently been published (CURRAN 1927; HULL 1949; THOMPSON & ROTHERAY 1998; THOMPSON & SKEVINGTON 2014; VOCKEROTH 1969; VOCKEROTH & THOMPSON 1987). Chris worked for a long time on a manuscript for the first identification key to all known hover fly genera of the Afrotropical

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Region, a part of which was included in Thompson & Skevington (2014) for the subfamily Syrphinae. A version of that key was recently published by Ssymank et al. (2021) in Volume 3 of the Manual of Afrotropical Diptera. Chris was one of the original authors of this chapter but at a later stage declined to be included in the authorship.

Besides his contribution to generic keys, Chris also worked on some specific genera of Afrotropical hover flies. Here, we provide a short overview of all major contributions from Chris to the taxonomy of Afrotropical Syrphidae. Since we are working on an update of Smith & Vockeroth's (1980) and Dirickx's (1998) catalogues of the Afrotropical Syrphidae, details and remarks on the taxonomy and classification concerning the genera and species listed below will be given therein (Jordaens et al. unpubl. data). Whenever possible, we provide pictures of the holotypes and labels of species described by Chris. Unfortunately, part of the type material of various species is still on Chris's work bench at the USNM and has not been sent to the various depositories mentioned in the species descriptions. For each species, the collection(s) where the type specimens are (or will ultimately be) deposited are indicated between parentheses, using museum acronyms as suggested by Evenhuis for Insect and Spider Collections of the World (available from http://hbs.bishopmuseum.org/codens/).

Collection acronyms

AMNH – American Museum of Natural History, New York, U.S.A.
ANSP – Academy of Natural Sciences of Philadelphia, Philadelphia, U.S.A.
BMSA – National Museum of South Africa, Bloemfontein, South Africa.
CAS – California Academy of Sciences, San Francisco, U.S.A.
CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada.
CSCA – California State Collection of Arthropods, Sacramento, U.S.A.
IRSM – Institut de Recherches Scientifiques de Madagascar, Antananarivo, Madagascar.
KMMA – Royal Museum for Central Africa, Tervuren, Belgium.
MNHN – Muséum National d'Histoire Naturelle, Paris, France.
MZL – Musée Cantonal de Zoologie, Lausanne, Switzerland.
NHMB – Naturhistorisches Museum, Basel, Austria.
NHMUK – Natural History Museum U.K., London, U.K.
NHRS – Naturhistoriska Riksmuseet Stockholm, Stockholm, Sweden.
NMSA – KwaZulu-Natal Museum, Pietermaritzburg, South Africa (formerly Natal Museum, South Africa).
RMNH – Naturalis Biodiversity Center, Leiden, The Netherlands.
USNM – National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.

Overview of Chris Thompson's contributions to the Afrotropical Syrphidae

SUBFAMILY SYRPHINAE

Afroxanthandrus Kassebeer, 2000

Thompson & Skevington (2014) considered *Afroxanthandrus* as a subgenus of *Xanthandrus* and Mengual (2020) proposed *Afroxanthandrus* as a valid genus, which we follow here. *Afroxanthandrus* is a genus endemic to the Afrotropical Region with three species: *Afroxanthandrus congensis* Curran, 1938 was described from the holotype female from Lukolela (Democratic Republic of the Congo) (Curran 1938b), but it is also known from Kenya (De Meyer et al. 1995; De Meyer 2001) and Ethiopia (Mengual et al. 2023). *Afroxanthandrus longipilus* Kassebeer, 2000 is only known from the holotype female from Kapanga (Democratic Republic of the Congo) (Kassebeer 2000a). In one of his last publications on the Afrotropical Syrphidae, Chris, who considered *Afroxanthandrus* as a junior synonym of *Xanthandrus,* described *Xanthandrus magnificus* Thompson, 2019 (Goeldlin de Tiefenau & Thompson 2019). The publication mentions that the holotype male has a handwritten label as follows: "I Cap Vert, Sao Tome, 16 March 1977, J. Denon". The holotype and one paratype female are deposited at MZL, while two paratype males and one paratype female are deposited at the USNM. However, the types have not been sent to MZL so we assume these are still at the USNM. Also interesting is that we could not find a locality "I Cap Vert" on São Tomé. Rather, we suspect that "I. Cap Vert" refers to "Ile Cap Vert", which is French for Cape Verde Islands especially since there is a locality named Sao Tomé on the Cape Verde island Santiago. Moreover, it seems that the authors in their identification key confused *Xanthandrus* with the genus *Betasyrphus* Matsumura, 1917. Indeed, according to their key both *A. congensis* and *A. longipilus* are supposed to have an "Abdomen black with grayish pollinose maculae", which is typical for many Afrotropical *Betasyrphus* species. Yet, both species have a large yellow-orange maculae on the abdomen, similar to the one illustrated in their Fig. 2 for *A. magnificus*. Thus, it remains unclear if *X. magnificus* is a valid species until its type material has been compared with the type material of both *Afroxanthandrus* species and of species of the genus *Betasyrphus.*

Melanostoma Schiner, 1860

Melanostoma is an almost cosmopolitan genus of 75 species, occurring in all zoogeographical regions (except Antarctica) and with 23 species widely distributed throughout the Afrotropics (Ssymank et al. 2021). The genus *Afrostoma* Skevington, Thompson & Vockeroth, 2014 was described with the single species *Afrostoma quadripunctatum* Skevington & Thompson, 2014 as the type species (Thompson & Skevington 2014) (Fig. 1 A–D). The type series consists of the holotype male from Kakamega Forest, Western Kenya (Kenya) (USNM) and

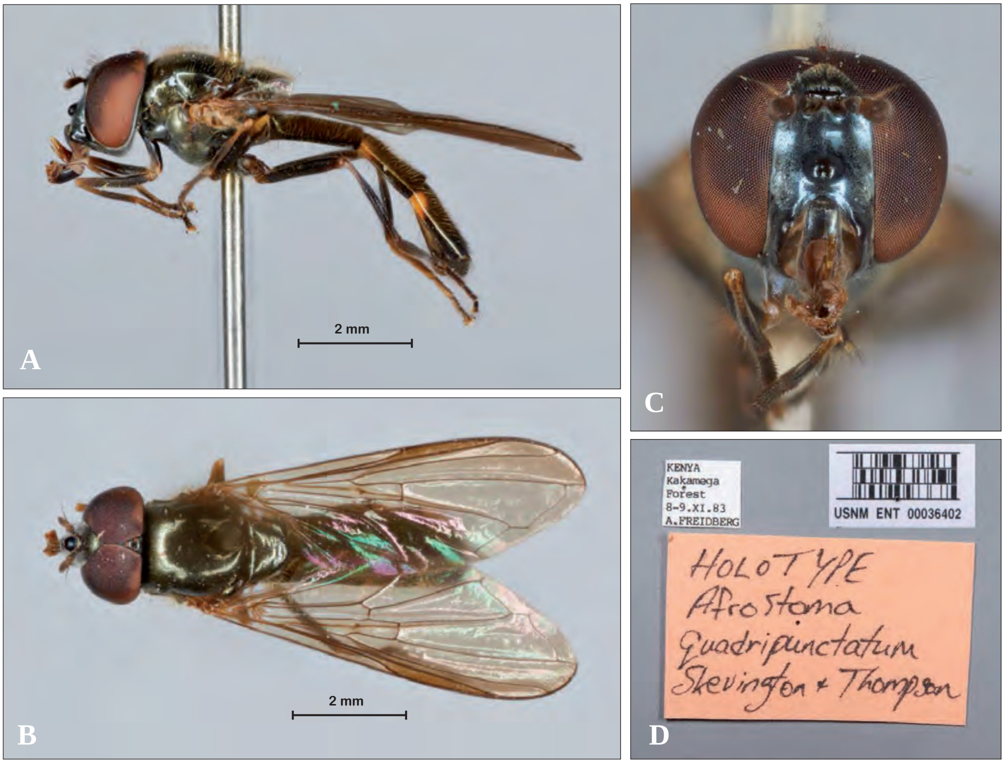


Fig. 1 A–D: *Melanostoma quadripunctatum* (Skevington & Thompson), holotype male (USNM). – **A**: Habitus in lateral view; – **B**: Habitus in dorsal view; – **C**: Head in frontal view; – **D**: Holotype labels.

three paratype males with the same data (two at USNM and one at CNC) and one male paratype from 5 km west of Kilembe in the Ruwenzori Mountains (Uganda) (CNC). The species has the metasternum entire whereas in *Melanostoma* the metasternum is greatly reduced, with a deep posterior incision laterally, so that the sclerotised part consists of a median diamond-shaped area and an anterior narrow anterior and lateral fascia. Recently, however, Mengual (2020) studied the phylogenetic relationships among the genera of the tribe Bacchini sensu lato (i.e., Syrphinae with simple, unsegmented aedeagus) and showed that *Afrostoma* clustered within *Melanostoma* and that, therefore, the former is a junior synonym of the latter.

SUBFAMILY ERISTALINAE

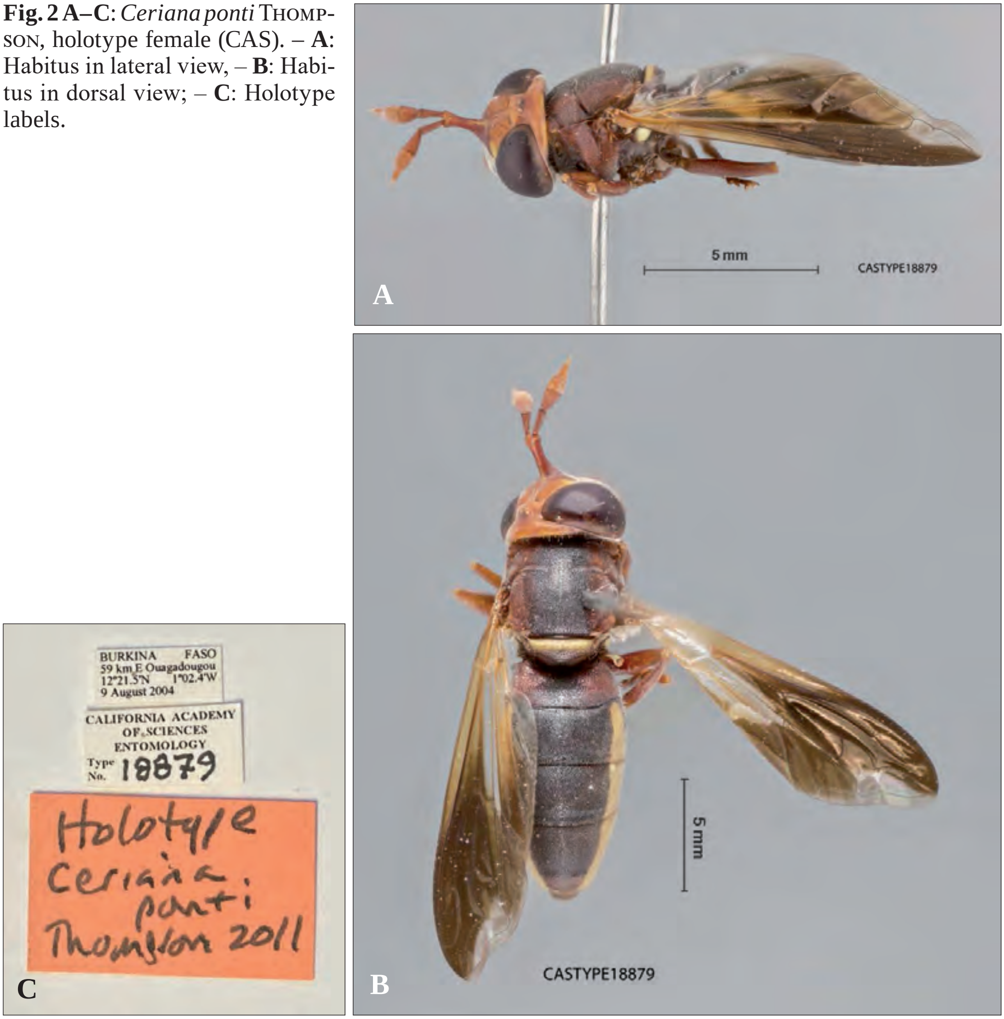
Ceriana Rafinesque, 1815

Ceriana is a north temperate, predominantly Old World genus, with 66 described species, but with an extended distribution in the Afrotropical and Neotropical Regions. Five species are recorded from the Afrotropics, distributed in Burkina Faso, Democratic Republic of the Congo, Namibia, Tanzania and Zimbabwe (Ssymank et al. 2021). The holotype of *Ceriana aurata* (Curran, 1927) is a female from Kisangani (as "Stanleyville") from the Democratic Republic of the Congo (AMNH) and is the only specimen known so far (Curran 1927, 1938a; Thompson 2013a, 2013b). *Ceriana brunnea* (Hull, 1944) is only known from the holotype male from Namibia (NHMUK) (Hull 1944a; Thompson 2013a, 2013b) and *Ceriana dilatipes* (Brunetti, 1929) was described from a single male from Sawmills, which is NW of Bulawayo (Zimbabwe) (NHMUK). The latter species is known in the Afrotropical Region from Tanzania (De Meyer et al. 1995) and Zimbabwe (Brunetti 1929; Thompson 2013a, 2013b) and in the Palaearctic Region from Saudi Arabia (Dawah et al. 2020). Chris described the other two most recent species of the Afrotropical Region (Thompson 2013a, 2013b). *Ceriana dirickxi* Thompson, 2013 was described from a female from Sawmills (Zimbabwe) (NMSA). Thompson (2013a) mentions the National Museum of Bloemfontein (BMSA) as the type depository, but the type belongs to NMSA. However, the type has never been returned (to either institution) and is probably still at USNM. *Ceriana ponti* Thompson, 2013 was described from a female from 59 km east of Ouagadougou (Burkina Faso) (CAS) (Thompson 2013b) (Fig. 2 A–D). Only the holotype is known for both species (Thompson 2013a, 2013b). In his 2013b publication, Chris also correctly placed in the genus *Monoceromyia* Shannon, 1922 the species *Cerioides maculipennis* Hervé-Bazin, 1913, which was previously placed in the genus *Sphiximorpha* Rondani, 1850 by Smith & Vockeroth (1980) and in *Ceriana* Rafinesque, 1815 by Dirickx (1998), based on the petiolate abdomen and its distinct antennifer (Thompson 2013b). That species has also been reported from the Democratic Republic of the Congo by Curran (1927).

Eristalinus Rondani, 1845

Eristalinus is an Old World genus of ca. 75 species, occurring in the Afrotropical, Australasian, Oriental and Palaearctic Regions, with a few species introduced into the New World. The genus is divided into six subgenera with 62 species occurring in the Afrotropical Region (Ssymank et al. 2021). Seven of the Afrotropical species belong to the subgenus *Merodonoides* Curran, 1931, which was recently revised by Chris (Thompson 2019), including the description of one new species, *Eristalinus* (*Merodonoides*) *megametapodus* Thompson, 2019. The type series comprises the holotype male from Lwiro River, 47 km north of Bukavu (Democratic Republic of the Congo) (CAS) (Fig. 3 A–C), 15 paratype females with same data (CAS, NHMUK, USNM) and one paratype male and one paratype female from Tanzania (CNC) (Thompson 2019). The specimens of the type series that have to be deposited at CAS, CNC and NHMUK are still at the USNM. The species has also been found in Uganda (Jor-

Fig. 2 A–C: *Ceriana ponti* THOMPSON, holotype female (CAS). – **A**: Habitus in lateral view, – **B**: Habitus in dorsal view; – **C**: Holotype labels.



BURKINA FASO
59 km E Ouagadougou
12°21.5'N 1°02.4'W
9 August 2004

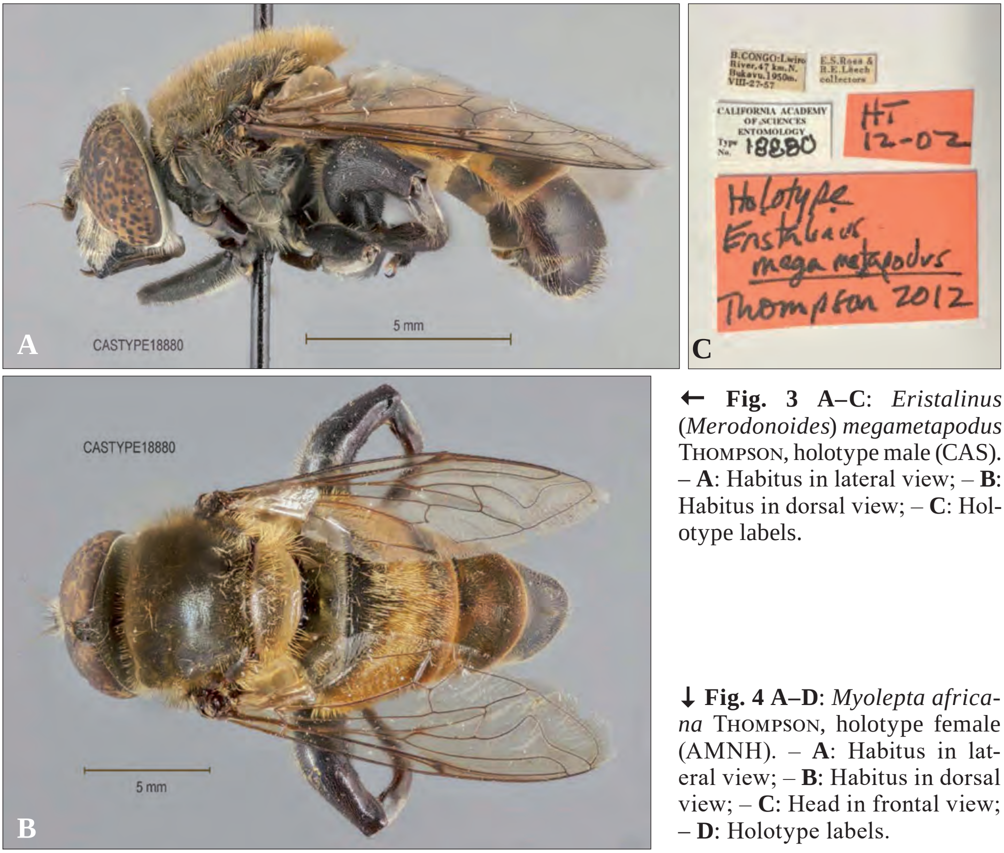
CALIFORNIA ACADEMY
OF SCIENCES
ENTOMOLOGY
Type No. 18879

Holotype
Ceriana
ponti
Thompson 2011

DAENS et al. unpubl. data) and there is also one male from Tshibinda, a group of pyroclastic cones in the east of the Democratic Republic of the Congo (KMMA).

Myolepta NEWMAN, 1838

Myolepta is a genus with 41 described species occurring in all zoogeographical regions, except Australasia and Antarctica. Chris was the first to recognize the genus in the Afrotropical Region from where he described all three currently known species from this region, each based on a single female (THOMPSON 1974b). The holotype of *Myolepta africana* THOMPSON, 1974 is from Kisangani (as "Stanleyville") (Democratic Republic of the Congo) (AMNH) (Fig. 4), that of *Myolepta similis* THOMPSON, 1974 is from Entebbe, at the border of Lake Victoria (Uganda) (CNC) (Fig. 5) and that of *Myolepta triangularis* THOMPSON, 1974 is from the Umtali District (North Vumba) in Zimbabwe (NMSA) (Fig. 6). *Myolepta triangularis* is also known from Benin and the Democratic Republic of the Congo (JORDAENS et al. unpubl. data).



← **Fig. 3 A–C**: *Eristalinus* (*Merodonoides*) *megametapodus* THOMPSON, holotype male (CAS). – **A**: Habitus in lateral view; – **B**: Habitus in dorsal view; – **C**: Holotype labels.

↓ **Fig. 4 A–D**: *Myolepta africana* THOMPSON, holotype female (AMNH). – **A**: Habitus in lateral view; – **B**: Habitus in dorsal view; – **C**: Head in frontal view; – **D**: Holotype labels.

Fig. 5 A–D: *Myolepta similis* THOMPSON, holotype female (CNC). – **A**: Habitus in lateral view; – **B**: Head in laterofrontal view; – **C**: Habitus in dorsal view; – **D**: Holotype labels.

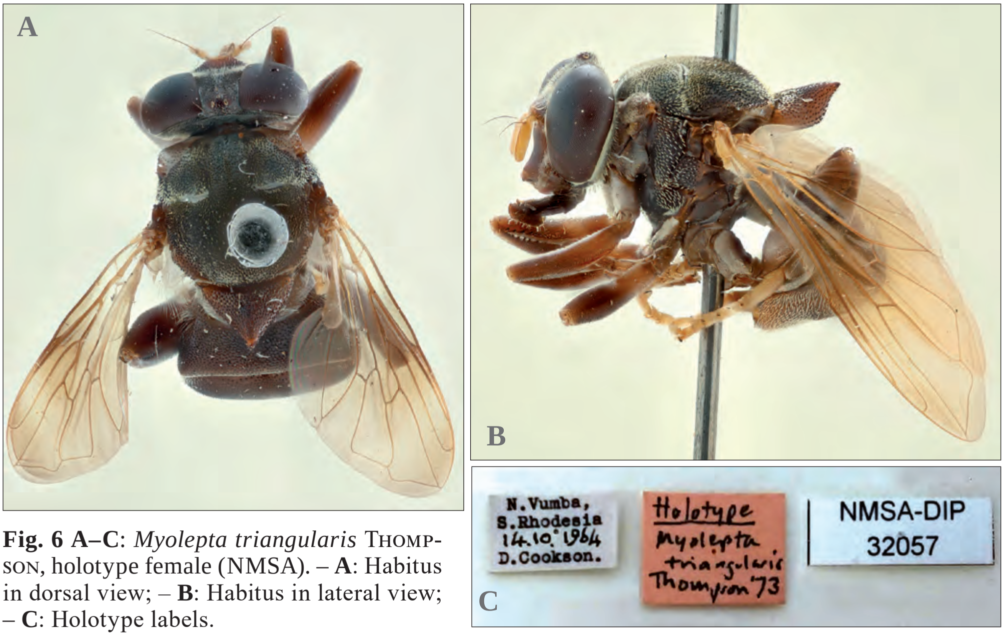


Fig. 6 A–C: *Myolepta triangularis* THOMPSON, holotype female (NMSA). – **A**: Habitus in dorsal view; – **B**: Habitus in lateral view; – **C**: Holotype labels.

Ornidia Le Peletier & Serville, 1828

Ornidia is a genus of five species which are endemic to the Neotropical Region (Thompson 1991; Carvalho-Filho & Esposito 2009; Ssymank et al. 2021). One species, *Ornidia obesa* (Fabricius, 1775), has been introduced into the Nearctic and Oriental Regions, the Old World tropics (Thompson 1991), and into French Polynesia (Ramage et al. 2018). In his revision of the genus where he assigned a male from "America" (= Virgin Islands) as lectotype, Thompson (1991) mentioned *O. obesa* in the Afrotropical Region (citing Smith & Vockeroth (1980) for the distribution) in the Seychelles, Madagascar, Mauritius and Réunion Is., but not from the Afrotropical mainland. It appears that the species has spread since that time and it has now been reported from many African countries including Cameroon (Ssymank 2012), Comoros, (De Meyer et al. 1990; Whittington & Rotheray 1997), Côte d'Ivoire (Whittington & Rotheray 1997), Kenya (De Meyer et al. 1995; Whittington & Rotheray 1997), Madagascar (Bigot 1859; Bezzi 1908; Smith & Vockeroth 1980; Thompson 1991; Whittington & Rotheray 1997), Mauritius (Bezzi 1908, 1920; Orian 1962; Smith & Vockeroth 1980; Thompson 1991; Whittington & Rotheray 1997), Nigeria (Whittington & Rotheray 1997), Réunion Is. (Bigot 1862; Bezzi 1908; Thompson 1991; Whittington & Rotheray 1997; Kassebeer 2000b; Marcos-García et al. 2013), Rodriguez Is. (Mauritius) (Bezzi & Lamb 1926; Whittington & Rotheray 1997), Seychelles (Giglio-Tos 1895; Bezzi 1908; Lamb 1922; Smith & Vockeroth 1980; Thompson 1991; Whittington & Rotheray 1997), South Africa (van Doesburg 1955; Whittington & Rotheray 1997), and Tanzania (Smith & Vockeroth 1980; Thompson 1991; De Meyer et al. 1995). The species is also found in Benin, Liberia and Togo (Jordaens et al. unpubl. data).

SUBFAMILY MICRODONTINAE

Afromicrodon Thompson in Cheng & Thompson, 2008

Afromicrodon (Fig. 7) is an endemic genus of five species confined to the Comoros (one species) and Madagascar (four species). Afrotropical species of the genus were previously placed in the genus *Ceratophya* Wiedemann, 1824 (with the Neotropical species *Ceratophya notata* Wiedemann, 1824 as type). Cheng & Thompson (2008), however, noted that Hull's world key to the genera of Microdontinae (1949: 306) incorrectly assumed that the wing vein R_{4+5} of *Ceratophya* did not have an appendix extending posteriorly into cell r_{4+5} and that the species of *Afromicrodon* were erroneously identified and placed in the genus *Ceratophya*. Since Neotropical *Ceratophya* species have wing vein R_{4+5} with an appendix, which is absent in the Afrotropical species, Chris (in Cheng &Thompson 2008) erected the new genus *Afromicrodon* Thompson for the Afrotropical species with *Microdon johannae* van Doesburg, 1957 as type species. *Ceratophya* is therefore restricted to the Neotropical Region and *Afromicrodon* to the Afrotropical Region (Cheng & Thompson 2008; see also Reemer & Ståhls 2013). All except one species of *Afromicrodon* seem very rare. *Afromicrodon comoroensis* (De Meyer, De Bruyn & Janssens 1990) is endemic to the Comoros and only known from the holotype male from Boboni, Grande Comore (Comoros) (KMMA) and four paratypes with same data (three at KMMA, one at MNHN) (De Meyer et al. 1990). *Afromicrodon johannae* (van Doesburg, 1957) was described based on the holotype male from Fenoarivo, Atsinanana (Madagascar) (MNHN), and four paratype males and one paratype female with the same data (RMNH) (van Doesburg 1957). *Afromicrodon luctiferus* (Hull, 1941) was described from the holotype female and one paratype female from the Oriental Forest, Fanovana, Toamasina (Madagascar) (ANSP). The male of the species is unknown (Hull 1941). *Afromicrodon madecassa* (Keiser, 1971) was based on the holotype male from Moramanga, 9 km south of

Fig. 7: Habitus in lateral view of *Afromicrodon* sp., female specimen from Fianarantsoa, Parc National Ranomafana (Madagascar).

Antananarivo (Madagascar) (NHMN) and the allotype female with the same data (NHMB). There is a paratype series of 25 specimens of both sexes with the same data (22 at NHMB, three at NMSA) and eight paratype males from four other localities on Madagascar (NHMB). The name is a possible junior synonym of *Afromicrodon luctiferus* according to Reemer & Ståhls (2013). *Afromicrodon stuckenbergi* Keiser, 1971 is only known by the holotype female from Vakoana Forest, Andringitra Massif (Madagascar) (MNHN) and the male of the species remains unknown (Keiser 1971).

Spheginobaccha de Meijere, 1908

Spheginobaccha is an Old World tropical genus of 18 species, of which eight occur in the Afrotropical Region and 10 in the Oriental Region. Afrotropical species are recorded from Malawi (one species), South Africa (four species) and Madagascar (three species) (Ssymank et al. 2021), and two of these Malagasy taxa were described by Thompson & Hauser (2015), one in honor of the famous African entomologist Brian Roy Stuckenberg, who is regarded by many as the "father of African dipterology" (Kirk-Spriggs 2012, 2017). *Spheginobaccha rotundiceps* (Loew, 1858) is the most common *Spheginobaccha* species although it is only known from South Africa (Loew 1858; Hull 1944b; Thompson 1974a; Thompson & Hauser 2015). The species was described based on a female from "Caffraria" [= Eastern and Northern South Africa] (South Africa) (NHRS?). The three other South African *Spheginobaccha* species are much more uncommon. *Spheginobaccha dexioides* Hull, 1944 is described from a male collected in Port St. Johns, Eastern Cape (South Africa) (NHMUK) (Hull 1944b) and is also known from another male from Port St. Johns (NMSA) and two males and one female from Gillitts, KwaZulu-Natal (South Africa) (NMSA) (Thompson 1974a). *Spheginobaccha dubia* Thompson, 1974 (Fig 8. A–C) is only known from the holotype male from Geekie's Farm, Karkloof, KwaZulu-Natal (South Africa) (NMSA) (Thompson 1974a). *Spheginobaccha pamela* Thompson & Hauser, 2015 (Fig. 9 A–C) was described based on the holotype male from Manguzi Forest Reserve, KwaZulu-Natal (South Africa) (BMSA) and two paratypes, one male with same collecting data (USNM) and one male from the St. Lucia Estuary, KwaZulu-Natal (South Africa) (CAS). The female is described in this issue (Midgley et al.

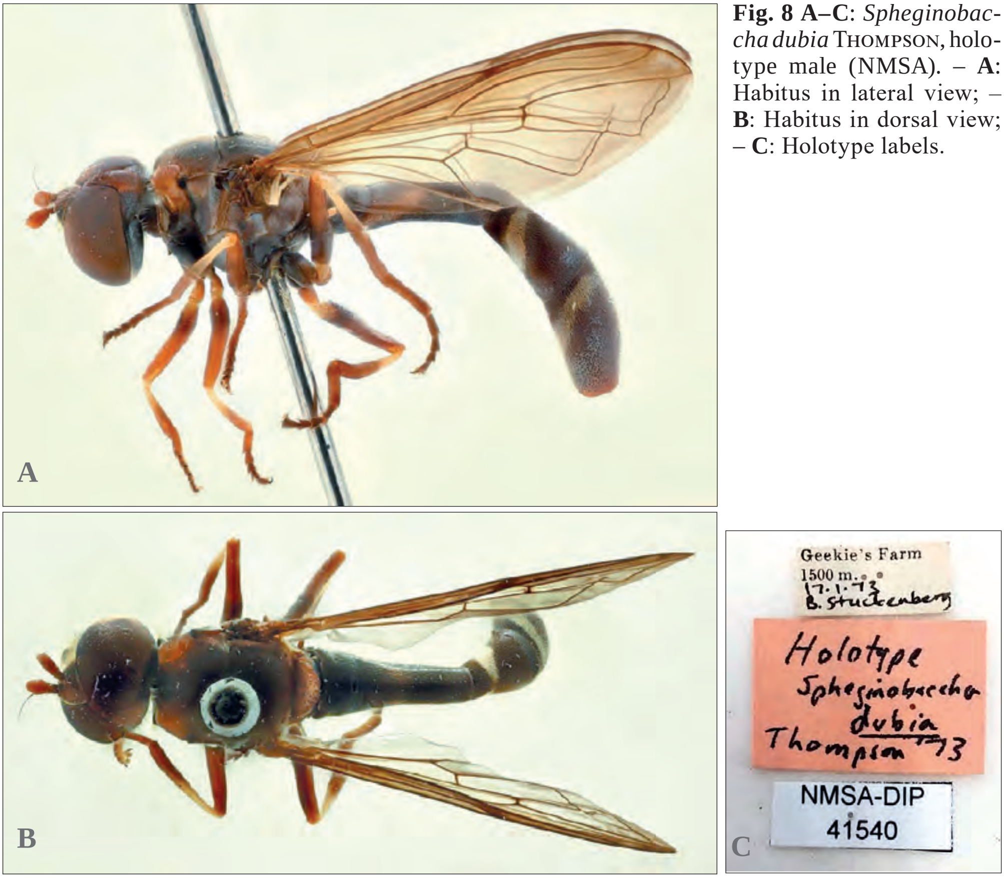


Fig. 8 A–C: *Spheginobaccha dubia* Thompson, holotype male (NMSA). – **A**: Habitus in lateral view; – **B**: Habitus in dorsal view; – **C**: Holotype labels.

2023). *Spheginobaccha perialla* Thompson, 1974 (Fig. 10 A–F) is known from Malawi and was described from the only known specimens of the species: the holotype male and the allotype female from Mlanje (NHMUK) (Thompson 1974a). The other three *Spheginobaccha* species from the Afrotropical Region are endemic to Madagascar. *Spheginobaccha guttula* Dirickx, 1995 was described from the holotype male and one paratype male from Ivondro, 10 km south of Toamasina (Madagascar) (MNHN) (Dirickx 1995). *Spheginobaccha ruginosa* Dirickx, 1995 is only known from the holotype female and one paratype female from the same locality as the previous species (MNHN) (Dirickx 1995; Thompson & Hauser 2015). *Spheginobaccha stuckenbergi* Thompson & Hauser, 2015 is only known from the type series: the holotype male from Majunga Analamanitra Forest, 14 km northeast of Misinjo, Mahajanga (Madagascar) (CAS) (Fig. 11 A–C), a paratype male from Namoroka Village, Befatika Andranovary, 7 km northwest of Vilanandro Village (Madagascar) (USNM), two paratype males from Majunga Ambatofolaka, Namoroka, 53 km from Soalala, 3 km north of Vilamando Village (CAS), and one paratype male from Parc National Tsingy de Bemaraha, 3.4 km from Bekpaka, Tombeau Vazimba (CSCA) (Thompson & Hauser 2015).

Discussion

Compared to Chris Thompson's contribution to the taxonomy and systematics of hover flies of other biogeographical regions (see Mengual 2023), his contribution to that of the Afrotropical Region seem limited. Nevertheless, several of Chris's and co-authors generic keys

Fig. 9 A–C: *Spheginobaccha pamela* Thompson & Hauser, holotype male (BMSA). – **A**: Habitus in lateral view; – **B**: Habitus in dorsal view; – **C**: Holotype labels.

Holotype
Spheginobaccha
pamela
Thompson 2011

RSA: KwaZulu-Natal
Manguzi Forest Reserve
26°59'32"S 32°43'25"E
13–17.xii.2010. 61 m
A.H. Kirk-Spriggs

Malaise traps
indigenous
sand forest

BMSA(D)
30059

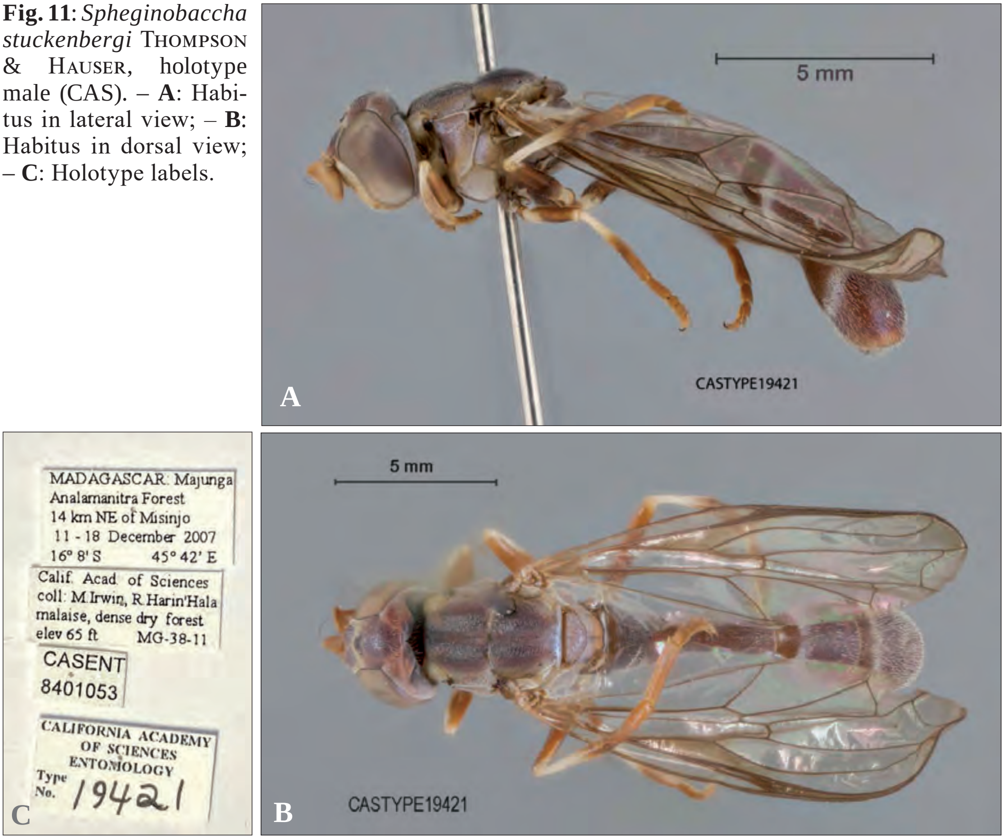
Entomology Dept
National Museum
P.O. Box 266
Bloemfontein 9300
South Africa

for other biogeographical regions or for selected hover fly subfamilies and tribes served as the basis for the first key to the genera of Afrotropical Syrphidae (Ssymank et al. 2021). Chris has described two new genera from the Afrotropical Region, *Afromicrodon* Thompson in Cheng & Thompson, 2008 and *Afrostoma* Skevington, Thompson & Vockeroth, 2014, although the latter is now considered a junior synonym of *Melanostoma* Schiner, 1860 (Mengual 2020). He also described ten new species belonging to six genera from the Afrotropical Region. Besides the genera and species descriptions, Chris also had a number of smaller contributions, published or unpublished, to the taxonomy of Afrotropical hover flies. He 1) placed *Eristalis jucundus* Walker, 1849 (type from unknown locality) in synonymy with *Eristalinus* (*Eristalodes*) *quinquelineatus* (Fabricius, 1791) (Thompson 1988); 2) designated a (headless) female as lectotype of *Senaspis dibapha* (Walker, 1849) (MNHN) (Thompson 1988) [a publication which was overlooked by De Meyer et al. (2020)]; 3) designated a female from Mauritius as lectotype of *Syritta decora* Walker, 1849 (NHMUK) (Thompson 1988); and 4) redescribed *Eumerus aquilinus* Walker, 1849 based on a single specimen, which he designated as lectotype (NHMUK) and which he believed was from the Afrotropical Region, although the origin and distribution of the species is unknown (Thompson 1988). Chris was also the first to report the Afrotropical species *Syritta flaviventris* Macquart, 1842 and *Eristalinus* (*Eristalodes*) *taeniops* (Wiede-

Fig. 10 A–F: *Spheginobaccha perialla* THOMPSON, holotype male (**A–C**) and allotype female (**D–F**) (NHMUK). – **A, D**: Habitus in lateral view; – **B, E**: Habitus in dorsal view; – **C, F**: Type labels.

MANN, 1818) in the U.S.A. (THOMPSON et al. 1990). Finally, Chris confidentially shared an unfinished manuscript on Afrotropical *Eristalinus* with the first author of the present work, and even though he received regular updates on the progress, he seemed to have lost interest in the manuscript and first wanted to finish some of his work on the Australian fauna. Too bad we could not finish the revision of *Eristalinus* together in time!

Fig. 11: *Spheginobaccha stuckenbergi* THOMPSON & HAUSER, holotype male (CAS). – **A**: Habitus in lateral view; – **B**: Habitus in dorsal view; – **C**: Holotype labels.



MADAGASCAR: Majunga
Analamanitra Forest
14 km NE of Misinjo
11 - 18 December 2007
16° 8' S 45° 42' E

Calif. Acad. of Sciences
coll: M.Irwin, R.Harin'Hala
malaise, dense dry forest
elev 65 ft MG-38-11

CASENT
8401053

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Selected species described by F. Christian THOMPSON. II.

Ximo MENGUAL

In 1999, in one of his most influential works on Neotropical Syrphidae, THOMPSON (1999) named a new genus and two species after Charles P. ALEXANDER and his wife Mabel Margarita. Charles had a great influence on Chris and he always called him "Alex". Years later, Chris found that this genus [*Xela* THOMPSON & VOCKEROTH, 1999] was a junior homonym of a fossil trilobite from Australia [*Xela* JELL, 1990] and used the other nickname of Charles P. ALEXANDER, known as "C.P." among his students, for a replacement name, *Cepa* THOMPSON & VOCKEROTH, 2007.

Fig. 3: Selected species described by F. Christian THOMPSON. *Cepa alex* (THOMPSON, 1999). From the original publication.

Chris Thompson's contributions to the study of Alaskan Diptera and the University of Alaska Museum Insect Collection

[Chris Thompson's Beitrag zum Studium
der Zweiflügler Alaskas und der Insektensammlung am
Museum der Universität von Alaska]

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Abstract

The insect collection of the University of Alaska Museum (UAM) is among the most thoroughly digitized collections in North America. Alaska is the largest state in the United States, with about one fifth of the country's total area, and the state with the most rapidly changing climate. The Alaskan Diptera fauna is the state's most species-rich and least well-studied. The main objectives of this paper are to document Chris Thompson's contributions to the study of Alaskan Diptera and the University of Alaska Museum Insect Collection.

Key words: Fairbanks, flies, Attu Island, Utqiaġvik, Barrow

Zusammenfassung

Die Insektensammlung des Museums der University von Alaska (UAM) gehört zu den am besten digital dokumentierten Sammlungen Nordamerikas. Alaska ist mit etwa einem Fünftel der Gesamtfläche des Landes der größte Staat der Vereinigten Staaten und der Staat mit dem sich am schnellsten ändernden Klima. Seine Diptera-Fauna ist die artenreichste und am wenigsten erforschte der Vereinigten Staaten von Amerika. Die Hauptziele dieser Abhandlung sind die Dokumentation von Chris Thompsons Beiträgen zum Studium der alaskischen Diptera und der Insektensammlung des Museums der Universität von Alaska.

Stichwörter: Fairbanks, Fliegen, Attu Island, Utqiaġvik, Barrow

Introduction

Alaska is the largest state in the United States of America, presents the greatest evidence of climate change (Hinzman et al. 2005), and its fauna has a complex biogeographical history due to its former connection with Asia via the Bering Land Bridge (Canitz et al. 2022). Alaska is a crossing-point for many Holarctic taxa and numerous taxonomic questions require material from Alaska to be resolved (Brooks & Cumming 2022; Brunke et al. 2020; Kohli et al. 2021).

The University of Alaska Museum Insect Collection (UAM) holds more than 2 million specimens represented by 360,000 online records shared with data aggregators like GBIF.org (as of July 2021). Diptera is the biggest order in the pinned collection, with 86,743 specimens (Smith et al. 2021), and is the most species-rich order of animals in Alaska (Sikes et al. 2017). Nevertheless, it has been the focus of less research than Coleoptera, Lepidoptera, and Hymenoptera.

Chris Thompson contributed greatly to the UAM Diptera collection by visiting the collection, accepting loans and identifying specimens, as well as through important field collections. The main objective of this paper is to document Chris's contributions to the study of Alaskan Diptera and the UAM fly collection.

Material and methods

Information about Chris's contributions and specimens were obtained from the Arctos Database (https://arctos.database.museum). Additionally, the UAM collection was directly accessed. Figure 1 was made using LibreOffice Calc 6.4, and Figure 2 is from the Arctos Database, based on Google Maps. Photographs of specimens (Figs 3–4) were taken using a Leica DFC425 digital camera attached to a Leica MZ16 stereomicroscope. Figures 5–6 were taken using a Motorola Smartphone (Moto G Power-2021), Figures 7–9 were taken using an iPhone (5c), and Figure 10 was taken using an Olympus (TG-3). The images were edited in Gimp 2.10.6 and the final plate was prepared in Inkscape 0.91.

Results

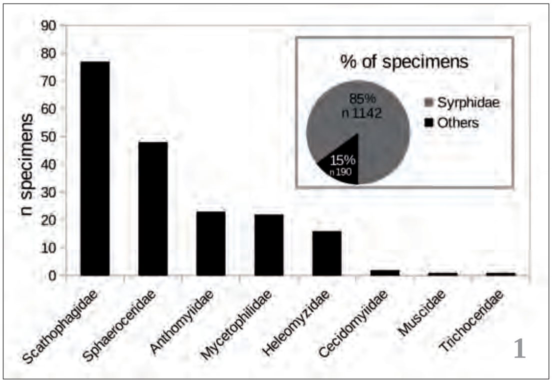
In the UAM collection there are 1,332 specimens identified by Chris Thompson (Table 1) (https://arctos.database.museum/SpecimenResults.cfm?identified_agent_id=21254086&collection_id=4). He identified specimens in nine families, 45 genera (1310 specimens), and 41 species (400 specimens). As expected, 85 % of these specimens are in the family Syrphidae (Fig. 1). Two-thirds of these specimens are from Kanuti National Wildlife Refuge [66°17'36.2" N 152°26'56.8" W], Kasatochi Island [52°10'36.8" N 175°30'05.7" W] (e.g., Figs. 3–6), and Denali National Park and Preserve [63°43'55.8" N 148°58‘48.7" W].

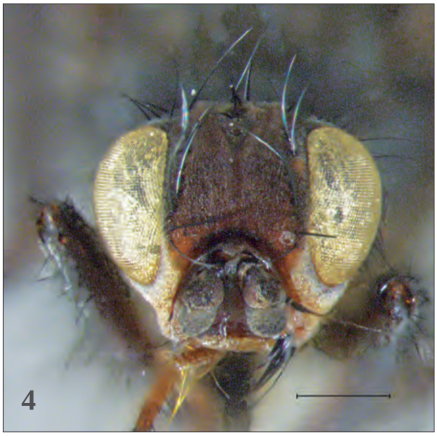
In addition, the Arctos database contains 61 Alaskan observation/literature specimen records identified by Thompson (https://arctos.database.museum/SpecimenResults.cfm?&collection_id=50&identified_agent_id=21254086). These records derive from the Barcode of Life Datasystems (BoLD), the US Forest Health Protection Collections in Alaska (USDA 'BigBug' Database, spreadsheet), and from the Attu Island article (Thompson & Epler 2008) commented below. He identified these specimens in twelve families, 26 genera, and 25 species (Table 2). Moreover, he identified specimens from more than 50 different localities spread throughout Alaska (Fig. 2). Beyond these contributions, Thompson donated more to the Alaska Entomological Society than any other out-of-state scientist, reflecting his strong interest in Alaska's entomofauna (D. Sikes, personal communication).

The state of Alaska spans the boundary between the eastern and western hemispheres and thus contains both the western-most and eastern-most points of the United States of America (Attu, in the Aleutians Islands 52°55' N 172°26' E), as well as the northernmost point (Utqiaġvik/Point Barrow, 71°23' N 156°28' W). Thompson may have been the only dipterist who collected at both Utqiaġvik and Attu.

From June 11th–13th 2000, Chris boarded a ship with bird-watching groups to Attu Island to collect Diptera. Details, including photos, are described in his paper (Thompson & Epler 2008). Since he was traveling with bird-watching groups, it was not possible for him to use Malaise or pan traps for sampling, which limited him to hand-netting during this expedition. Together, Chris Thompson and John Epler identified a total of 224 Dipteran specimens, in 12 families, 21 genera, and 27 species (https://arctos.database.museum/SpecimenResults.cfm?&publication_id=10006199). The richest and most abundant family was Chironomidae with 11 species and 120 specimens collected. Two species from this family were recorded for the first time from North America, further emphasizing the importance of this field collection.

Fifteen years later (July 2015), Chris returned to Alaska for a field trip to collect at the northernmost point of the United States: Utqiaġvik/Point Barrow (Figs 7–8). Accompanied by Derek S. Sikes (Curator of Insects, UAM) (Fig. 9) and Todd Sformo (Department of Wildlife Management Utqiaġvik - Barrow) (Fig. 10), he spent three days (16–18/July) collecting specimens with hand-nets and a Malaise trap. Thompson traveled to Utqiaġvik with a goal





Figs 1–6: – **1**: University of Alaska Museum Specimens identified to family by Chris THOMPSON; – **2**: Map of Alaska showing the localities (red dots) of specimens identified by Chris; – **3–6**: Examples of Alaskan specimens identified by Chris THOMPSON. – **3**: *Scathophaga frigida* (COQUILLETT), habitus (UAM100041264), scale bar: 1 mm; – **4**: *S. frigida*, head (UAM100041264), scale bar: 1 mm; – **5**: *S. frigida* (UAM100041206); – **6**: Sample of Alaskan specimens identified by Chris THOMPSON from University of Alaska Museum.

Table 1. University of Alaska Museum specimens identified to genus and species level by Chris THOMPSON.

Family	**Genus**	**Species**
Anthomyiidae	*Delia*	–
Cecidomyiidae	*Lestremia*	–
Heleomyzidae	*Neoleria*	
		Neoleria prominens (BECKER, 1897)
	Scoliocentra	
		Scoliocentra fraterna LOEW, 1863
Muscidae	*Phaonia*	–
Mycetophilidae	*Boletina*	–
	Mycetophila	–
Scathophagidae	*Scathophaga*	
		Scathophaga frigida (COQUILLETT, 1900)
Sphaeroceridae	*Thoracochaeta*	
		Thoracochaeta seticosta (SPULER, 1925)
Syrphidae	*Baccha*	
		Baccha elongata (FABRICIUS, 1775)
	Blera	–
	Chalcosyrphus	–
	Cheilosia	
		Cheilosia bigelowi CURRAN, 1926
		Cheilosia borealis COQUILLETT, 1900
		Cheilosia columbiae CURRAN, 1922
		Cheilosia laevis (BIGOT, 1883)
		Cheilosia latrans (WALKER, 1849)
		Cheilosia rita (CURRAN, 1922)
		Cheilosia yukonensis SHANNON, 1922
	Chrysosyrphus	–
	Chrysotoxum	–
	Dasysyrphus	
		Dasysyrphus amalopis (OSTEN SACKEN, 1875)
		Dasysyrphus venustus (MEIGEN, 1822)
	Didea	–
	Epistrophe	
		Epistrophe grossulariae (MEIGEN, 1822)
	Eriozona	
		Eriozona laxus (OSTEN SACKEN, 1875)
	Eristalis	
		Eristalis cryptarum (FABRICIUS, 1794)
		Eristalis flavipes WALKER, 1849
		Eristalis hirta (LOEW, 1866)
		Eristalis tenax (LINNAEUS, 1758)
	Eumerus	–
	Eupeodes	
		Eupeodes americanus (WIEDEMANN, 1830)
		Eupeodes curtus (HINE, 1922)
		Eupeodes luniger (MEIGEN, 1822)

Family	Genus	Species
	Ferdinandea	–
	Helophilus	–
	Hiatomyia	–
	Lejops	–
	Melangyna	
		Melangyna arctica (ZETTERSTEDT, 1838)
	Melanostoma	
		Melanostoma mellinum (LINNAEUS, 1758)
	Meligramma	
		Meligramma triangulifera (ZETTERSTEDT, 1843)
	Meliscaeva	
		Meliscaeva cinctella (ZETTERSTEDT, 1843)
	Neoascia	–
	Neocnemodon	
		Neocnemodon rita (CURRAN, 1921)
	Orthonevra	–
	Parasyrphus	
		Parasyrphus genualis (WILLISTON, 1887)
		Parasyrphus tarsatus (ZETTERSTEDT, 1838)
	Parhelophilus	–
	Pipiza	
		Pipiza macrofemoralis CURRAN, 1921
	Platycheirus	
		Platycheirus ciliatus BIGOT, 1884
		Platycheirus obscurus (SAY, 1824)
		Platycheirus peltatoides CURRAN, 1923
	Sericomyia	
		Sericomyia nigra PORTSCHINSKY, 1873
	Sphaerophoria	
		Sphaerophoria philanthus (MEIGEN, 1822)
	Sphegina	–
	Syrphus	
		Syrphus attenuatus HINE, 1922
		Syrphus ribesii (LINNAEUS, 1758)
	Temnostoma	–
	Volucella	
		Volucella bombylans (LINNAEUS, 1758)
		Volucella facialis WILLISTON, 1882
	Xylota	
		Xylota subfasciata LOEW, 1866
Trichoceridae	*Trichocera*	–

of collecting a rare species of syrphid, which he unfortunately did not find. It is likely that he was trying to find *Sericomyia tolli* (FREY, 1915), which had previously been collected at this location (SKEVINGTON & THOMPSON 2012). The specimens from this expedition are being processed, and the results will be published in the near future (PEREIRA & SIKES in prep.).

Table 2. List of genera and species identified by Chris Thompson, based on Arctos database observation/literature.

Family	Genus	Species
Anthomyiidae	*Chirosia*	
		Chirosia latipennis Zetterstedt, 1837
	Delia	
		Delia antiqua (Meigen, 1826)
		Delia platura (Meigen, 1826)
	Fucellia	
		Fucellia fucorum (Fallén, 1819)
	Pegomya	
		Pegomya geniculata (Bouche, 1834)
Bibionidae	*Bibio*	
		Bibio xanthopus Wiedemann, 1828
	Dilophus	
		Dilophus fulvicoxa Walker, 1848
Dolichopodidae	*Dolichopus*	
		Dolichopus nigrilineatus Van Duzee, 1924
Muscidae	*Phaonia*	
		Phaonia consobrina (Zetterstedt, 1828)
		Phaonia rugia (Walker, 1849)
Phoridae	*Megaselia*	–
Piophilidae	*Amphipogon*	
		Amphipogon hyperborea (Greene, 1919)
Scathophagidae	*Scathophaga*	
		Scathophaga crinita Coquillett, 1901
		Scathophaga frigida (Coquillett, 1900)
Simuliidae	*Prosimulium*	–
Syrphidae	*Brachyopa*	
		Brachyopa ferruginea (Fallén, 1817)
		Brachyopa notata Osten Sacken, 1875
	Cheilosia	–
	Chrysotoxum	
		Chrysotoxum fasciolatum (De Geer, 1776)
	Eristalis	
		Eristalis compactus Walker, 1849 [Valid name: *Eristalis* (*Eoseristalis*) *cryptarum* (Fabricius, 1794)]
		Eristalis hirta (Loew, 1866)
		Eristalis obscura (Loew, 1866)
	Eupeodes	
		Eupeodes lapponicus (Zetterstedt, 1838)
	Helophilus	
		Helophilus borealis Staeger, 1845
	Platycheirus	
		Platycheirus subordinatus Becker, 1915
	Sericomyia	
		Sericomyia chalcopyga Loew, 1863

Family	Genus	Species
	Syrphus	
		Syrphus ribesii (LINNAEUS, 1758)
	Temnostoma	–
Tabanidae	*Chrysops*	–
	Hybomitra	–
Therevidae	*Pandivirilia*	–
Trichoceridae	*Trichocera*	
		Trichocera japonica MATSUMURA, 1915

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Figs 7–10: – **7**: Northernmost point of the U.S.A., Utqiaġvik/Point Barrow; – **8**: Northernmost point of the U.S.A., Utqiaġvik/Point Barrow; – **9**: Derek SIKES (Curator of Entomology collection at the UAM) and Chris THOMPSON; – **10**: Todd SFORMO (Department of Wildlife Management Utqiaġvik - Barrow) and Chris THOMPSON.

In conclusion, although I personally never had the chance to meet Chris, his contribution to the UAM Diptera collection is clear. Furthermore, his identifications are not only important contributions for future studies of Alaskan Diptera but are also essential components for studying topics such as climate change and biogeographic history.

Acknowledgments

Thanks for support from the Centennial Postdoctoral Initiative (University of Alaska Fairbanks) for my Postdoctoral Fellowship and to the University of Alaska Museum and Derek SIKES (UAF) for the logistical support. Thanks to Hannah DOERRIER for the English suggestions and to Derek SIKES for the Barrow field trip photos.

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Three new Nearctic species of Syrphidae

[Drei neue nearktische Arten von Syrphidae]

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[1] Ottawa, Canada [2] Guelph, Canada [3] Florida, U.S.A. [†] Deceased

Abstract

This work describes three of 18 new species recognized in the recent book, “Field Guide to the Flower Flies of Northeastern North America”. The three taxa described herein were planned to be described by Chris Thompson as part of his unpublished but widely distributed “A conspectus of the flower flies (Diptera: Syrphidae) of the Nearctic Region”. This massive work was not published before his death, so we are validating three of the long-recognized taxa here to provide names for species in the Field Guide. All three species have DNA barcodes available that support the morphology. New species treated in this paper include *Neoascia sandsi* **spec. nov.**, *Xylota appalachia* **spec. nov.** and *Xylota wellesleyana* **spec. nov**. Common names follow the “Field Guide”. *Neoascia willistoni* **nom. nov.** is also validated here as a replacement name for *Neoascia unifasciata* Curran, 1925, a junior homonym of *Neoascia unifasciata* (Strobl, 1898). *Neoascia guttata* Skevington & Moran, 2019 **syn. nov.** and *Neoascia willistoni* **syn. nov.** are proposed as junior synonyms of *Neoascia geniculata* (Meigen, 1822).

Keywords: new species, taxonomy, flower flies, hover flies, Diptera, new synonym

Zusammenfassung

Diese Veröffentlichung beschreibt drei von 18 neuen Arten, die in dem kürzlich erschienenen Buch “Field Guide to the Flower Flies of Northeastern North America” anerkannt wurden. Die drei hier beschriebenen Taxa sollten von Chris Thompson als Teil seines unveröffentlichten, aber weit verbreiteten “A conspectus of the flower flies (Diptera: Syrphidae) of the Nearctic Region” beschrieben werden. Dieses umfangreiche Werk wurde vor seinem Tod nicht veröffentlicht, daher validieren wir hier drei der seit langem anerkannten Taxa, um Namen für Arten im Field Guide bereitzustellen. Alle drei Arten verfügen über DNA-Barcodes, die die Morphologie unterstützen. Zu den neuen Arten, die in diesem Artikel behandelt werden, gehören *Neoascia sandsi* **spec. nov.**, *Xylota appalachia* **spec. nov.** und *Xylota wellesleyana* **spec. nov.** Gebräuchliche Namen folgen dem “Field Guide”. *Neoascia willistoni* **nom. nov.** wird hier auch als Ersatzname für *Neoascia unifasciata* Curran, 1925, ein Junior-Homonym von *Neoascia unifasciata* (Strobl, 1898), validiert. *Neoascia guttata* Skevington & Moran, 2019 **syn. nov.** und *Neoascia willistoni* **syn. nov.** werden als Junior-Synonyme von *Neoascia geniculata* (Meigen, 1822) vorgeschlagen.

Stichwörter: neue Art, Taxonomie, Schwebfliegen, neues Synonym

Introduction

One of the most used manuscripts on North American Syrphidae was never published. Chris Thompson wrote a draft paper entitled “A conspectus of the flower flies (Diptera: Syrphidae) of the Nearctic Region” and started circulating it to anyone interested in identifying or working on Syrphidae in 1991. Keys in the Conspectus were either pulled from historical literature or created by Dick Vockeroth or Chris for their own use. This created the first comprehensive one-stop shop for keys to almost all Nearctic flower fly genera in almost a century. Some keys (notably *Cheilosia* Meigen, 1822) were incomplete and tough to use while others were restricted to the eastern Nearctic, but in many cases the keys provided were either the first for the group or long-overdue updates to older keys. The Conspectus hence provided the best and often the only way to identify North American syrphid species. Chris recognized the importance of getting information like this into peoples' hands to catalyze research on the family and propel syrphids to the forefront of ecological and pollination studies. He was always extremely open and gracious about sharing unpublished manuscripts with colleagues. In addition to his North American Conspectus, Chris wrote unpublished Conspectuses of varying degrees of completeness to other Biogeographic Regions of the world—these resources will doubtlessly contribute to taxonomic publications for decades to come.

As well as promoting work on Syrphidae through Conspectus writing, Chris also first coined the common name flower flies for the family. Although they are still also widely known as hover flies, the name flower flies has caught on and advertises the importance of this family as pollinators. We now know that flower flies are globally important pollinators, perhaps even outperforming native bees in this critical agricultural ecosystem service (Rader et al. 2016; Skevington et al. 2019a). Bee research is still more prevalent, but we can thank Chris for helping to promote and instigate the growing body of research on syrphid pollinators.

The popularity of Syrphidae, both as research subjects and as the subject of amateur natural history pursuits, has been increasing in recent years and field guides are emerging that capitalize on this interest. The first such guide was focused on the United Kingdom fauna and, although not comprehensive, provided an excellent entry into the taxonomy and identification of the group (Ball & Morris 2013, 2015). In 2019 two comprehensive guides to syrphids were published. The first, by Bot & Van de Meutter (2019), treated all 384 species found or expected to be found in the Netherlands and Belgium. The second, by Skevington et al. (2019a), treated 413 species found in north-eastern North America. This book includes 18 undescribed species of Syrphidae that are illustrated but not given scientific names. Eleven of these 18 new taxa were officially described in a following paper by Skevington et al. (2019b).

Three more will be officially described here. These species were planned to be described by Chris Thompson as part of his unpublished but widely distributed Conspectus. The final four undescribed species from the field guide include three *Cheilosia* and a *Palpada* Macquart, 1834. The *Palpada* was suspected to be a new species ("*Palpada* undescribed species 1") but we are now confident (based on further studies of DNA and morphology) that it is just the widespread *Palpada furcata* (Wiedemann, 1819). The *Cheilosia* species will have to be described later in the context of a complete revision.

Chris and JHS argued at length about publishing the new species described below in Skevington et al. (2019b). Chris wanted to publish them separately because one is named after his high school mentor who got him involved in Entomology and another after the town where he was born. They were thus very close to him and of major importance. It's a pity that he never got a chance to see them published but we are happy to finally be able to make these tributes for Chris here. Despite little disagreements like this, JHS and ADY are both extremely grateful to Chris for his mentorship and willingness to share his data. Chris poured himself into teaching others about syrphids and was always quick to accept any opportunity to teach about flower flies. He opened up his lab and his home to those who were interested. We have included two photos (Figs 48 and 49) that depict Chris with some of his disciples.

Materials and methods

Adult specimens were pinned directly after collecting or stored in ethanol and later critical point dried in the case of Malaise trap samples. Clearing and removing male genitalia were necessary to view internal characters useful for classification and species delimitation. The genitalia capsule was removed by cutting between tergites 7 and 8 and then cleared by heating in 88 % lactic acid overnight. A complete list of the material examined list is provided with each species description. Specimens were borrowed from the following institutions and individuals (collection codes based on Evenhuis (2007) are used in the material examined sections):

ANSP – Academy of Natural Sciences of Drexel University, Philadelphia, Pennsylvania, U.S.A.
CBG – Centre for Biodiversity Genomics, Guelph, Ontario, Canada.
CNC – Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada.
FSCA – Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.
NBMB – New Brunswick Museum, St. John’s, New Brunswick, Canada.
UNHC – University of New Hampshire, Durham, New Hampshire, U.S.A.
USNM – National Museum of Natural History, Washington, D.C., U.S.A.
UTCI – University of Tennessee at Chattanooga Insect Collection, Chattanooga, Tennessee, U.S.A.
WSB – Wouter van Steenis personal collection, Breukelen, The Netherlands.

Coordinates are either interpreted from label data or copied directly from the labels. CNC efforts to identify source data for coordinates in the database have been inconsistent so coordinate accuracy should be assumed to vary from exact to as much as 5 km. Label data information is all interpreted by the authors (short forms are written out so that it is easier for future users). For holotypes, photos of the labels are included below so that verbatim information is available without question. External habitus photos of the holotypes are also provided to show the condition of the specimens.

Habitus and genitalia photographs for all specimens were taken using a Leica M205-C stereoscope (Leica Microsystems Inc., Concord, Ontario, Canada) using 0.6 × (habitus) and 1.6 × (genitalia) lenses. Raw images to be used in depth-of-field photomontages were captured using Leica Application Suite (Leica Microsystems 2019) and final images were created using Zerene Stacker (Littlefield 2018). Specimen measurements were taken using the Leica measurement module in Leica Application Suite. Figures are presented alphabetically.

The right hind leg was removed from some specimens and either sequenced by Scott Kelso at the CNC or sent to the University of Guelph, Biodiversity Institute of Ontario, for sequencing of the 5’ end of the mitochondrial Cytochrome *c* Oxidase subunit I gene (COI) or Barcoding region, following protocols published in Hajibabaei et al. (2005). Specific primers and methods can be found in Skevington et al. (2019b). All sequence data are stored on the BOLD website (www.boldsystems.org) in the ‘New Species of Syrphidae from Field Guide2’ (DS-NSSFG2) dataset, available at http://www.boldsystems.org/index.php/Public_SearchTerms?query=DS-NSSFG2. GenBank Numbers (GB) and unique identifiers (‘Sample ID’) of specimens sequenced are included in the material examined list. Pairwise distances were calculated using MEGA version X (Stecher et al. 2020).

Syrphidae-specific terminology follows Thompson (1999), while all other morphological terminology follows Cumming & Wood (2017). A visual glossary of common terminology used is available in Skevington et al. (2019a). Abbreviations used throughout the text include JSS – for Jeff_Skevington_Specimen and CNCD – for CNC_DIPTERA (part of the unique identifiers on specimens). In the material examined sections, ‘…’ before the information indicates that the data are a duplicate of the previously listed specimen.

All species included here can be identified using Skevington et al. (2019a) but we also provide keys below as an additional aid, and the three new species are authored by all the three authors. FCT wrote descriptions for all of the species which were adapted and extended by JHS and ADY.

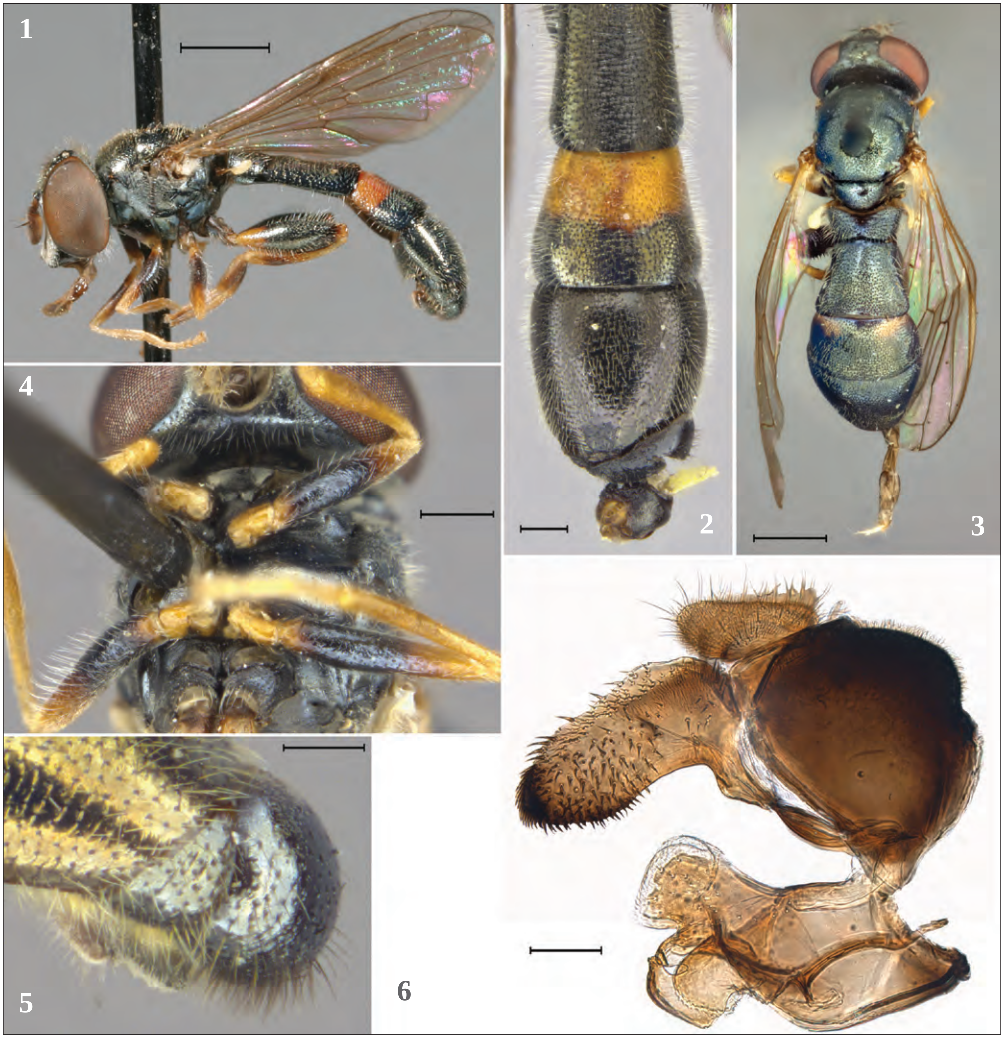
Results and discussion

Neoascia sandsi Skevington, Young & Thompson spec. nov.

(Figures 1–9, 19, 26)

Neoascia undescribed species 1 of: Skevington et al. (2019a: 234).
Neoascia spec. nov. 76–34 of: Thompson (1991); Thompson unpublished notes.
Neoascia distincta Williston, 1887 of authors.

Diagnosis. Postmetacoxal bridge absent. Single abdominal band on tergite 3 usually meeting lateral margin. Abdominal segment 8 black pilose. Genitalia must be checked to be certain: male surstyli elongate (much longer than broad, stubby and bent ventrally in *Neoascia globosa* Walker 1849); gonostylus simple with no protuberances (with mid-dorsal protuberance in *N. globosa*); phallapodeme with centre of shaft curved, weakly C-shaped (straight in *N. globosa*).



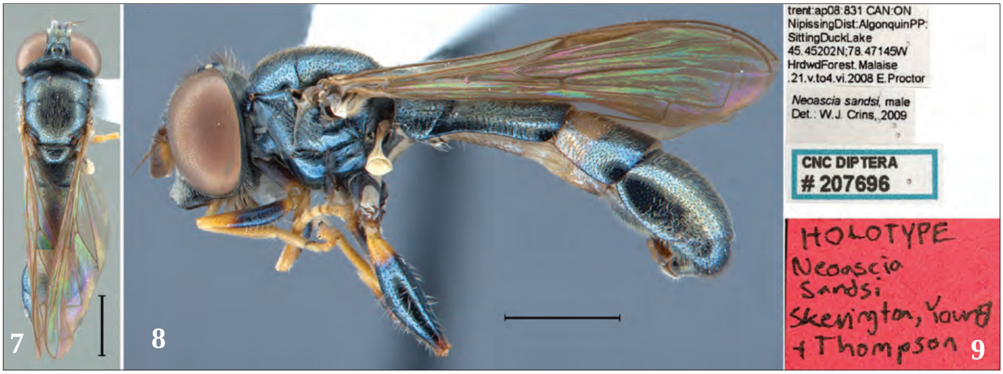
Figs 1–6: *Neoascia sandsi* **spec. nov.** – **1**: Left lateral habitus of male, scale bar = 1 mm, CNCD608; – **2**: Dorsal of male abdomen, scale bar = 0.25 mm, CNCD169714; – **3**: Dorsal habitus of female, scale bar = 1 mm, CNCD207701; – **4**: Ventral of male thorax, scale bar = 0.25 mm, CNCD169714; – **5**: Left lateral of tip of abdomen to show pile, scale bar = 0.25 mm, CNCD169710; – **6**: Right lateral of male genitalia, scale bar = 0.1 mm, CNCD207697.

Material examined. Type material. *Holotype*, ♂, **CANADA**: **Ontario**: Nipissing District, Algonquin Provincial Park, Sitting Duck Lake, 45.452022, –78.471450, hardwood forest, 21.v–4.vi.2008, E. Proctor, Malaise trap, accession#trent:ap08:831, CNCD207696 (CNC). *Paratypes*: **CANADA**: **Manitoba**: 1 ♂, Whitewater Lake, 4 miles north of Whitewater, 49.250624, –100.227926, 14.viii.1958, R. B. Madge, CNCD152328 (CNC); 1 ♂, Ninette, 49.4, –99.6, Maple-Elm floodplain community, 17.v.1958, J. F. McAlpine, CNCD152348 (CNC); 1 ♂, 5 miles southwest of Shilo, 49.753932, –99.720027, floodplain community near Tamarack bog, 28.v.1958, J. F. McAlpine, CNCD152359 (CNC); **New Brunswick**: 1 ♀, Westmorland Co., Aboushagan Road, ~10 km north of Sackville, 45.998003, –64.359003, dirt road through coniferous woods, 7.v.2010, J. Klymko, S. L. Robinson, D. M. Mazerolle, JK492, GB: JN992015 (NBMB); 1 ♂, 1 ♀, Carleton County, Lakeville railbed in *Typha*/*Larix*, 46.351800, –67.681603, 25.v.2011, J. Klymko, S. L. Robinson, accession#JK01459, JK01460, CNCD162955, GB: MZ870597, CNCD162956, GB: MZ870595 (CNC); 2♂♂, Kouchibouguac National Park, 46.85, –64.97, 1.vi.1977, J. R. Vockeroth, accession#51110, 51985, CNCD170057, CNCD170063 (CNC); ♀, … 22.v.1977, Hanley & Cooper, accession51110, CNCD170079 (CNC); 1 ♀, … 7.vi.1978, D. B. Lyons, accession# 7031K, CNCD170067 (CNC); **Ontario**: 1 ♂, St. Williams, 42.667223, –80.415089, 23.v.1956, J. R. Vockeroth, CNCD608 (CNC); 2 ♂♂, Normandale, 42.710880, –80.319467, 22.v.1955, J. R. Vockeroth, CNCD169686–7 (CNC); 1 ♂, … 22.v.1956, J. R. Vockeroth, CNCD169714 (CNC); 1 ♀, … 28.v.1956, J. R. Vockeroth, CNCD169740 (CNC); 3 ♂♂,1 ♀, … ~29.v.1956, J. R. Lonsway, CNCD169742, CNCD169684–5, CNCD43925 (CNC); 1 ♀, … 29.v.1956, J. R. Vockeroth, CNCD169741 (CNC); 1 ♀, … 30.v.1956, J. R. Vockeroth, CNCD169739 (CNC); 1 ♂, … Orillia, 44.716667, –79.483333, 2.v.1921, H. Curran, CNCD169690 (CNC); 1 ♂, … 5.v.1921, H. Curran, Frank M. Hull Collection C.N.C. 1973, CNCD169689 (CNC); 1 ♂, Simcoe, 42.833333, –80.3, 23.vi.1939, G. S. Walley, CNCD169682 (CNC); 1 ♀, Strathroy, 42.95007, –81.63317, 5.v.1927, H. F. Hudson, CNCD169749 (CNC); 1 ♂, Port Hope, 43.9492, –78.2935, 24.v.1894, G. S. Walley, CNCD169688 (CNC); 1 ♂, Rockport, 44.380305, –75.935417, 9.v.1961, G. H. Mann, CNCD169691 (CNC); 1 ♂, Thousand Islands National Park, 44.453000, –75.865000, 91 m, shoreline transition area (from emergent *Typha* marsh to mixed forest edge), 21.v–4.vi.2014, M. Brown, Malaise trap, T1: heavy rainfall event, BIOUG20504-C11, GB: MF833914 (CBG); 1 ♀, Marmora, 44.48, –77.68, swept from *Salix*, 29.iv.1952, J. F. McAlpine, CNCD169743 (CNC); … 1 ♂, 5.vi.1952, J. R. Vockeroth, CNCD43926 (CNC); 1 ♀, Georgian Bay Islands National Park, 44.741800, –79.850100, 190 m, wetland, 12.v–3.vi.2013, Chris Johnstone, Malaise trap, BIOUG10648-A09, GB: KR383479 (CBG); 1 ♂, Midland, 44.75, –79.89, 12.v.1959, J. G. Chillcott, CNCD169681 (CNC); 1 ♂, Port Severn, 3 miles N., 44.800000, –79.716667, black spruce bog, 22.v.1959, J. G. Chillcott, CNCD607 (CNC); 1 ♀, Spencerville, Limerick Forest, 44.860190, –75.607096, 12.v.1954, R. Lambert, CNCD169747 (CNC); 1 ♂, Go Home Bay, 8 miles West of Bala, 44.983333, –79.933333, wet maple woodland, 22.v.1959, J. G. Chillcott, CNCD169683 (CNC); 1 ♀, Osgoode, 45.144769, –75.605322, 15.v.1964, J. R. Vockeroth, CNCD169746 (CNC); 1 ♀, … 22.v.1964, J. R. Vockeroth, CNCD169745 (CNC); 1 ♀, … 28.v.1965, J. R. Vockeroth, CNCD169744 (CNC); 1 ♂, 7 miles east of Griffith, 45.243279, –77.031193, 8.vi.1983, B. E. Cooper, CNCD95558 (CNC); 1 ♂, Manotick, 45.25, –75.7, 27.v.1952, Malaise trap, CNCD43928 (CNC); 1 ♀, Algonquin Provincial Park, Crossbar Lake, Haliburton County, 45.327631, –78.300822, hardwood forest, 12–27.v.2007, E. Proctor, Malaise trap, accession#trent:ap07:1033, CNCD207701 (CNC); 2 ♀♀, Algonquin Provincial Park, Florence Lake, Haliburton County, 45.442692, –78.488761, hardwood forest, 6–13.v.2007, E. Proctor, Malaise trap, accession#trent:ap07:1034, ap07:1035, CNCD207703, CNCD207706 (CNC); 1 ♂, Algonquin Provincial Park, Cecil Lake, 45.450581, –78.496622, 19.v–3.vi.2009, E. Proctor, Malaise trap, accession#trent:ap09:2046, CNCD207700 (CNC); 1 ♂, Algonquin Provincial Park, Sitting Duck Lake, 45.452022, –78.471450, 6–20.v.2009, E. Proctor, Malaise trap, accession#trent:ap08:831, CNCD207697 (CNC); 1 ♂, Copeland, 44.5700, –79.6997, *Sphagnum* bog, 31.v.1998, B. de Jonge, CNCD235227 (CNC); 1 ♂, 1 ♀, Algonquin Provincial Park, Pondweed Lake, Haliburton County, 45.462672, –78.430061, hardwood forest, 16–28.v.2007, E. Proctor, Malaise trap, accession#trent:ap07:1039, accession# trent:ap07:1043, CNCD207702, CNCD207705 (CNC); 1 ♂, … 9–16.v.2007, accession#trent:ap07:1045, CNCD207704 (CNC); 1 ♂, 1 ♀, … 20.v–3.vi.2009, accession#trent:ap09:1556, ap09:1753, CNCD2 07698–9 (CNC); 1 ♀, … 6–19.vi.2008, E. Proctor, Malaise trap, accession#trent:ap08:829, CNCD207689 (CNC); 1 ♂, Algonquin Provincial Park, Trailer Sanitation Station, 45.581817, –78.451869, on flowers of *Fragaria* and *Taraxacum*, 3.vi.2018, J. H. Skevington, M. M. Locke, JSM11260, CNC1042854 (CNC); 1 ♂, Mer Bleue Bog, Ottawa, 45.4, –75.5, 2.vi.1923, C. H. Curran, CNCD169668 (CNC); 1 ♂, Ottawa, 45.423, –75.698, 1.vi.1951, J. F. McAlpine, CNCD43927 (CNC); 1 ♂, Wilberforce Township, near Douglas, 45.509000, –76.676000, 16.v.2010, Alex Smith, Malaise trap, BIOUG01475-F12, GB: MG165412 (CBG); 1 ♀, Kenora, 49.772692, –94.474448, 13.vi.1960, Kelton & Whitney, CNCD169748 (CNC); 1 ♀, IBA 124- Longridge Point, 51.876225, –80.798025, 8.vii.2009, Zaid Jumean, sweeping, Plot Type: NH, ZJ-2009-00235, CNC640461 (CNC); **Quebec**: 1 ♀, Kingsmere, 45.4934700, –75.845565, 16.v.1958, J. G. Chillcott, CNCD152375 (CNC); 2 ♂♂,3 ♀♀, Old Chelsea, 45.5, –75.8, 16.v.1958, J. R. Vockeroth, CNCD152372–4, CNCD43930, CNCD43933 (CNC); 1 ♀, 6 miles South East Lac Megantic, 45.531633, –70.796550, 22–24.vi.1982, H. J. Teskey, CNCD96855 (CNC); 2 ♂♂, Gatineau Park, SW Meech Lake, 45.54, –75.89, 12.v.2012, O. Lonsdale, CNCD245170–1 (CNC); 1 ♀, Harrington Lake, Gatineau Park, Lac Mousseau, 45.568, –75.954, 10.vi.1954, W. R. Richards, CNCD152370 (CNC); 1 ♀, Gatineau Park, Gatineau, 45.587912, –75.975159, 8.vi.1954, W. R. M. Mason, CNCD152369 (CNC); 1 ♂, Gatineau Park, 45.594868, –76.002392, 1963, J. W. Boyes, CNCD43935 (CNC); 1 ♀, Beech Grove, 45.650000, –76.133333, 3.v.1968, J. F. McAlpine, CNCD169704 (CNC); 2 ♂♂, … 16.v.1962, J. R. Vockeroth, CNCD169710, CNCD170061 (CNC); 2 ♂♂, … 21.v.1964, J. R. Vockeroth, CNCD96786, CNCD169711 (CNC); 1 ♀, … 21.v.1999, J. F. McAlpine, CNCD169706 (CNC); … 1 ♂, J. R. Vockeroth, CNCD169713 (CNC); … 2 ♂♂,1 ♀, 25.v.1965, J. R. Vockeroth, CNCD169703, CNCD43931–2 (CNC); 1 ♂, … 27.v.1963, J. R. Vockeroth, CNCD43929 (CNC); 1 ♂, Hull, 45.4, –75.7, 18.v.1926, C. H. Curran, CNCD152322 (CNC); 1 ♂, … 20.v.1923, C. H. Curran, CNCD170066 (CNC); 3 ♂♂, … 22.v.1923, C. H. Curran, CNCD152320–3 (CNC); 1 ♂, … 24.v.1923, C. H. Curran, CNCD152324 (CNC); 1 ♂, … 27.v.1923, C. H. Curran, CNCD152319 (CNC); 1 ♀, Knowlton, 45.216716, –72.514769, 17.v.1953, G. E. Shewell, 8 emerged into cage, CNCD152368 (CNC); **U.S.A.**: **Maryland**: 1 ♂, Hyattsville, 38.957473, –76.951252, 9.v.1917, C. T. Greene , CNC1135077 (USNM); 1 ♂, Montgomery Co., Bethesda, 38.974601, –77.116605, 21.iv.1974, G. C. Steyskal, CNC1135076 (USNM); **Massachusetts**: 5 ♂♂, Belchertown, 42.277576, –72.403090, v.1964, F. C. Thompson, CNC1135064–8 (USNM); **Minnesota**: 1 ♀, Snake River Dam, 48.245513, –96.700722, 8.v.1948, CNCD110912 (CNC); **Nebraska**: 1 ♂, Keya Paha Co., Springview, 8 miles W, Cub Creek lake, 730 m asl., 42.82, –99.91, 20.iv.2004, J. & W. van Steenis, wvs12278 (WSB); 1 ♂,1 ♀, Sioux Co., Fort Robinson SP, Soldier Creek, 1240 m asl., 42.69, –103.55, 19.iv.2004, J. & W. van Steenis, wvs12277, wvs12276 (WSB); **New Hampshire**: ♂, Coos County, Lancaster, 44.488946, –71.569251, 19.vi.1982, J. R. Vockeroth, CNCD107623 (CNC); **New York**: 1 ♂, Ithaca, 42.433333, –76.483333, 22.v.1915, Frank M. Hull Collection C.N.C. 1973, CNCD169942 (CNC); 1 ♂, McLean, 42.55, –76.283333, 29.v.1915, Frank M. Hull Collection C.N.C. 1973, CNCD169941 (CNC); 1 ♂, Tompkin Co., McLean, 42.552267, –76.291086, 15.v.1922, CNC1135074 (USNM); **North Carolina**: 2 ♂♂, Jackson Co., 8.2 miles S of Cashiers, Fish Hatchery, N J. Passmore Residence, RT#NC.107, 35.017077, –83.058303, 883 m, on *Spiraea thunbergi*, 18.iv.1964, H. V. Weems, Jr., CNC1135159–60 (FSCA, USNM); 1 ♂, Highlands, 35.050000, –83.183333, 1158 m, 6.v.1957, J. R. Vockeroth, CNCD9751 (CNC); 1 ♂, 35.053575, –83.199732, 914 to 1524 m, iv.1936, R. C. Shannon, CNC1135128 (USNM); **North Dakota**: 1 ♂, Richland Co., Mirror Pool nr. Kindred, 46.644300, –97.017000, 10.v.1993, J. M. Cumming, JSS42211 (CNC); **Pennsylvania**: 1 ♂, Huntington Co., Whipple Dam State Park, 40.683125, –77.866046, 10–12.v.1983, F. C. Thompson, CNC1135075 (USNM); **Vermont**: 1 ♂, Jacksonville, Laurel Lake, 42.818036, –72.816343, 31.v.1977, H. D. Pratt, CNC1135069 (USNM); **Virginia**: 1 ♂, Mount Vernon, 38.716041, –77.108390, on flowers of *Amelanchier*, 22.iv.1917, W. L. McAtee, CNC1135093 (USNM); **West Virginia**: 1 ♂, Cranberry Glades, 38.207817, –80.282386, 1.vi.1955, H.V. Weems, Jr., CNC1135094 (USNM); 1 ♂, Sharp Knob, Pocahontas County, 38.42696, –80.164657, 1372 m, 18.v.1965, J.G. Chillcott, CNCD169940 (CNC).

Description

Size: Body length: 3.7 to 4.8 mm; wing length: 2.8 to 4.1 mm.

MALE. **Head**: Black with metallic sheen; face silvery-white pollinose and white pilose; gena shiny, bare anteriorly, white pollinose and pilose posteriorly; frons shiny, rugose, white pilose on ventral 2/3, black pilose dorsally; vertex shiny, smooth, black pilose; occiput sparsely gray pollinose and black pilose dorsally, becoming densely silvery white pollinose and white pil-



trent:ap08:831 CAN:ON
NipissingDist:AlgonquinPP:
SittingDuckLake
45.45202N;78.47145W
HrdwdForest.Malaise
.21.v.to4.vi.2008 E.Proctor

Neoascia sandsi, male
Det.: W.J. Crins, 2009

CNC DIPTERA
207696

HOLOTYPE
Neoascia
Sandsi
Skevington, Young
+Thompson

Figs 7–9: *Neoascia sandsi* **spec. nov.**, holotype male specimen CNCD207696, scale bars = 1 mm. – **7**: Dorsal habitus; – **8**: Left lateral habitus; – **9**: Labels.

ose ventrally; antenna dark brown except orange basiventral 1/3 of postpedicel; postpedicel elongate, about twice as long as wide; arista short, as long as postpedicel.

Thorax: Black with metallic sheen; postpronotum silvery-white pollinose anteromedially, elsewhere shiny, yellowish-white pilose; mesonotum shiny except white pollinose anterolaterally (adjacent to postpronotum), yellowish-white pilose; scutellum shiny, yellowish-white pilose, with apicomedial yellow seta; pleuron grayish-white pollinose except shiny on most of katepisternum, meron and katatergite, white pilose; postmetacoxal bridge absent; metathoracic epimera broadly separated. **Wing**: Hyaline, completely microtrichose; calypter white; halter white to orange. **Legs**: Coxae dark brown, grayish-white pollinose, white pilose; trochanters orange; pro and mesofemora narrowly orange basally and on apical 1/3, black elsewhere, white pilose; pro and mesotibiae and tarsi orange, pale pilose; metafemur orange on basal 1/5 and narrowly on apex, black elsewhere, white pilose; metatibia orange basally and apically, usually brown to black on apicomedial 1/3, rarely entirely pale, white pilose; metatarsus bicolored, pale pilose; metabasitarsomere brown except orange apically; 2nd and 3rd metatarsomeres orange; apical 2 metatarsomeres brown.

Abdomen: Black with metallic sheen except orange on basal 1/2 of tergite 3, white pilose.

Genitalia: Male terminalia black pilose; epandrium compact, shorter than surstylus; cercus elliptical; surstylus elongate; distiphallus with an acute bend so tip faces dorsally; hypandrium quadrate; gonostylus simple with no protuberances; phallapodeme with centre of shaft curved, weakly C-shaped; ejaculatory apodeme tiny, parasol-shaped.

FEMALE. Similar to male except for normal sexual dimorphism and abdominal fasciae usually reduced to maculae.

Etymology. This species is dedicated to Douglas SANDS, the high school biology teacher who introduced THOMPSON to the Science as well as the joy of taxonomy.

Distribution. Widespread in eastern Canada (Manitoba, New Brunswick, Ontario, Quebec) and U.S.A. (Maryland, Massachusetts, Minnesota, Nebraska, New Hampshire, New York, North Carolina, North Dakota, Pennsylvania, Vermont, Virginia, West Virginia).

Ecology. This species is found in wetlands in hardwood and coniferous forests, including bogs. They have been found nectaring on *Amelanchier* MEDIKUS, *Fragaria* LINNAEUS, *Spiraea thunbergia* SIEBOLD ex BLUME and *Taraxacum* F. W. WIGGERS. The species appears to be univoltine with flight times from mid-April to early July. The single specimen on August 14th could indicate that a partial second generation is possible in some years.

Remarks. The synonymy of *Neoascia distincta* WILLISTON, 1887 with *N. globosa* (see SKEVINGTON et al. 2019a) left this widespread eastern species without a name. Male genitalia should be checked to confirm identification as external morphology is not reliable. *Neoascia globosa* is genetically closest to *N. sandsi* **spec. nov**. based on available COI data (3.0 to 4.1 percent different). Pairwise COI intraspecific variation within *N. sandsi* **spec. nov**. is 0.3 to 0.6 percent (n = 6 specimens).

Common name. The common name given to the species by SKEVINGTON et al. (2019a) is Sands's Fen Fly.

Key to Nearctic species of *Neoascia*

* Supplemental illustrations of most species are available in SKEVINGTON et al. 2019a. We include plates to compare heads (Figs. 16–22, see page 92) and male terminalia (Figs. 23–29, see pages 92 and 93) for all Nearctic species here to resolve some issues around *Neoascia geniculata* (MEIGEN, 1822) and to make all Nearctic species easily identifiable. Note that we have determined that *Neoascia meticulosa* (SCOPOLI, 1763) does not occur in North America as previously proposed (EVENHUIS & PAPE 2022).

1 Face with distinct snout, longer than half eye width, strongly concave (Fig. 21); postpedicel long and very broad, 0.7 times as broad as long, cone-shaped, black (Fig. 21); pro and mesocoxae and trochanters dark, brownish black, protarsi all black; front smooth, very broad, broader than eye width at antenna; abdomen narrow, parallel sided, entirely black; male surstylus quadrate with brush of dorsal setae on tip (Fig. 28) .... ***subchalybea* CURRAN, 1925**

Northern distribution (Northwest Territories south to Alberta, east to Quebec and south to Minnesota and Pennsylvania; Russia).

– Face never with a snout, not strongly concave (cf. Fig. 18); postpedicel usually not as broad, 0.4–0.7 times as broad as long, oval to rectangular, usually partially pale, yellow to orange (cf. Fig 18); pro and mesocoxae and trochanters partially pale, yellow to orange, protarsi at least partly yellow; front narrower, frequently rugose; abdomen petiolate, frequently with pale fasciae.. **2**

2 Protarsi all yellow; face concave (cf. Fig. 17)... **4**

– Apical two protarsi black, proximal three protarsi yellow; face straight, long (Figs 16 and 20)... **3**

3 Postpedicel stubby, as long as wide (Fig. 16); male cercus simple (Fig. 23)...................... ....***geniculata* (MEIGEN, 1822)**[1]

Northwestern (Alaska to Manitoba, Europe, Russia).

– Postpedicel more elongate (Fig. 20); male cercus forked (Fig. 27)................................... ....***sphaerophoria* CURRAN, 1925**

Western Nearctic boreal and montane distribution (Alaska to Northwest Territories and Manitoba, South to Colorado).

4 Protibia entirely yellow; postmetacoxal bridge present.. **6**

– Protibia yellow with brown central band; postmetacoxal bridge present......................... **5**

5 Metafemur black to apex; female abdomen immaculate; male surstylus with hump at base (Fig. 29)...***tenur* (HARRIS, 1780)**

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[1] An unpublished manuscript name (*willistoni*) of THOMPSON's is circulating in the literature, but there is no need to validate it as we are synonymizing the species it was intended to replace, *Neoascia unifasciata* CURRAN, 1925. The name *Neoascia unifasciata* CURRAN, 1925 is a junior homonym of *Neoascia unifasciata* (STROBL 1898) [the latter originally described as *Ascia podagrica* var. *unifasciata* STROBL 1898] and is an invalid name according to Article 57 of the International Code of Zoological Nomenclature (ICZN 1999). We have studied the type of *unifasciata* CURRAN and specimens from across the range of *geniculata* (including the type locality) and find that the genitalia and external morphology are indistinguishable from *Neoascia geniculata* (MEIGEN). This combined with COI DNA evidence (putative *unifasciata* CURRAN and *geniculata* share the same haplotype – see published dataset http://dx.doi.org/10.5883/DS-NEOASCIA) supports our decision to synonymize *Neoascia unifasciata* (STROBL, 1898) **(syn. nov.)** with *Neoascia geniculata*.

Widespread boreal, montane distribution (Alaska to Newfoundland, south to northern California and Colorado in the west and Maryland in the east; Europe, Russia).

– Metafemur usually yellow apically; female abdomen with 2 pale fasciae or 4 pale maculae; male surstylus stubby and nearly square in profile (Fig. 25).. ....***metallica*** **(WILLISTON, 1882)**
Widespread and typically slightly more southern than *N. tenur* (Yukon to Newfoundland, south to northern California and Colorado in the west and North Carolina in the east).

6 Male tergite 3 with pale fascia continuous, extending over lateral margin in its full width; male abdominal segment 8 black pilose; male surstylus elongate, much longer than broad (Fig. 26); female abdomen with one orange fascia................................ ***sandsi*** **spec. nov.**
Northeastern (Manitoba east to New Brunswick, south to West Virginia).

– Male tergite 3 with pale fascia usually isolated from lateral margin; male abdominal segment 8 partly to completely pale pilose; male surstylus broad, semicircular dorsally, about as broad as long (Fig. 24); female abdomen maculate..... ***globosa*** **(WALKER, 1849)**
Mostly restricted to the extreme Northeast (Ontario to Newfoundland, south to Maryland; outliers from North Carolina, Manitoba and North Dakota).

Remark to *Neoascia guttata* SKEVINGTON & MORAN, 2019

Also note that *N. guttata* is proposed as a new synonym (**syn. nov.**) of *N. geniculata*. It was a strange combination of circumstances that led to the mistake of describing *guttata*. *Neoascia guttata* was based on a male holotype from Nova Scotia and two presumed females from Alberta. The male is the only specimen of *Neoascia* from eastern North America with a straight face. The yellow band on tergite 3 in typical *geniculata* is replaced with a pair of yellow spots in the *guttata* holotype. Some *geniculata* specimens have a narrow connecting band but no others we have seen have separated spots. We obtained DNA barcodes from a putative female of the new species (SKEVINGTON et al. 2019b), and it was unlike any other barcodes for the genus, supporting our concept that it was undescribed. However, we now have males with similar barcodes and realize that this cluster of taxa refers to *Neoascia sphaerophoria*, a taxon for which we had not barcodes at the time. The DNA barcode for the holotype male of *guttata* is short (434 base pairs) and it was associated with a contaminated sequence through long branch attraction. Removal of the contaminated sequence during the current study led to the *guttata* sequence clustering with the *geniculata* specimens. Genitalia of the *guttata* holotype is consistent with the genitalia of *geniculata* specimens. We are thus now confident that the different abdominal pattern is simply variation. The Nova Scotia record is a considerable outlier for this otherwise western Nearctic and Old World species, another confounding factor in the original research.

Xylota appalachia SKEVINGTON, YOUNG & THOMPSON spec. nov.

(Figures 10–12, 30–38)

Xylota appalachia THOMPSON manuscript name of: THOMPSON (1991).
Xylota undescribed species 78-1 of: SKEVINGTON et al. (2019a: 196).

Diagnosis. Cell c bare on basal two thirds or more; arista long (2.7 times as long as postpedicel); frontal triangle entirely pollinose; probasitarsomere without long pile. This species is most similar to *Xylota confusa* SHANNON, 1926 which has cell c bare on basal 1/3 or less; arista short, 2.2 to 2.3 times the length of the postpedicel; frontal triangle extensively shiny; probasitarsomere with a long apicolateral pilus, as long as 2nd tarsomere.

Material examined. Type material. *Holotype*, ♂, **U.S.A.**: **Pennsylvania**: Centre County, Bear Meadows Natl. Area, 40.731100, –77.763700, ex. mosses, base of deciduous tree, 17.vi.1987, F. D. FEE, ex.

Frank D. Fee Collection 2014.1, JSS50002 (ANSP). *Paratypes,* **CANADA**: **Quebec**: ♂, Summit of King Mountain, Old Chelsea, 45.48, –75.87, 12.vi.1970, D. M. Wood, CNCD91698 (CNC); ♀, 45.488889, –75.862500, 21.vi.2001, J.H. Skevington, CNC484479, GB: MZ870604 (CNC); 2♂♂, 45.48, –75.87, 23.vi.1970, USNM_ENT248750–1 (CNC); **U.S.A.**: **Connecticut**: ♂, Stamford, 41.05343, –73.538734, 19.vi.1963, S.J.L., F. C. Thompson Collection 1974–75, USNM_ENT248748 (USNM); **Illinois**: 1, Mason Co., Sand Ridge State Forest, 40.390820, –89.866192, 10.vi.1975, C. T. Maier, CNC1185367 (USNM); **Maryland**: Beltsville, 39.034833, –76.907475, 26.vii.1917, C. T. Greene, USNM_ENT248747 (USNM); 2♂♂, Allegany County, Fifteen-Mile Creek, Green Ridge State Forest, 39.617, –78.383, *Physocarpus*, 11.vi.1980, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50044; JSS50047 (ANSP); 2♂♂, ♀, ... *Rosa multiflora*, JSS50048–50 (ANSP); ♂, ... *Physocarpus*, 11.vi.1981, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50051 (ANSP); ♂, ... *Rosa multiflora*, 14.vi.1980, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50052 (ANSP); ♂, ... *Rhus,* 27.vi.1979, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50046 (ANSP); ♂, ... *Physocarpus*, 5.vi.1981, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50053 (ANSP); **Nebraska**: 3 ♀♀, Cass Co., South Bend, Platte River State Park, 320m asl., 40.98, –96.21, 6.vi.2003, W. van Steenis, wvs13411-wvs13413 (WSB); **New York**: 1 ♀, Canandaigua Lake, Finger Lakes, 42.845735, –77.261938, 16.vii.1894, N.S.C., USNM_ENT248754 (USNM); **Pennsylvania**: ♂, Roxborough, 40.033333, –75.216667, 27.v.1911,, USNM_ENT248753 (USNM); 1 ♀, Stovedale, 40.246117, –76.705582, 20.vi.1917, W. S. Fisher, flying, USNM_ENT248752 (USNM); ♂, Inglenook, 40.413142, –76.981088, 14.vi.1913, W.S. Fisher, flying, USNM_ENT248749 (USNM); ♂, Huntingdon County, Laurel Run, Whipple Dam State Park, 40.693850, –77.857447, fern in forest swamp, 27.v.1980, F. D. Fee, Frank D. Fee Collection 2014.1, JSS44130 (ANSP); ♂, Huntingdon County, Route 26, 1.1 km west of Whipple Dam State Park, 40.693850, –77.857447, *Cornus racemosa*, 18.vi.1988, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50003 (ANSP); 1 ♀, Centre County, Bear Meadows Natl. Area, 40.731100, –77.763700, *Viburnum dentatum*, 16.vi.1988, F. D. Fee, Frank D. Fee Collection 2014.1 JSS50035 (ANSP); ♀, *Spiraea*, 30.vii.1987, JSS50042 (ANSP); ♂, herbage, 25.vi.1980, JSS44135 (ANSP); ♂, *Rosa multiflora,* 30.vi.1982, JSS44141 (ANSP); ♀, Centre County, Route 26, Tussey Mountain, 1.3 miles south of Pine Grove Mills, 40.768800, –77.740500, *Hydrangea arborescens* L., 13.vii.1979, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50016 (ANSP); ♂, Centre County, Colyer Lake, 3.4 km southwest of Potters Mills, 40.774800, –77.682900, *Rubus*, 26.v.1985, F. D. Fee, Frank D. Fee Collection 2014.1, JSS44154 (ANSP); 2♂♂, … 2.vi.1982 JSS44137–8 (ANSP); ♀, ... *Rubus* sp., 29.v.1982, JSS50028 (ANSP); ♂, ... 6.vi.1980, JSS44131 (ANSP); ♂, ♀, ... 7.vi.1980, JSS44132; JSS50030 (ANSP); ♂,2♀♀, ... 9.vi.1979, JSS44112; JSS50012–3 (ANSP); ♂, ... *Rosa multiflora*, 9.vi.1982, JSS44140 (ANSP); ♀, Centre County, Scotia Barrens, 7 km west of State College, 40.783331, –77.955531, *Thalictrum*, 5.vii.1982, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50022 (ANSP); ♂,... moist sandy soil, 22.v.1979, JSS44110 (ANSP); ♂, 5.vi.1979, JSS44111 (ANSP); ♂, Huntingdon County, Beaver Pond, Pennsylvania State University Recreational Area, 40.805672, –77.868137, *Kalmia latifolia*, 14.vi.1987, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50001 (ANSP); ♀, *Kalmia*, 18.vi.1988, JSS50036 (ANSP); ♀, Centre County, Spring Creek, 4.1 km north-northeast of Houserville, 40.860668, –77.809492, damp soil, creek trail, 14.vii.1983, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50034 (ANSP); ♂, ... moist soil, 26.v.1983, JSS44145; ♂, ... JSS44146, GB: MZ870596 (ANSP); ♀, ... moist soil, creek trail, 26.vi.1983, JSS50033 (ANSP); ♂, ... vegetation near rotting log, 7.vi.1982, JSS44139 (ANSP); ♂, ♀, ... *Rosa multiflora*, 12.vi.1979, JSS44114; JSS50009 (ANSP); ♂, 2.vi.1976, JSS44106, GB: MZ870600 (ANSP); ♀, ... moist soil, creek trail, 5.vi.1980, JSS50024 (ANSP); ♂, ...moist soil, 27.v.1984, JSS44151 (ANSP); ♂, ... 7.v.1985, JSS44153 (ANSP); 2♂♂, Centre County, Black Moshannon State Park, Rush Township, 40.915503, –78.059340, *Sambucus* sp., 11.vii.1979, F. D. Fee, Frank D. Fee Collection 2014.1 JSS44125–6 (ANSP); 7♂♂,3♀♀, ... *Rubus* sp., 13.vi.1979, JSS44113; JSS44115–7; JSS44119; JSS44121–2; JSS50014–5; JSS50017 (ANSP); 2♂♂, ... 17.vi.1979, JSS44118; JSS44120 (ANSP); ♂, ... 27.vii.1979, JSS44127 (ANSP); ♂, ... *Rubus* sp., 29.vi.1979, JSS44123 (ANSP); ♂, ... 3.vii.1979, JSS44124 (ANSP); ♀, ... 31.vii.1979, JSS50026 (ANSP); ♀, ... *Aronia* sp., 1.vi.1980, JSS50029 (ANSP); 2♀♀, ... *Sambucus* sp., 11.vii.1979, JSS50020; JSS50021 (ANSP); 2 ♂♂, ... *Rubus* sp., 12.vi.1980, JSS44133; JSS44134 (ANSP); ♂, ... *Viburnum dentatum*, 14.vi.1986, JSS50000 (ANSP); ♂, ... *Thalictrum*, 14.vii.1989, JSS50010 (ANSP); ♂, ... *Sambucus*, 15.vii.1979, JSS44129 (ANSP); ♂, ... *Daucus carota*, 15.viii.1982, JSS44144 (ANSP); ♂, ... *Viburnum cassinoides,* 18.vi.1984, JSS44152 (ANSP); ♂, ... *Rubus*, 18.vi.1984, JSS50006 (ANSP); ♂, ... *Viburnum cassinoides,* 18.vi.1989, JSS50007 (ANSP); ♂, ... *Viburnum cassinoides*, 19.vi.1988, JSS50004 (ANSP); ♂, ♀, ... *Clematis virginiana*, 2.viii.1982, JSS44143; JSS50032 (ANSP); ♂, ... *Thalictrum*, 20.vii.1985, JSS44157 (ANSP); ♂, ... 22.v.1977, JSS44107 (ANSP); ♀, ... *Thalictrum*, 23.vii.1989, JSS50045 (ANSP); ♀, ... *Crateagus*, 24.v.1985, JSS50039 (ANSP); ♂, ... *Viburnum dentatum*, 25.vi.1989, JSS50008 (ANSP); ♀, ... *Spiraea*, 25.vii.1986, JSS50041 (ANSP); ♂, ... *Sambucus*, 26.vi.1990, JSS50011 (ANSP); ♂, ... *Spiraea*, 26.vii.1982, JSS44142 (ANSP); ♂, ... 27.v.1985, JSS44156 (ANSP); ... ♂, ♀, *Sambucus*, JSS44128; JSS50023 (ANSP); ♀, ... *Spiraea*., 27.vii.1979, JSS50025 (ANSP); ♀, ... *Spiraea*, 27.vii.1985, JSS50037 (ANSP); ... ♀, *Crateagus*, 28.v.1980, JSS50027 (ANSP); ... ♂, *Crateagus*, 28.v.1986, JSS44159 (ANSP); 2♂♂, ... *Rubus* (red raspberry), 30.vi.1983, JSS44147; JSS44148 (ANSP); ♂, ... *Sambucus*, 30.vi.1985, JSS44158 (ANSP); ♂, ... *Thalictrum* sp., 30.vii.1983, JSS44149 (ANSP); ♂, ... *Sambucus*, 4.vii.1985, JSS44150 (ANSP); ♀, ... *Spiraea*, 4.vii.1985, JSS50038 (ANSP); ♂, ... 5.vii.1977, JSS44108 (ANSP); ♂, ... *Sambucus*, 5.vii.1988, JSS50005 (ANSP); ♂, ... *Viburnum cassinoides*, 6.vi.1985, JSS44155 (ANSP); ♀, ... *Chrysanthemum leucanthemum*, 6.vii.1982, JSS50031 (ANSP); 2 ♀♀, ... *Rubus* sp.; herbage, 7.vii.1979, JSS50019;JSS50018 (ANSP); ♂, ... *Spiraea*, 7.viii.1980, JSS44136 (ANSP); ♀, ... *Viburnum cassinoides*, 9.vi.1985, JSS50040 (ANSP); ♂, ... 9.vii.1977, JSS44109 (ANSP); ♀, ... *Sambucus*, 3.vii.1988, JSS50043 (ANSP); **Tennessee**: ♂, Great Smoky Mountains National Park, 35.562778, –83.498611, CNC1185368 (USNM); **Washington, D.C.**: ♂, Rock Creek Park, 38.949811, –77.045393, 4.vii.1917, W. S. FISHER, USNM_ENT248755 (USNM).

Description

Size: Body length: 9.7 to 13.7 mm; wing length: 7.3 to 8.7 mm.

MALE. Head: Black; face and frontal triangle densely silvery white pollinose; gena shiny and bare anteriorly, silvery white pollinose and white pilose posteriorly; frontal lunule orange; vertical triangle shiny, white pilose; occiput silvery white pollinose, white pilose; antenna black, black pilose; arista bare, black, elongate, ~2.7 times as long as postpedicel.

Thorax: Black; postpronotum shiny laterally, silvery white pollinose medially, white pilose; mesonotum shiny, except silvery white pollinose anterolaterally, short appressed yellow pilose except a few brown pili dorsad to wing; postalar callus white pilose, sometimes with 1–2 anterior short black pili; scutellum shiny, white pilose, with 3–4 longer marginal setae; subscutellar fringe long, white; pleuron shiny except thinly silvery white pollinose on posterior anepisternum and katepisternum, white pilose; without distinct anepisternal seta; metathoracic spiracular fringe brown. **Wing**: Hyaline, microtrichose except bare cell h, basal 2/3 cell c, basal 1/2 of cell br, basal 1/2 cell bm, anterobasal edge of cell cua, and narrowly anterior to

PA:CENTRE CO.Bear
Meadows Natl.Area
17 June-1987
FDFee Ex: mosses -
base of decid.tree

ex Frank D. Fee
Collection 2014.1

J.Skevington
Specimen #
50002

HOLOTYPE
Xylota
appalachia
Skevington, Young
& Thompson

Figs 10–12: *Xylota appalachia* **spec. nov.**, holotype male specimen JSS50002, scale bars = 2 mm. – **10**: Dorsal habitus; – **11**: Left lateral habitus; – **12**: Labels.

vein A_1; calypter white; halter orange. **Legs**: Coxae black, silvery white pollinose, white pilose; femora black except apices of pro and mesofemora narrowly yellow, white pilose except metafemur brown pilose on apical 1/2; metafemur with black short ventral setae on apical 2/3; metatrochanter with distinct tubercle; pro and mesotibiae yellow except dark on apical 1/2 but not apex, white pilose; meta tibia black except yellow on basal 1/3, white pilose, with very small apicoposterior spur; pro and mesotarsi yellow except black apical 2 tarsomeres, white pilose except black pilose on black apical tarsomeres; metatarsus black, white pilose on basal 2 tarsomeres, black pilose apically; probasitarsomere without apicolateral seta.

Abdomen: Generally black, white pilose; tergite 1 shiny; tergite 2 with large rectangular yellow macula occupying 1/2 length of tergite and beginning at basal 1/6, dull black pollinose except shiny on macula, middle 1/3 black pilose anteriorly, widening gradually to middle 2/3 black pilose posteriorly; tergite 3 comparable to tergite 2 except yellow macula smaller, slightly more triangular, with medial edge 1/2 as long as lateral edge; tergite 4 shiny except narrowly black pollinose basally, short black pilose except long white pilose basolaterally; sternite 1 black, shiny, long white pilose; sternite 2 yellow, shiny, short white pilose; sternite 3 black, shiny, short white pilose; sternite 4 black, dull black pollinose, long erect white pilose laterally, short appressed white pilose medially, with longer black pile on apical margin.

Genitalia: Black, shiny, yellow and black pilose; epandrium compact, about as long as wide; cercus subquadrate, with apex rounded and slightly narrower at base; medial lobe of surstylus narrow, elongate, curving downwards slightly past midpoint, tapering towards apex; lateral lobe of surstylus truncate, subrectangular, forward-facing, with a distinct lateral point near base; distiphallus rounded with edges curving inwards towards basiphallus in dorsal view, rounded at tip; gonostylus thin, flanged and pointed at tip, with an upwards facing spine on the dorsal surface near base.

FEMALE. Similar to male except for normal sexual dimorphism and: front shiny except pollinose on medial 1/3, white pilose; abdomen with very faint silvery pollinose maculae in place of yellow maculae, some specimens with faint orangish-brown maculae in centre of silvery pollinose maculae.

Etymology. The specific epithet, *appalachia*, is derived from the Appalachian Mountains, the region where this species is most common. The name is to be treated as a noun in apposition.

Distribution. Canada: Quebec, and U.S.A.: Connecticut, District of Columbia, Illinois, Maryland, Nebraska, New York, Pennsylvania, Tennessee.

Ecology. Adults are often found on moist soil in wet forests or around potential oviposition sites (such as excavated stumps, dry logs and fresh cut pine logs). Flowers visited include *Actaea* LINNAEUS, *Clematis* LINNAEUS, *Cornus* LINNAEUS, *Crataegus* TOURNEFORT ex. LINNAEUS, *Ilex* LINNAEUS, *Ranunculus* LINNAEUS, *Rhus* LINNAEUS, *Rosa* LINNAEUS, *Rubus* LINNAEUS, *Sambucus* LINNAEUS, *Spiraea* LINNAEUS, *Thalictrum* TOURNEFORT ex. LINNAEUS and *Viburnum* LINNAEUS. Flight times are primarily from late May to early August with one specimen collected in early May (JSS44153).

Genetics. *Xylota appalachia* **spec. nov**. is genetically closest to the Indian species *X. nursei* BRUNETTI, 1923 based on available COI data (1.0 to 3.5 percent different). Pairwise COI intraspecific variation within *X. appalachia* **spec. nov**. is 0.0 to 0.5 percent (n=3 specimens).

Common name. The common name given to the species by SKEVINGTON et al. (2019a) is Appalachian Leafwalker.

Xylota wellesleyana Skevington, Young & Thompson spec. nov.

(Figures 13–15, 39–47)

Xylota wellesleyana Thompson manuscript name of: Thompson (1991).
Xylota undescribed species 78-3 of: Skevington et al. (2019a: 192).

Diagnosis. Mesonotum with mostly short, depressed pile; frontal triangle entirely pollinose basolaterally; tergite 4 black pilose on medial two thirds. This species is most similar to *Xylota ejuncida* Say, 1824 which has the mesonotum with uniformly short erect pile; male frontal triangle extensively shiny; 4th tergite extensively golden pilose, with only a few black pili basomedially.

Material examined. Type material. *Holotype*, ♂, **U.S.A.**: **Pennsylvania**: Huntingdon County, Whipple Dam State Park, 40.693850, –77.857447, ex. *Ilex*, 4.vii.1988, F. D. Fee, ex Frank D. Fee Collection 2014.1, JSS44033, GB: MZ870602 (ANSP). *Paratypes,* **CANADA**: **Ontario**: ♂, Niagara Glen, 43.133333, –79.050000, 17.vii.1926, G. S. Walley, CNCD91687 (CNC); **Quebec**: ♀, Covey Hill, 45.019681, –73.745746, 28.vi.1923, C. H. Curran, CNCD91694 (CNC); **U.S.A.**: **Illinois**: ♀, Crete, 41.447086, –87.637377, 19.vi.1995, CNCD246497 (CNC); ♂, ... 8.vi.1995, CNCD246499 (CNC); **Maryland**: ♂, College Park, 38.99463, –76.932189, 25.v.1913, Fred K. Knab, USNM_ENT248767 (USNM); ♂, Allegany Co., Fifteen-Mile Creek, Green Ridge State Forest, 39.617000, –78.383000, *Rosa multiflora*, 11.vi.1980, F. D. Fee, ex. Frank D. Fee Collection 2014.1, JSS45122 (ANSP); ♂, ... *Rhus* sp., 27.vi.1979, JSS50086 (ANSP); **Massachusetts**: Wellesley, 42.304278, –71.285508, 8.vi.1963, Meissner, F. C. Thompson Collection 1974–75, USNM_ENT248761 (USNM); **Mississippi**: 7 ♂♂,4 ♀♀, Lafayette County, 34.4, –89.5, iv–v.1946, F. M. Hull, Frank M. Hull Collection C.N.C. 1973, CNCD91679–85; CNCD91688–91 (CNC); ♀, ... vii.1945, CNCD91692 (CNC); **New Hampshire**: 2 ♂♂, Strafford County, Spruce Hole, 3 miles South West of Durham, 43.126196, –70.967838, 12–26.v.1987, D. C. Chandler, Malaise trap, CNCD91696–97 (UNHC); ♀, Strafford County, Durham, 43.133974, –70.926448, 10.vi.1987, W. J. Morse, CNCD91695 (UNHC); ♀, Durham, 43.136477, –70.931215, 10.vi.1987, W. J. Morse, CNC1185365 (UNHC); **New York**: ♂, Hartsdale, 41.018986, –73.798188, 20.vi.1941, G. P. Engelhardt, on red oak, USNM_ENT248757 (USNM); **North Carolina**: ♀, Swain Co., Great Smoky Mountains National Park, Big Cove Road, Site#3, 35.512683, –83.298217, 28.iv–4.v.2001, B. Wiegmann, Wiegmann survey, site 3, CNC483919, GB: MZ870599 (CNC); ♂, Mortimer Rec. Area, 35.992423, –81.760607, 25.v.1999, F. C. Thompson, CNC1185366 (USNM); **Pennsylvania**: ♂, Huntingdon County, Whipple Dam State Park, 40.693850, –77.857447, *Ranunculus* sp., 27.v.1980, F. D. Fee, ex Frank D. Fee Collection 2014.1, JSS44013 (ANSP); ♂, ... *Ilex* sp., 1.vii.1989, JSS45121 (ANSP); ♂, ... 29.vi.1989, JSS44039 (ANSP); ♂, ... fern in forest swamp, 27.v.1980, JSS44014 (ANSP); ♀, ... aster, 28.ix.1990, JSS50085 (ANSP); ♂, ... 8.vi.1989, JSS44034 (ANSP); ♂, ... *Cornus racemosa*, JSS44038 (ANSP); ♂, … *Crataegus* sp., 22.vi.1989, JSS44036 (ANSP); ♂, … 19.vii.1979, JSS43986 (ANSP); ♂,2 ♀♀, … *Ilex* sp., 1.vii.1989, JSS44037; JSS50071; JSS50083 (ANSP); ♂, … veg., swamp forest, 12.vi.1988, JSS44031 (ANSP); ♂, … 19.vi.1989, JSS44035 (ANSP); ♀, … *Ilex*, 28.vi.1988, JSS50075 (ANSP); ♂, ♀, … 29.vi.1989, JSS50077; JSS50054 (ANSP); 2♀♀, … *Ilex*, 3.vii.1990, JSS50080; JSS50082 (ANSP); ♂, ♀, … *Ilex*, 4.vii.1988, JSS50076; ♀, … *Ilex*, 9.vii.1989, JSS50084 (ANSP); 2♂♂, … 1.vii.1989, JSS50056–57 (ANSP); ♂, … *Cimifuga*, 6.vii.1989, JSS50058 (ANSP); ♂, Centre County, Bear Meadows National Area, 40.731100, –77.763700, base dead hemlock, 16.vi.1988, F. D. Fee, ex Frank D. Fee Collection 2014.1, JSS50081, GB: MZ870603 (ANSP); ♂, … base of dead hemlock, 16.vi.1988, JSS44032 (ANSP); ♂, Centre County, Colyer Lake, Potter Tp., 40.774800, –77.682900, *Rosa multiflora*, 22.vi.1979, F. D. Fee, Frank D. Fee Collection 2014.1, JSS43985 (ANSP); … ♂, *Rubus* sp., 9.vi.1979, JSS43984 (ANSP); ♂, ♀, … *Rubus*, 26.v.1985, JSS50078; JSS44022 (ANSP); ♂, Centre County, Scotia Barrens, Patton Tp., 40.783331, –77.955531, at base of stump, 22.v.1980, F. D. Fee, ex Frank D. Fee Collection 2014.1, JSS44010 (ANSP); ♂, … 23.vii.1979, F. D. Fee, ex Frank D. Fee Collection 2014.1, JSS43990 (ANSP); 7 ♂♂, … 25.vii.1979, F. D. Fee, JSS43991; JSS43992–97 (ANSP); ♂, … base of rotting stump- power line, 26.v.1980, JSS44011 (ANSP); ♂, … moist sandy soil-forest trail, JSS44012 (ANSP); 12 ♂♂, … dry log in power line, 30.vii.1979, F. D. Fee, JSS43998–44009 (ANSP); 3 ♂♂, … 5.vi.1979, JSS43981–83 (ANSP); ♀, moist soil, 27.v.1983, JSS50072 (ANSP); ♂, … *Cornus paniculata*, 10.vi.1986, JSS44027 (ANSP); 2♀♀, … dry log in powerline, 30.vii.1979, JSS50066;

JSS50068 (ANSP); ♀, … *Sambucus*, 8.vii.1978, JSS50062 (ANSP); ♂, Centre County, Spring Cr., 4.1 km NNE Houserville, 40.860668, –77.809492, mud, spring seepage, 15.v.1982, F. D. Fee, ex Frank D. Fee Collection 2014.1, JSS44016 (ANSP); 2 ♂♂, … 16.v.1982, JSS44018–19 (ANSP); ♂, … fresh cut pine log, 18.v.1979, JSS43980 (ANSP); 3 ♂♂, … remains excavated stump, 22.vii.1979, JSS43987–89 (ANSP); ♂, … moist soil, 17.vii.1985, JSS44024 (ANSP); ♂, … 26.v.1983, JSS44021 (ANSP); ♀, … 11.v.1979, JSS50059 (ANSP); ♀, … *Rosa multiflora*, 12.vi.1979, JSS50061 (ANSP); ♀, … moist woods, 4.vi.1979, JSS50060 (ANSP); ♀, … moist soil, 7.v.1985, JSS50073 (ANSP); ♂, Centre County, 2km SW Fisher'an's Paradise, 40.890400, –77.804000, *Clematis*, 13.viii.1986, F. D. Fee, ex. Frank D. Fee Collection 2014.1, JSS44029 (ANSP); ♀, Centre County, Black Moshannon State Park, 40.915503, –78.059340, *Sambucus* sp., 11.vii.1979, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50064 (ANSP); ♀, … *Ilex verticulata*, 13.vii.1982, JSS50069 (ANSP); 2 ♂♂, … *Thalictrum*, 17.vii.1987, JSS44030; JSS44023 (ANSP); ♂, … 19.vii.1985, JSS44025 (ANSP); ♀, … *Spiraea*, 2.viii.1990, JSS50087 (ANSP); ♀, … *Thalictrum*, 20.vii.1985, JSS50079 (ANSP); ♀, … *Thalictrum* sp., 21.vii.1982, JSS50070 (ANSP); ♂, ♀, … *Spiraea*, 25.vii.1986, JSS44028; JSS50074 (ANSP); 2 ♀♀, … *Spiraea*, ~27.vii.1979, JSS50063; JSS50067 (ANSP); ♂, … *Thalictrum*, 27.vii.1985, JSS44026 (ANSP); ♂, ♀, … *Spiraea*, 6.viii.1982, JSS50065; JSS44020 (ANSP); ♂, … *Crateagus*, 13.v.1985, JSS44017 (ANSP); ♂, … coll. at mud, 1.vi.1980, JSS44015 (ANSP); ♂, Tioga County, 3.7 miles northwest of Morris, State Game Lands #268, 41.630551, –77.341657, 579m, *Viburnum cassinoides*., 20.vi.1979, F. D. Fee, Frank D. Fee Collection 2014.1, JSS50055 (ANSP); **Tennessee**: ♂, Great Smoky Mountains National Park, Por'er's Creek, 35.682296, –83.395941, F. C. Thompson, USNM_ENT28867 (USNM); ♀, Great Smoky Mts Nat Park, Husky Gap Trail, 35.666667, –83.533333, 30.v–4.vi.2001, J. Skevington & J. M. Cumming, Malaise trap, CNC484467, GB: MZ870598 (CNC); ♀, U.T. Farm, Knox County, 35.949663, –83.92944, 12.v.1951, A.C. Cole, CNCD91693 (UTCI); ♂, … 9.v.1951, W. Cloyd, CNCD91686 (UTCI); **Virginia**: ♀, Bull Run Regional Park, 38.768058, –77.411111, 5.iv–25.vi.2015, K. Moran, Malaise trap, JSM7131, CNC469482, GB: MZ870601 (CNC); ♂, Falls Church, 38.883333, –77.166667, 2.v.1915, USNM_ENT248763 (USNM); 2♂♂, … 5.vi.1916, C.T. Greene, USNM_ENT248758–59 (USNM); ♂, Dead Run, Fairfax County, 38.9, –77.45, 23.v.1919, R. C. Shannon, USNM_ENT248766 (USNM); 2♂♂, … 23.v.1939, USNM_ENT248756; USNM_ENT248762 (USNM); 2 ♂♂, … 5.vi.1939, USNM_ENT248760; USNM_ENT248765 (USNM); ♂, … 9.vi.1915, USNM_ENT248764 (USNM); **Locality unknown:** ♀, 20.vi.1996, Bellam, CNCD246500 (CNC); ♀, 8.vi.1995, CNCD246498 (CNC).

Description

Size: Body length: 8.1 to 11.2 mm; wing length: 6.1 to 7.5 mm.

MALE. **Head**: Black; face and frontal triangle densely silvery white pollinose; gena shiny and bare anteriorly, silvery white pollinose and white pilose posteriorly; frontal lunule orange; vertical triangle shiny, yellowish white pilose; occiput silvery white pollinose, white pilose; scape and pedicel brown, black pilose; postpedicel orangish brown; arista bare, brown, elongate, ~2.8 times as long as postpedicel; eye bare.

Thorax: Black; postpronotum shiny laterally, silvery white pollinose medially, white pilose; scutum shiny, except silvery white pollinose anterolaterally, short subappressed yellow pilose, a few brown pili dorsal to wing; postalar callus white pilose, with 1–2 anterior short black setae; scutellum shiny, white pilose, with 3–4 longer marginal setae; subscutellar fringe long, white; pleuron shiny except silvery white pollinose posterior anepisternum and katepisternum, white pilose; metathoracic spiracular fringe brown. **Wing**: hyaline, microtrichose except bare as follows: cell h, basal 1/4 cell c, basal half of cell br, basal 1/4 cell r_1, basal 2/3 cell bm, anterobasal edge of cell cua, and narrowly anterior to vein A; calypter white; halter orange; alula microtrichose. **Legs**: coxae black, silvery white pollinose, white pilose; femora black except apices of pro and mesofemora narrowly yellow, white pilose except metafemur black pilose on apical 1/4; metafemur with black ventral short setae on apical 3/4; metatrochanter with distinct calcar; pro and mesotibiae yellow except slightly darker on apical 1/2 except apex, white pilose; metatibia black except yellow on basal 1/3, white pilose, with very

PA:HUNTINGDON CO.
Whipple Dam St.Pk.
4 July -1988
FDFee
ex: Ilex

ex Frank D. Fee
Collection 2014.1

J.Skevington
Specimen #
44033

Legs removed
for DNA
analysis

HOLOTYPE
Xylota
wellesleyana
Skevington, Young
and Thompson

Figs 13–15: *Xylota wellesleyana* **spec. nov.**, holotype male specimen JSS44033, scale bars = 2 mm. – **13**: Dorsal habitus; – **14**: Left lateral habitus; – **15**: Labels.

small apicoposterior spur; pro and mesotarsi yellow except black apical 2 tarsomeres, white pilose except black pilose on black apical tarsomeres; metatarsus black, white pilose on basal 2 tarsomeres, black pilose apically; probasitarsomere with long apicolateral seta.

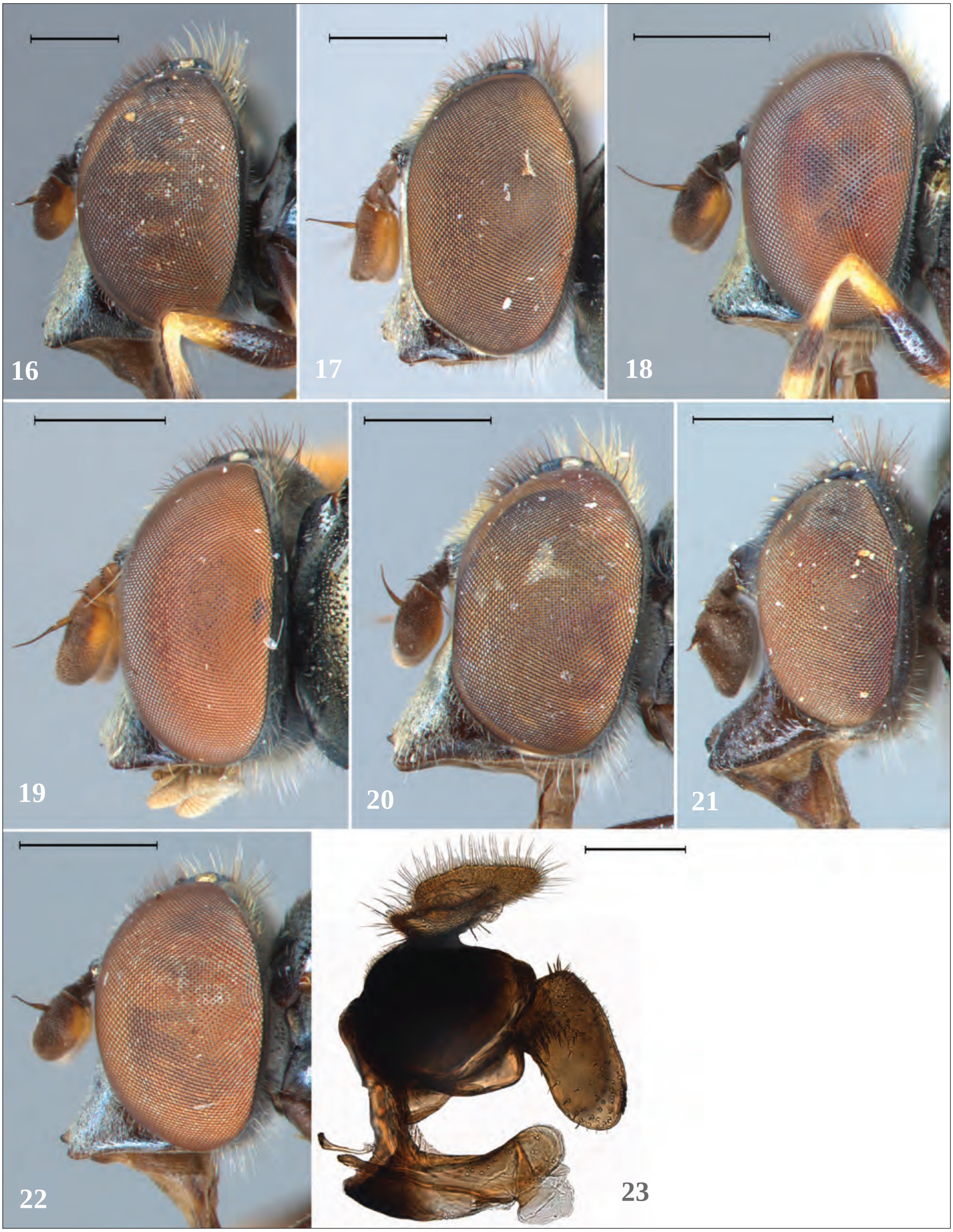
Abdomen: Generally black, white pilose; tergite 1 shiny; tergite 2 with triangular yellow macula occupying 1/2 length of tergite and beginning at basal 1/6, dull black pollinose except shiny on macula, middle 1/3 black pilose anteriorly, widening gradually to middle 2/3 black pilose posteriorly; tergite 3 similar to 2 except yellow macula smaller, slightly more triangular, with medial edge 1/2 as long as lateral edge; tergite 4 shiny except narrowly black pollinose basally, white pilose laterally, with long pile basolaterally and short pile elsewhere, short black pilose on middle 2/3; sternite 1 black, shiny, long white pilose; sternite 2 yellow, shiny, short white pilose; sternite 3 black, shiny, short white pilose; sternite 4 black, dull black pollinose, long erect white pilose laterally, short appressed white pilose medially. **Genitalia**: Abdominal segment 8 black, shiny, white pilose; epandrium compact, about as long as broad; cercus subquadrate, with apex rounded and slightly narrower at base; medial lobe of surstylus narrow, elongate, curving downwards slightly past midpoint, tapering towards apex then slightly swollen at apex; lateral lobe of surstylus truncate, subrectangular, forward facing; distiphallus parallel-sided in dorsal view, excavated at tip; gonostylus robust, hooked downwards, left gonostyle with one forward facing spine on dorsal surface, right gonostyle with two upwards facing spines on dorsal surface.

FEMALE. Similar to male except for normal sexual dimorphism and: front shiny except pollinose on medial 1/3, white pilose; probasitarsomere without long apicolateral seta; abdomen with silvery pollinose maculae in place of yellow maculae, some specimens with faint orangish brown macula in center of silvery pollinose maculae, tergite 4 with anterior 1/2 silvery pollinose.

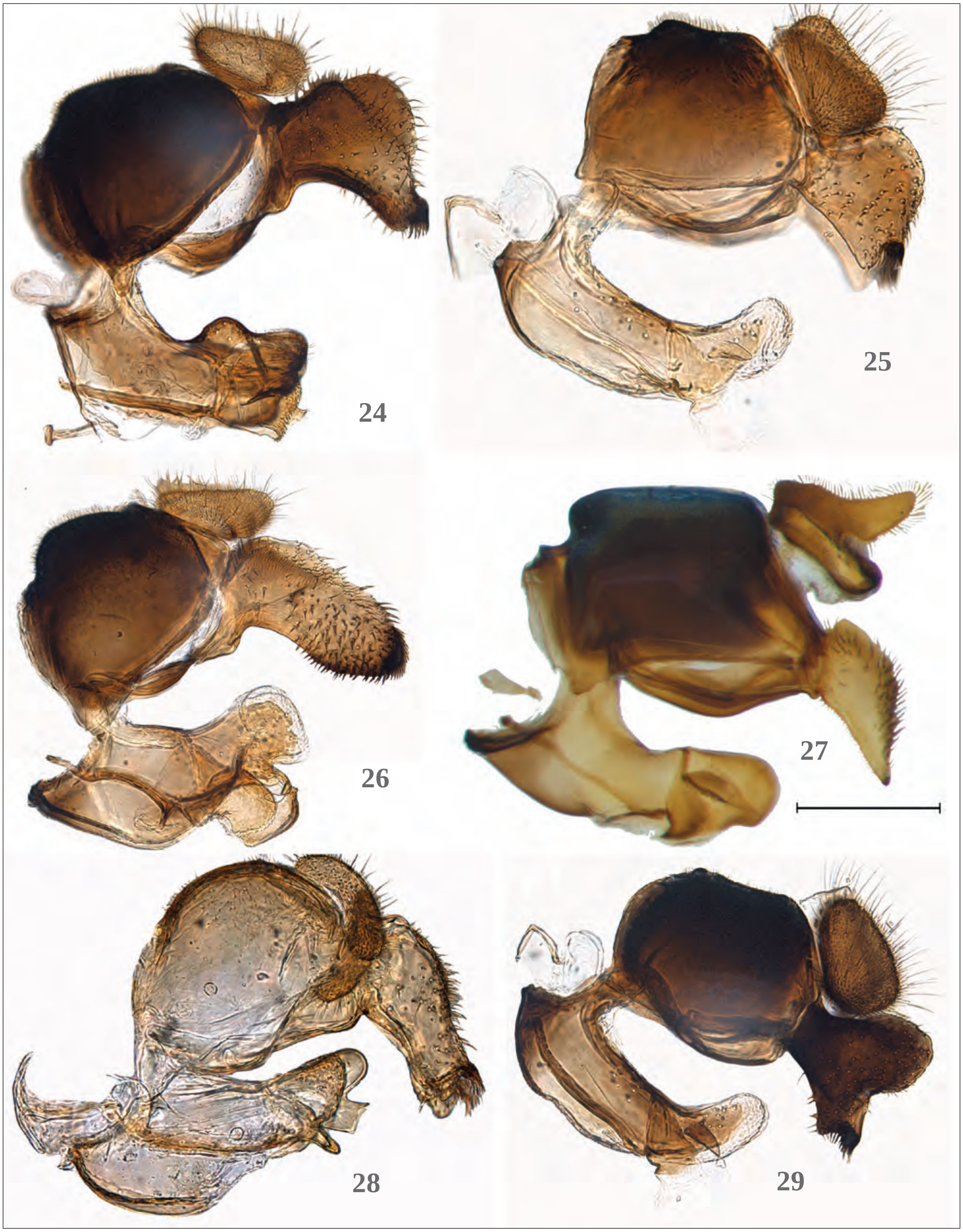
Etymology. The specific epithet, *wellesleyana*, is derived from the name of the town of Wellesley, THOMPSON's birth town, and one of the paratype locations. It is to be treated as a noun in apposition.

Distribution. Canada: Ontario, Quebec. U.S.A.: Illinois, Maryland, Massachusetts, Mississippi, New Hampshire, New York, North Carolina, Pennsylvania, Tennessee, Virginia.

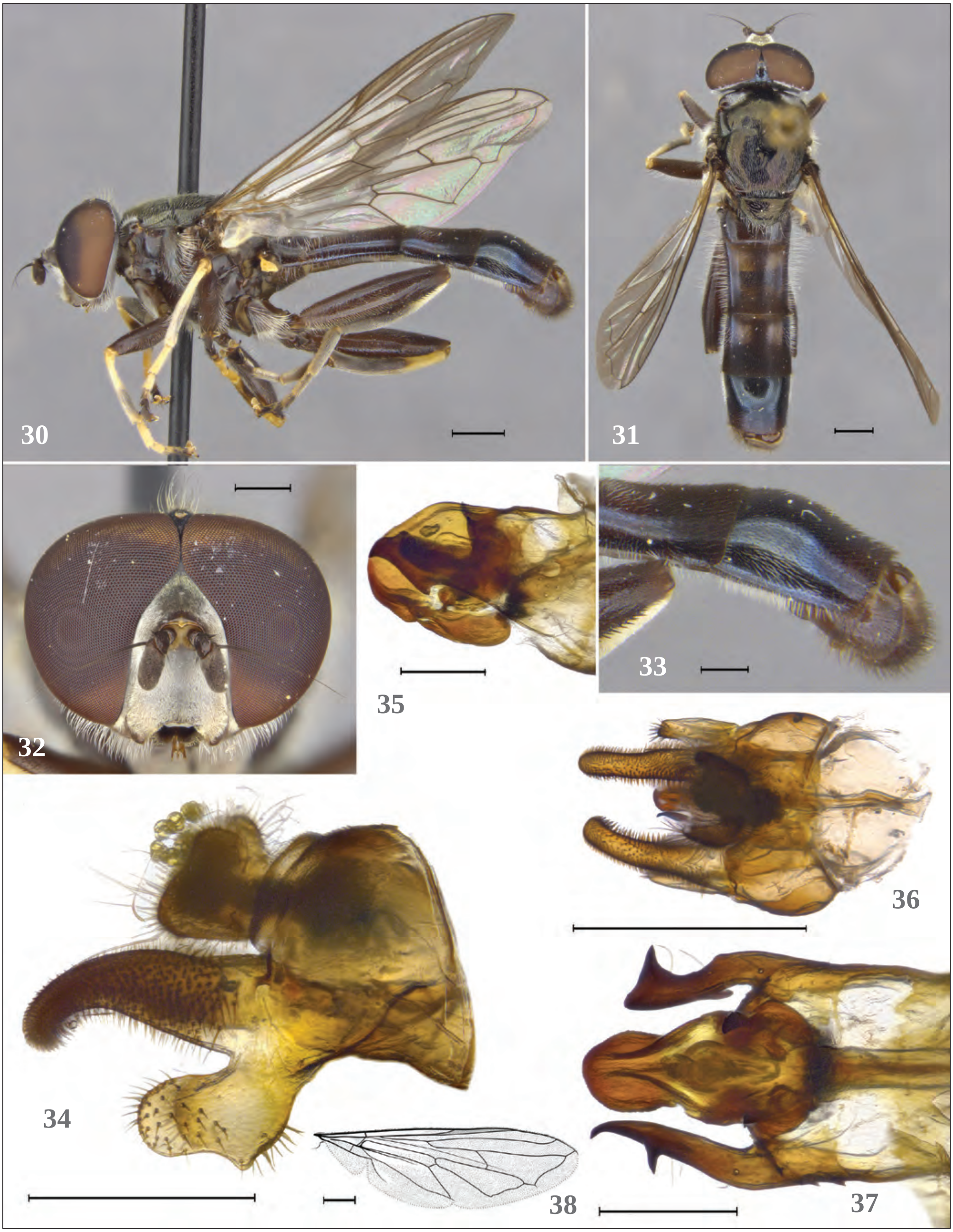
Ecology. They are often found around moist soil or rotting logs. Flowers visited include *Aronia* MEDIKUS, *Chrysanthemum* LINNAEUS, *Clematis, Cornus, Crataegus, Daucus* LINNAEUS, *Hydrangea* GRONOVIUS ex. LINNAEUS, *Kalmia* LINNAEUS, *Physocarpus* (CAMBESS.) RAFINESQUE,



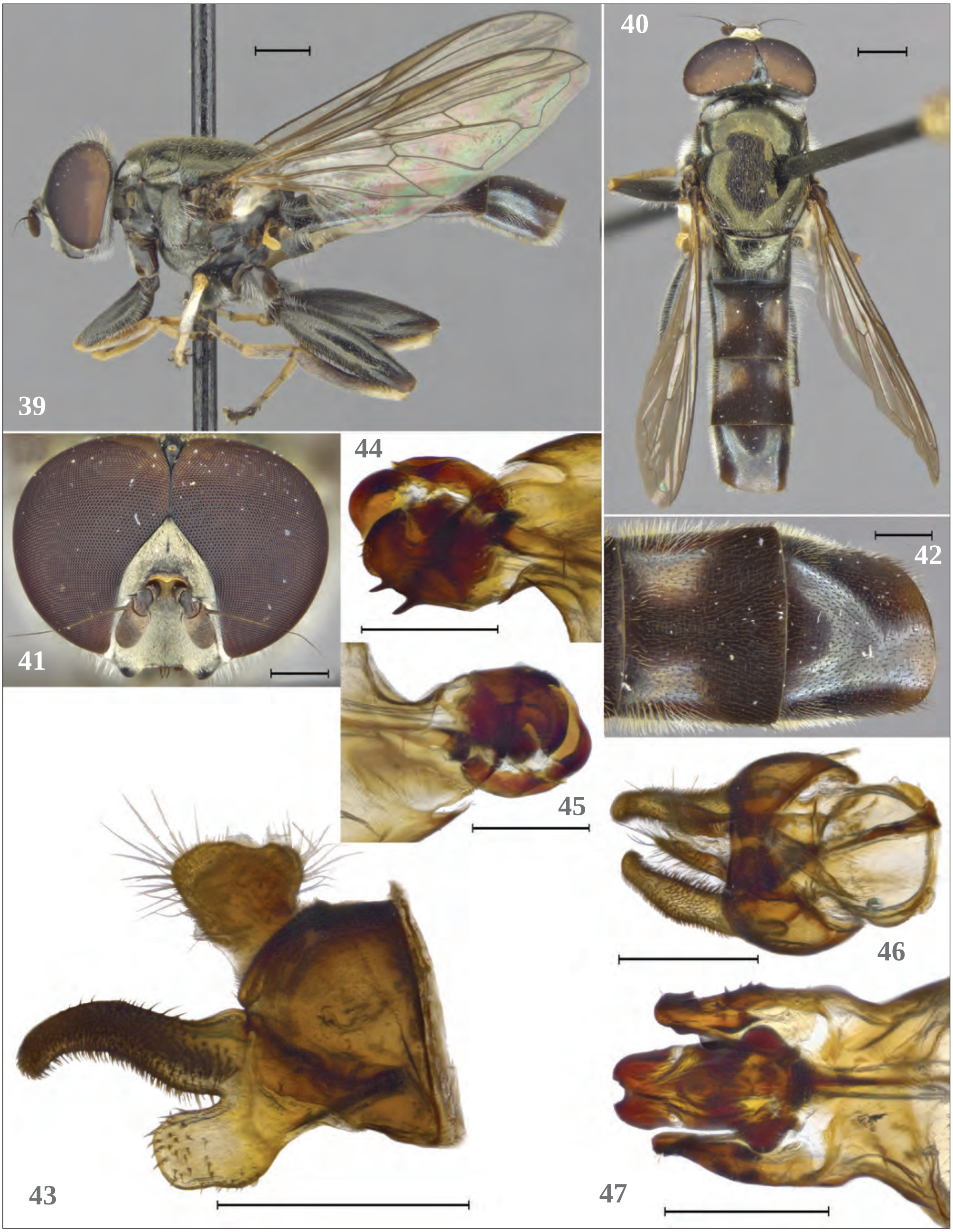
Figs 16–22: *Neoascia* heads, left lateral, scale bar = 0.5 mm. – **16**: *N. geniculata* (MEIGEN), CNCD170032; – **17**: *N. globosa* (WALKER), CNCD169677; – **18**: *N. metallica* WILLISTON, CNCD57468; – **19**: *N. sandsi* **spec. nov.**, CNCD207702; – **20**: *N. sphaerophoria* CURRAN, CNCD43939; – **21**: *N. subchalybea* CURRAN, CNCD47405; – **22**: *N. tenur* HARRIS, CNCD169983; **Fig. 23**: *N. geniculata* (MEIGEN) male terminalia, left lateral, scale bar = 0.25 mm, CNCD170046.



Figs 24–29: *Neoascia* male terminalia, left lateral, scale bar = 0.25 mm. – **24**: *N. globosa* (Walker), CNCD52716; – **25**: *N. metallica* Williston, CNCD96852; – **26**: *N. sandsi* **spec. nov.**, CNCD207697 (duplicated from Fig. 6 for comparative purposes); – **27**: *N. sphaerophoria* Curran, BIOUG71205-G01; – **28**: *N. subchalybea* Curran, holotype, CNCD47418; – **29**: *N. tenur* Harris, CNCD136110.



Figs 30–38: *Xylota appalachia* **spec. nov.** – **30**: Left lateral habitus of male, scale bar = 1 mm, JSS44108; – **31**: Dorsal habitus of male, scale bar = 1 mm, JSS44108; – **32**: Frontal of male head, scale bar = 0.5 mm, JSS44108; – **33**: Left lateral of tip of abdomen to show pile, scale bar = 0.5 mm, JSS44108; – **34**: Right lateral of male terminalia, scale bar = 0.5 mm, JSS44109; – **35**: Right lateral of male distiphallus, scale bar = 0.25 mm, JSS44109; – **36**: Dorsal of male genitalia, scale bar = 1 mm, JSS44109; – **37**: Dorsal of hypandrium and distiphallus, scale bar = 0.25 mm, JSS44109; – **38**: Wing of male to show vestiture, scale bar = 1 mm, JSS44109.



Figs 39–47: *Xylota wellesleyana* **spec. nov.**, specimen JSS43992. – **39**: Left lateral habitus of male, scale bar = 1 mm; – **40**: Dorsal habitus of male, scale bar = 1 mm; – **41**: Frontal of male head, scale bar = 0.5 mm; – **42**: Dorsal of distal abdomen to show pile, scale bar = 0.5 mm; – **43**: Right lateral of male terminalia, scale bar = 0.5 mm; – **44**: Right dorsolateral of male distiphallus, scale bar = 0.25 mm; – **45**: Left lateral of male distiphallus, scale bar = 0.25 mm; – **46**: Dorsal of male genitalia, scale bar = 0.5 mm; – **47**: Dorsal of male hypandrium and distiphallus, scale bar = 0.25 mm.

Rosa, Rubus, Sambucus, Spiraea, Thalictrum and *Viburnum*. Flight times are typically from early May to mid-August with one outlier collected at the end of September (JSS50085).

Genetics. *Xylota wellesleyana* **spec. nov**. is genetically closest to *X. quadrimaculata* LOEW, 1866 (3.2 to 7.2 percent different) and *X. tuberculata* (CURRAN, 1941) (3.3 to 4.8 percent different) based on available COI data. Pairwise COI intraspecific variation within *X. wellesleyana* **spec. nov**. is 0 to 1.1 percent (n=5 specimens). No sequence data for the morphologically similar *X. ejuncida* are available.

Common name. The common name given to the species by SKEVINGTON et al. (2019a) is Black-backed Leafwalker.

Key to the Nearctic species of *Xylota*, adapted from THOMPSON (1991)

* Illustrations of most species are available in SKEVINGTON et al. (2019a: 184–201)

1 Arista pubescent, with fine distinct pile, about 1/2 to 1/3 as long as basal width of arista .... ***subfasciata* LOEW, 1866**

Distribution: Alaska to Newfoundland, south to Arizona and Virginia

– Arista bare, without any pile **2**

2 Tergites 2 and 3 black; if with red to yellow lateral maculae, then maculae broadly separated by continuous black median vitta **7**

– Tergites 2 and 3 largely or entirely red to orange, with black median vitta either broken or absent **3**

3 Alula microtrichose; metatibia yellow on basal 1/3; male metatrochanter with a ventral spine **5**

– Alula bare; metatibia entirely black; male metatrochanter without a spine, with at most a small tubercle **4**

4 Arista black; legs black, except mesobasitarsomere yellowish brown; scutal pile short, depressed; scutum with yellow pile dorsad to wing base .... ***azurea* (FLUKE, 1953)**

Distribution: New Mexico south to Jalisco, Mexico

– Arista yellow; legs more extensively pale, pro- and mesotibiae yellow on basal 1/2; probasitarsomere yellow, mesotarsus with basal 2 tarsomeres yellow; scutal pile long, erect; scutum with black spinose pile dorsad to wing .... ***bicolor* LOEW, 1864**

Distribution: Nebraska to Quebec, south to Mississippi and Florida

5 Cell bm bare on basal 2/3; anal lobe bare anterior to vein A_1; metatarsus with basal 3 tarsomeres pale; male metatrochanter with short spur, with spur about twice as long as basal width.. ***flavitibia* BIGOT, 1884**

Distribution: Alaska to Nova Scotia south to California, New Mexico and Maine

– Cell bm almost entirely microtrichose, bare on extreme base only; anal lobe microtrichose; metatarsus entirely dark; male metatrochanter with long, slender spur, with spur about 6 times as long as basal width.. 6

6 Protarsus with basal 3 tarsomeres pale, yellow; cell c with a small bare area basally; metafemur with anteroventral spines long, widely separated, 7 to 8 in number .... ***segnis* (LINNAEUS, 1758)**

Distribution: Ontario to Newfoundland, south to Virginia; Europe and Russia; presumably introduced in North America

– Protarsus entirely dark, brownish black; cell c entirely microtrichose; metafemur with anteroventral spines short and densely clustered (western Nearctic).. ***argoi* (SHANNON, 1926)**

Distribution: British Columbia to Alberta south to New Mexico

7 Face entirely black in ground color **10**
– Face yellow, at least on ventral 1/3 or more........ **8**
8 Tergite 3 entirely dark; tergite 4 with long dense, opaque golden tomentose pile, obscuring ground color........ ***nebulosa*** **JOHNSON, 1921**
Distribution: South Dakota, New Mexico, Texas

– Tergite 3 with large yellow macula; tergite 4 without golden tomentose pile **9**
9 Arista orange, thick, short, only about as long as facial width; male metatrochanter with a distinct spur; epandrium black pilose; male frontal triangle with small shiny area dorsad to lunule .... ***analis*** **WILLISTON, 1887**
Distribution: British Columbia, south to Durango, Mexico

– Arista black, thin, long, much longer than facial width; male metatrochanter with small indistinct tubercle; epandrium pale pilose; male frontal triangle entirely pollinose .... ***lovetti*** **CURRAN, 1925**
Distribution: British Columbia to Idaho and California

10 Scutellum without subscutellar pile fringe; tergite 2 with rectangular spots resting on anterior margin of tergite in their entire width; tarsi all black; wing almost completely microtrichose, only bare narrowly in bases of cells bm and cua; alula microtrichose .... ***flukei*** **(CURRAN, 1941)**
Distribution: Wisconsin to Newfoundland south to New Hampshire

– Scutellum with ventral pile fringe; tergite 2 either entirely dark or with pale spots separated from anterior margin of tergite by a lateral expansion of median black vitta for most of their width; other characters variable........ **11**
11 Eyes widely separated (dichoptic, females)........ **27**
– Eyes contiguous (holoptic, males) **12**
12 Anepisternum entirely pale pilose **14**
– Anepisternum with at least a few black pili on upper posterior margin **13**
13 Metatrochanter with a very short spine, scarcely discernible, shorter than its basal width; abdomen dark .... ***tuberculata*** **(CURRAN, 1941)**
Distribution: Alberta to Quebec, south to Utah to Pennsylvania

– Metatrochanter with a distinct spine, at least as long as its basal width; abdomen with dull yellow spots .... ***naknek*** **SHANNON, 1926**
Distribution: Alaska to Nova Scotia, south to northern California, Colorado and Maine

14 Abdomen with pale spots, yellow to brownish orange, at least on tergite 2 .... **17**
– Abdomen all dark, black to blue black **15**
15 Postalar callus black pilose; scutellum with long black marginal pile; tergite 4 extensively black pilose; metatrochanter with very small tubercle .... ***ouelleti*** **(CURRAN, 1941)**
Distribution: Saskatchewan to Nova Scotia south to the District of Columbia

– Postalar callus pale (yellow to white) pilose, at most with a few anterior black pili; scutellum with pale (yellow to white) marginal pile; tergite 4extensively yellow pilose **16**
16 Frontal triangle with small anterior shiny area; posterior spiracle separated from metacoxa by a distance greater than its height; cell c completely microtrichose; metatrochanter with a distinct spine .... ***flavifrons*** **WALKER, 1849**
Distribution: Alaska to Newfoundland south to California, Colorado and Pennsylvania
– Frontal triangle entirely pollinose; posterior spiracle close to metacoxa, separated by little less than height of spiracle; cell c with a small but distinct bare area on base; metatrochanter with a small tubercle .... ***barbata*** **LOEW, 1864**
Distribution: southern Alaska to Manitoba, south to California and Colorado

17 Alula bare medially; tergite 3 usually entirely black, rarely with very small indistinct yellow spots, much smaller than those of tergite 2; tarsi with middle tarsomere bright yellow .... ***angustiventris* Loew, 1866**

Distribution: Minnesota to Nova Scotia, south to Kansas, Mississippi and Georgia

– Alula completely microtrichose; tergite 3 with pale markings at least as distinct as those on tergite 2 .... **18**

18 Wing with cell c completely microtrichose **22**

– Wing with cell c bare on base **19**

19 Pro- and mesotibiae pale, reddish orange to yellow; male genitalia pale pilose, golden to white pilose; probasitarsomere with long fine curved pale pile, subequal to length of 2nd tarsomere, on apicolateral corner **21**

– Pro- and mesotibiae black on apical 1/2 or more; male genitalia extensively black pilose; probasitarsomere variable **20**

20 Cell c bare on basal 1/3 or less; arista short, shorter than facial width; frontal triangle extensively shiny; probasitarsomere with a long apicolateral pile, as long as 2nd tarsomere .... ***confusa* Shannon, 1926**

Distribution: British Columbia to Nova Scotia, south to Wisconsin and Delaware

– Cell c bare on basal 2/3 or more; arista long, much longer than facial width; frontal triangle entirely pollinose; probasitarsomere without long pile .... ***appalachia* spec. nov.**

Distribution: Illinois to Quebec, south to Tennessee

21 Mesonotum with uniformly short erect pile; male frontal triangle extensively shiny; tergite 4 extensively golden pilose, with only a few black pili basomedially .... ***ejuncida* Say, 1824**

Distribution: Minnesota to Maine, south to Mississippi and Florida

– Mesonotum with mostly short, depressed pile, with some pile much longer and erect; male frontal triangle entirely pollinose basolaterally; tergite 4 yellow pilose on anterior 2/3, black pilose on disal 1/3 .... ***wellesleyana* spec. nov.**

Distribution: Illinois to Quebec south to Mississippi and North Carolina

22 Wing microtrichose in front of A_1; frontal triangle with small shiny area above antenna. **26**

– Wing with an extensive bare area in front of A_1, with narrow bare area anterior to spurious vein on basal 1/2 of cell br; frontal triangle usually completely pollinose **23**

23 Katepisternum shiny on ventral 2/3, pollinose on dorsal 1/3; fore and mid tibiae yellow, at most slightly darkened on apical 1/2 .... ***quadrimaculata* Loew, 1866**

Distribution: British Columbia to Newfoundland, south to Colorado, Mississippi and Florida

– Katepisternum entirely pollinose; pro- and mesotibiae black on apical 1/2 .... **24**

24 Tarsi with apical 3 tarsomeres black; arista long, much longer than face; male frontal triangle entirely pollinose; metatrochanter with long spine, longer than its base .... ***annulifera* Bigot, 1884**

Distribution: Alaska to Nova Scotia, south to Oregon, Tennessee and New Jersey

– Tarsi with apical 2 tarsomeres black; frontal triangle and metatrochanter variable...... **25**

25 Arista very finely pubescent, long much longer than facial width; frontal triangle entirely pollinose; male terminalia yellow pilose; metatrochanter with a long ventral spine .... ***subfasciata* Loew, 1866**

Distribution: Alaska to Newfoundland, south to Arizona and Virginia

– Arista bare, short, only about as long as facial width; frontal triangle extensively shiny; male terminalia black pilose; metatrochanter with small ventral tubercle .... ***confusa* SHANNON, 1926**
Distribution: British Columbia to Nova Scotia, south to Wisconsin and Delaware

26 Posterior callus yellow pilose, with at most only a very few black pili at anterior end; frontal triangle shiny on anterior 2/3; cell bm bare on anterobasal 1/2 .... ***confusa* SHANNON, 1926**
Distribution: British Columbia to Nova Scotia, south to Wisconsin and Delaware

– Posterior callus yellow pilose with numerous black bristle-like pile intermixed on anterior 2/3 or more; frontal triangle shiny only on anterior 1/3; cell bm bare on anterobasal 1/3 or less .... ***hinei* (CURRAN, 1941)**
Distribution: British Columbia to Nova Scotia, south to Oregon and North Carolina

27 Alula extensively bare medially; wing extensively bare, cells bm and cua almost completely bare, cells c and br bare on basal 1/2 or more; abdomen usually without markings; tarsi with medial tarsomeres bright yellow .... ***angustiventris* LOEW, 1866**
Distribution: Minnesota to Nova Scotia, south to Kansas, Mississippi and Georgia

– Alula completely microtrichose; other characters variable... **28**
28 Postalar callus with black bristle-like pilenumerous on anterior 1/2 or more **33**
– Postalar callus with at most a few (not more than 3) black pili on anterior edge........... **29**
29 Terga 2 and 3 entirely dark **32**
– Terga 2 and 3 with at least faint yellow spots... **30**
30 Katepisternum shiny on ventral 2/3, strongly contrasting with dorsal pollinose 1/3 .... ***quadrimaculata* LOEW, 1866**
Distribution: British Columbia to Newfoundland, south to Colorado, Mississippi and Florida

– Katepisternum pollinose, ventral 2/3 not strongly contrasting with dorsal 1/3 .... **31**
31 Wing with anal lobe completely microtrichose; pro- and mesotibiae yellow; metafemur with apicoventral spinose setae regularly spaced and of uniform length .... ***ejuncida* SAY, 1824**
Distribution: Minnesota to Maine, south to Mississippi and Florida

– Wing with a broad bare vitta in front of A_1; pro- and mesotibiae dark on apical 1/2; metafemur with apicoventral spinose setae closely and irregularly spaced, decreasing in length towards base .... ***annulifera* BIGOT, 1884**
Distribution: Alaska to Nova Scotia, south to Oregon, Tennessee and New Jersey

32 Frons extensively pollinose, with only a small triangular shiny area above antenna .... ***flavifrons* WALKER, 1849**
Distribution: Alaska to Newfoundland south to California, Colorado and Pennsylvania

– Frons with a large rectangular shiny area above antenna .... ***confusa* SHANNON, 1926**
Distribution: British Columbia to Nova Scotia, south to Wisconsin and Delaware

33 Terga with at most weak reddish markings; metafemur with ventral surface between anteroventral and posteroventral spinose setae with at most weak black setulae; scutellum with 4 pairs of marginal setae .... ***naknek* SHANNON, 1926**
Distribution: Alaska to Nova Scotia, south to northern California, Colorado and Maine

– Terga with distinct yellow spots; metafemur with ventral surface between anteroventral and posteroventral spinose setae with weak black setae; notopleuron without black bristle-like pile; scutellum with 2 pairs of marginal setae .... ***hinei* (CURRAN, 1941)**
Distribution: British Columbia to Nova Scotia, south to Oregon and North Carolina

48

49

Figs 48–49: Chris THOMPSON in his element. – **48**: Chris in the middle of the back row at the K.W. Neatby building in Ottawa, home of the Canadian National Collection. Chris dropped everything and came to Ottawa twice to teach a course on Syrphidology with JHS (fourth from left in back row) and ADY (right). About 18–20 students were registered in each course. They were taught for a week about syrphid identification and ecology and for another week about bees by a different team. This course was funded by the Canpolin network grant of which JHS was a part and resulted in a lot of syrphid datasets and publications that would have never happened otherwise. Other syrphidologists in the photo that readers may recognize include Gil MIRANDA (second from right), Scott KELSO (two to the right of FCT), Michelle LOCKE (left and in front of FCT) and John KLYMKO (front row, fourth from the right); – **49**: From left, JHS, ADY, FCT and Kevin MORAN at Chris and Betty's house in Florida. We visited on multiple occasions during preparation of the syrphid field guide (SKEVINGTON et al. 2019a) to run ideas past Chris and ask him a myriad of questions. Betty and Chris were always patient and fabulous hosts.

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The flower flies (Diptera: Syrphidae) of Nebraska (U.S.A.)

[Die Schwebfliegen (Diptera: Syrphidae) von Nebraska
(Vereinigte Staaten von Amerika)]

Wouter van Steenis

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Abstract

For the first time since 1924 an overview of the flower flies of Nebraska is compiled. The collection of the University of Nebraska State Museum, records from literature and other collections and specimens from fieldwork by the author are summarized. A total of 5,061 specimens are databased. Altogether 160 species are recorded from Nebraska, increasing the number of state records by 49. One new synonym is proposed: *Chilosia laevifrons* Jones, 1907 = *Cheilosia comosa* Loew, 1863.

Key words: new state records, fauna, new synonym

Zusammenfassung

Erstmals seit 1924 wird eine Übersicht über die Schwebfliegen von Nebraska gegeben. Die Sammlung des Museums der Universität von Nebraska (University of Nebraska State Museum), Aufzeichnungen aus der Literatur und andere Sammlungen sowie Exemplare aus Feldforschungen des Autors sind in der vorliegenden Publikartion zusammengefasst. Insgesamt sind 5,061 Exemplare in der Datenbank verzeichnet. Insgesamt sind 160 Arten aus Nebraska bekannt, was die Zahl der für diesen Bundesstaat bekannten Aufzeichnungen um 49 erhöht. Ein neues Synonym wird vorgeschlagen: *Chilosia laevifrons* Jones, 1907 = *Cheilosia comosa* Loew, 1863.

Stichwörter: neue Nachweise im Bundesstaat, Nebraska, Fauna, neues Synonym

Introduction

The flower flies (Diptera: Syrphidae), also known as hover flies, were the main interest of Chris (F. Christian) Thompson. It is an honour for me to dedicate this paper on the flower flies of one state of the U.S.A. to him, since he started his life in Syrphidae with collecting and studying the Nearctic Syrphidae. His knowledge and his never officially published but quite well spread conspectus “Nearctic flower flies (Diptera: Syrphidae)” were invaluable for my understanding of the North American species.

Syrphidae form a diverse family of Diptera. The adults vary from small black flies to large bee and wasp mimics. Adults of most species are frequent flower visitors. Many larvae feed on aphids or other soft-bodied Hemiptera, while others are phytophagous, filter feed in water, or live in rotting wood or herbaceous vegetation, and some are predators or even parasitoids in ants nests (Skevington et al. 2019a; Rotheray & Gilbert 2011).

The Syrphidae fauna of Nebraska is poorly studied. Jones (1907) and Wehr (1924) gave an overview of Syrphidae present in the Museum collection at their times. Jones (1907) listed 78 species and Wehr (1924) listed 107 species. Most material in Jones (1907) and Wehr (1924) was collected in eastern Nebraska (especially Nemaha, Sarpy and Lancaster Counties) and in north western Nebraska (mainly Sioux Co.). Since then only Knutson (1973), Thompson (1981), Vockeroth (1986, 1990, 1992), Young et al. (2016), and Skevington et al. (2019a) gave records for Nebraska. The present study gives an overview of the Syrphidae of Nebraska and provides species accounts and maps for the species.

The state of Nebraska, one of the Great Plains states, almost in the centre of the United States of America, is 200,673 km^2 (Ratcliffe & Paulsen 2008). The elevation ranges from 251 m in the southeast gradually rising to 1655 m in the southwest. All of Nebraska is part of ecoregion 9.0 – Great Plains. The eastern 20 % is ecoregion 9.2 temperate prairies. Of the remaining, the southern half and the western quarter is ecoregion 9.4 south-central semi-arid prairies. The remainder of the state, the central part extending far to the north, is ecoregion 9.3 west-central semi-arid prairies. The riverine forests in eastern Nebraska are western extensions of the vast deciduous forests of ecoregion 8.0, eastern temperate forests. The north western forests, mostly in Sioux Co., are eastern extensions of ecoregion 6.0 north western forested mountains (https://www.epa.gov/eco-research/ecoregions-north-america).

The eastern third of the state has largely been converted to cropland. The rest is largely dry mixed prairie (Ratcliffe & Paulsen 2008).

Materials and methods

Identification to genus was done using Vockeroth & Thompson (1987) and Miranda et al. (2013). Identification to species partly relied on generic revisions, but was very much helped by the unpublished conspectus of F. Christian Thompson (2004), including keys to the species of many of the Nearctic genera, and by the Field Guide to the Flower Flies of Northeastern North America (Skevington et al. 2019a). For species identification the following additional literature was used: *Allograpta*: Vockeroth (1992); *Anasimyia*: Curran & Fluke (1926), Skevington et al. 2019b; *Asemosyrphus*: Curran & Fluke (1926), Curran (1939a); *Blera*: Curran (1953); Barkalov & Mutin (1991a, b); *Brachyopa*: Curran (1922); *Brachypalpus*: Shannon (1926); *Ceriana*: Shannon (1925), Curran (1941); *Chalcosyrphus*: Shannon (1926), Curran (1941), Hippa (1978); *Cheilosia*: Fluke & Hull (1946, 1947), Hull & Fluke (1950); *Chrysogaster*: Sedman (1959); *Copestylum*: Curran (1930); *Dasysyrphus*: Locke & Skevington (2013); *Didea*: Vockeroth (1992); *Epistrophella*: Vockeroth (1992); *Eristalinus*: Thompson et al. (1990); *Eristalis*: Telford (1970), Hippa et al. (2001); *Eumerus*: Latta & Cole (1933), Garcette-Barrett et al. (2020); *Helophilus*: Curran & Fluke (1926); *Heringia*: Curran (1921); *Hiatomyia*: Hull & Fluke (1950); *Hypocritanus*: Vockeroth (1992); *Lapposyrphus*: Vockeroth (1992); *Lejota*: Fluke & Weems (1956); *Microdon*: Thompson (1981); *Milesia*: Hull (1924); *Myolepta*: Fluke & Weems (1956); *Neocnemodon*: Curran (1921); *Ocyptamus*: Vockeroth (1992); *Orthonevra*: Shannon (1916), Sedman (1964, 1966); *Paragus*: Vockeroth (1986, 1992), Vujić et al. (1999); *Pipiza*: Coovert (1996); *Platycheirus*: Vockeroth (1990, 1992), Young et al. (2016); *Pseudoscaeva*: Vockeroth (1992); *Pyrophaena*: Vockeroth (1990, 1992), Young et al. (2016); *Sphaerophoria*: Knutson (1973), Vockeroth (1992); *Sphecomyia*: Moran & Skevington (2019); *Sphegina*: Coovert & Thompson (1977); *Spilomyia*: Thompson (1997); *Syritta*: Thompson et al. (1990); *Syrphus*: Vockeroth (1983, 1992); *Temnostoma*: Curran (1939b), Shannon (1939); *Toxomerus*: Vockeroth (1992); *Trichopsomyia*: Curran (1921); *Tropidia*: Shannon (1926); *Xylota*: Shannon (1926), Curran (1941), Hippa (1978).

Species names follow Skevington et al. (2019a), for species not included there and some changes in genus names Mengual et al. (2018), Mengual (2020), Miranda et al. (2013) and Miranda et al. (2020) are used. Chris Thompson helped me very much with the identification of many specimens.

Collections are referred to with the following abbreviations:

AMNH – American Museum of Natural History, New York, New York, U.S.A.
CNC – Canadian National Collection, Agriculture Canada, Ottawa, Canada.
CSU – Colorado State University Museum, Fort Collins, Colorado, U.S.A.
INHS – Illinois Natural History Survey, Champaign, Illinois, U.S.A.
MZC – Museum of Comparative Zoology, Harvard University, Cambridge, United Kingdom.
UNL – University of Nebraska, Lincoln, Nebraska, U.S.A.
USNM – National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.
WSB – Wouter van Steenis personal collection, Breukelen, The Netherlands.
WSUC – Washington State University Collection, Pullman, Washington, U.S.A.

Specimens studied by me are deposited in the collections of CSU, INHS, UNL and WSB. Data from the CNC database (provided by J. H. Skevington; https://cnc.agr.gc.ca/) include specimens deposited in CNC, USNM, AMNH, INHS, MCZ, and WSUC, and some records retrieved from the BugGuide website. For each species, collections with Nebraskan specimens are stated in the species account.

All specimens studied, literature records and records from iNaturalist (https://www.inaturalist.org/) and BugGuide (https://bugguide.net) are databased. For all records without coordinates, the coordinates were retrieved using The Nebraska Atlas & Gazetteer (DeLorme 2000) and Google Earth Pro (Google 2020). Maps were made with Qgis 3.16.8 Hannover.

Results

A total of over 5061 specimens from Nebraska are identified and databased. All data are given in an on-line Appendix 1 [https//www.ampyx-verlag.de]. They belong to 160 species. Of these, 49 are new state records. The species are listed alphabetically by genus and specific epithet. In the species accounts, all names used by Jones (1907) and Wehr (1924) and other sources with Nebraskan records are listed. Details are only given for new state records with few records and some very rare species.

Species accounts

Genus *Allograpta* Osten Sacken, 1875

***Allograpta exotica* (Wiedemann, 1830)**. Map 1 – NEW STATE RECORD.

Two ♂♂ were photographed in Omaha, Douglas Co.
Examined material: **Douglas Co.**: 1 ♂, Omaha, 41.213273, –96.146361, 3 October 2018, Rachel Hall, photograph (https://www.inaturalist.org/observations/62309031); 1 ♂, Omaha, 41.213273, –96.146361, 30 September 2020, Rachel Hall, photograph (https://www.inaturalist.org/observations/61331830).

***Allograpta obliqua* (Say, 1823)**. Map 1.

Allograpta obliqua in Jones (1907), Wehr (1924), Skevington et al. (2019a).
A very common species in Nebraska. Recorded 25 April–4 October.
Examined material: 55 ♂♂ 77 ♀♀ (CSU, MCZ, UNL, WSB); 29 iNaturalist records.

Genus *Anasimyia* Schiner, 1864

***Anasimyia anausis* (Walker, 1849)**. Map 2 – NEW STATE RECORD.

This species is confined to watersides. Most records consist of one or two specimens. At Cub Creek Lake (Keya Paha Co.) 25 ♂♂ were sitting on reeds (20–30 cm above the ground) in the sun, probably waiting for ♀♀ to pass by. Recorded 20–27 April. Possibly not recorded before 2004 due to the early flight period.
Examined material: 29 ♂♂ 4♀♀ (WSB); 2 iNaturalist records.

***Anasimyia bilinearis* (Williston, 1887)**. Map 2 – NEW STATE RECORD.

Not listed by Wehr (1924), but there is a ♂ in UNL from 1908 that was previously identified as *Helophilus* sp. On 19 April 2004 20 ♂♂ were documented sitting on a low, dense vegetation of reeds at Cotton Wood Lake SRA, Merriman, Cherry Co., waiting for ♀♀ to pass by. Once a ♀ was noticed, several ♂♂ would fly after her. The first to arrive would mate in flight and the couple would fly away from the marsh. On 20 and 21 April 2004 many ♂♂ were observed in willow *Salix* Linnaeus marshes at Niobrara State Park, 2 mi northwest of Niobrara, Knox Co., mostly sitting on low vegetation and flying around. Recorded 19 April–9 May.
Examined material: 59 ♂♂ 14 ♀♀ (UNL, WSB).

***Anasimyia chrysostomus* (Wiedemann, 1830)**. Map 3.

Helophilus chrysostomus in Wehr (1924).
Recorded 25 June–10 September.
Examined material: 17 ♂♂ 8 ♀♀ (UNL, WSB); 1 iNaturalist record.

***Anasimyia perfidiosus* (Hunter, 1897)**. Map 3 – NEW STATE RECORD.

Examined material: **Cherry Co.**: 1 ♂, Hackberry Lake, 42.559302, –100.666118, 2.vi.1969, W. W. Wirth, pinned, USNM_ENT248410 (USNM).

Genus *Asemosyrphus* Bigot, 1822

***Asemosyrphus polygrammus* (Loew, 1872)**. Map 4 – NEW STATE RECORD.

The specimen, a ♂, was flying fast through flowering shrubs about 100 m from Steverson Lake.
Examined material: **Cherry Co.**: 1 ♂, Steverson Lake, 1,100 m asl., 42.41, –101.71, 28.vi.2003, W. van Steenis, wvs11458, pinned (WSB).

Genus *Blera* Billberg, 1820

***Blera umbratilis* (Williston, 1887)**. Map 4.

Criorhina umbratilis in Jones (1907).
Cynorrhina umbratilis in Wehr (1924).
Examined material: **Cass Co.**: 1 ♀, South Bend, 320 m asl., 40.98, –96.23, 17.v.1905, Jones, wvs13501, pinned (UNL).

Genus *Brachyopa* Meigen, 1822

***Brachyopa cynops* Snow, 1892**. Map 4 – NEW STATE RECORD.

Examined material: **Sioux Co.**: 1 ♀ pupa, Harrison, 6 mi. NNE, Gilbert Baker SWMA, Monroe Canyon, behind bark of an old Eastern Cottonwood *Populus deltoides* W. Bartram ex Marshall, 1350 m asl., 42.76, –103.92, 18.iv.2004, ex. pupa 24.iv.2004, J. & W. van Steenis, wvs11459, pinned (WSB).

***Brachyopa vacua* Osten Sacken, 1875**. Map 4 – NEW STATE RECORD.

All specimens were collected at sites with old trees, mostly in riverine forests. Most specimens were collected on flowers of *Prunus* Linnaeus species. Recorded 17 April–31 May.
Examined material: 20 ♂♂ 3 ♀♀ (WSB).

Genus *Brachypalpus* Macquart, 1834

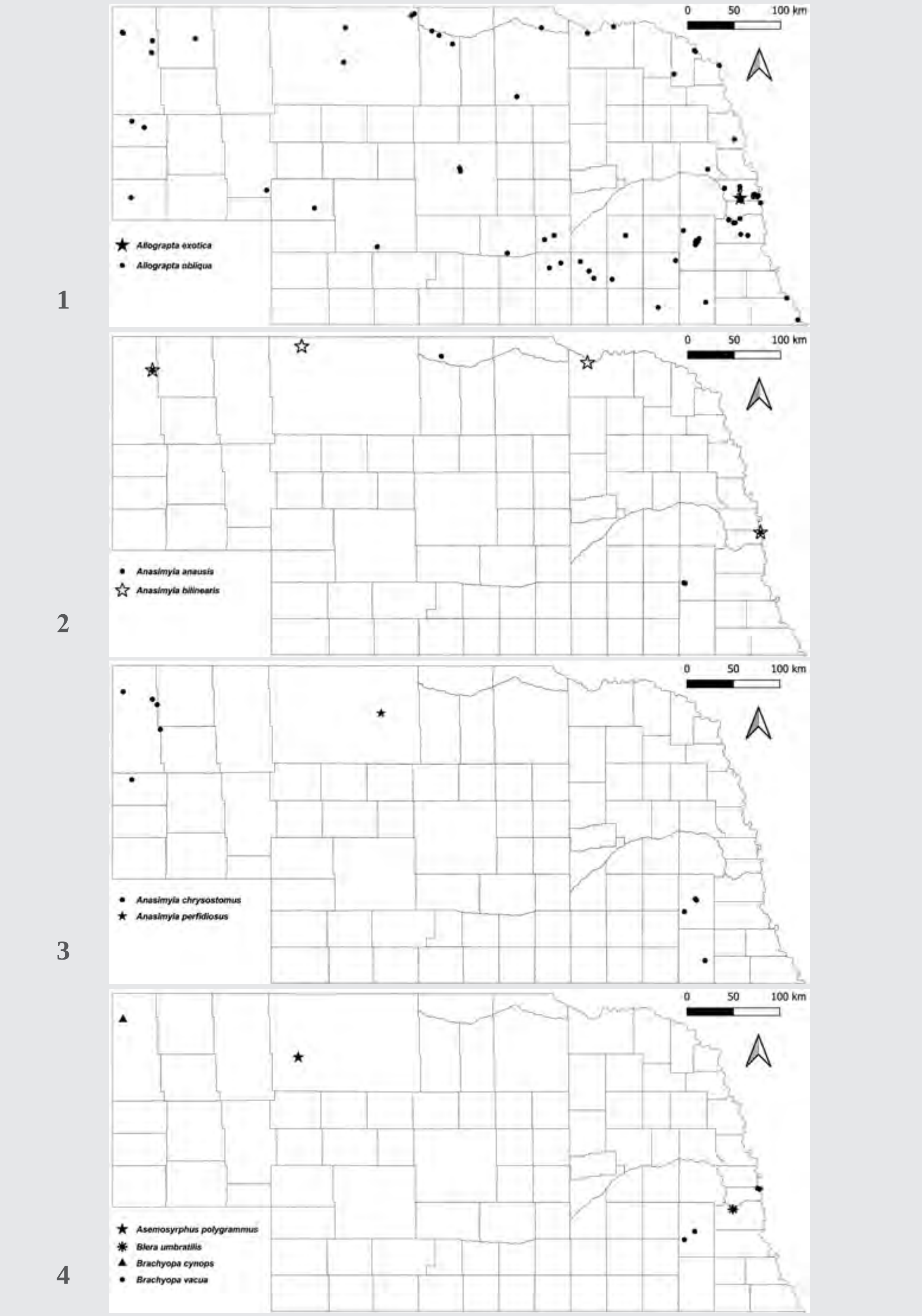
***Brachypalpus oarus* (Walker, 1849)**. Map 5 – NEW STATE RECORD.

The specimens are from hillside forests along the Missouri, Niobrara and Platte Rivers. Most individuals were collected flower visiting on *Prunus* species with large flowers; some ♂♂ were sitting on trunks. Recorded 27 March–23 April.
Examined material: 13 ♂♂ 3 ♀♀ (WSB); 2 iNaturalist records.

Genus *Callicera* Panzer, 1806

***Callicera erratica* (Walker, 1849)**. Map 5 – NEW STATE RECORD.

Examined material: **Lancaster Co.**: 1 ♂, Lincoln, 5.iv.2021, Bennett Grappone (UNL & https://www.inaturalist.org/observations/105189134).



Maps 1–4: Localities of Syrphidae species in Nebraska. – **1**: *Allograpta exotica* (WIEDEMANN) and *A. obliqua* (SAY); – **2**: *Anasimyia anausis* (WALKER) and *A. bilinearis* (WILLISTON); – **3**: *Anasimyia chrysostomus* (WIEDEMANN) and *A. perfidiosus* (HUNTER); – **4**: *Asemosyrphus polygrammus* (LOEW), *Blera umbratilis* (WILLISTON), *Brachyopa cynops* SNOW, and *B. vacua* OSTEN SACKEN.

Genus *Ceriana* Rafinesque, 1815

Ceriana abbreviata (Loew, 1864). Map 6.

Ceria abbreviata in Jones (1907).
Cerioides abbreviata in Wehr (1924).
Ceriana abbreviata in Skevington et al. (2019a).
The specimens cited by Jones (1907) and Wehr (1924) are probably lost. However, the characters stated by Wehr (1924) are convincing enough to accept these records as belonging to *Ceriana abbreviata*. Recorded 17 May–3 July.
Examined material: [including the lost specimens of Wehr (1924)]: 3 ♂♂, 1 ♀, 2 adults (USNM); 1 iNaturalist record.

Ceriana willistoni (Kahl, 1897). Map 6.

Ceria willistoni in Jones (1907).
Cerioides willistoni in Wehr (1924).
The specimens listed by Jones (1907) and Wehr (1924) are lost. Recorded 17 May–27 June.
Examined material (including lost specimens): 7 ♀♀ (UNL, WSB).

Genus *Chalcosyrphus* Curran, 1925

Chalcosyrphus chalybeus (Wiedemann, 1830). Map 7.

Xylota chalybea in Wehr (1924).
Recorded 11 June.
Examined material: 1 ♂ (UNL).

Chalcosyrphus dubius (Shannon, 1926). Map 7.

= *Xylota obscura* of Jones (1907), Wehr (1924).
The species is found along creeks near old deciduous trees. In Soldier Creek (Dawes Co.), specimens were sitting on grassy plants half a meter above the water of a small creek. Recorded 22 May–5 August.
Examined material: 3 ♂♂ 4 ♀♀ (UNL, WSB).

Chalcosyrphus metallicus (Wiedemann, 1830). Map 7 – NEW STATE RECORD.

The species is sometimes abundant in moist deciduous forests along the Missouri and Platte rivers and around larger lakes. The flies were mostly seen sitting on fallen trunks or branches above stagnant water. Some were resting on vegetation close to dead wood in the water. Several times the species was flying together with the closely related *Chalcosyrphus nemorum* (Fabricius, 1805). Recorded 25 July–12 September.
Examined material: 23 ♂♂ 11 ♀♀ (UNL, WSB).

Chalcosyrphus metallifer (Bigot, 1884). Map 8 – NEW STATE RECORD.

The ♂♂ were guarding territories near and on fallen trunks of Eastern Cottonwood *Populus deltoides* in the flood plain of the Missouri River.
Examined material: **Sarpy Co.**: 3 ♂♂, Bellevue, Fontenelle Forest, 290–370 m asl., 41.17, –95.89, 22.iv.2004, J. & W. van Steenis, wsb11519-20, pinned (WSB).

Chalcosyrphus nemorum (Fabricius, 1805). Map 9.

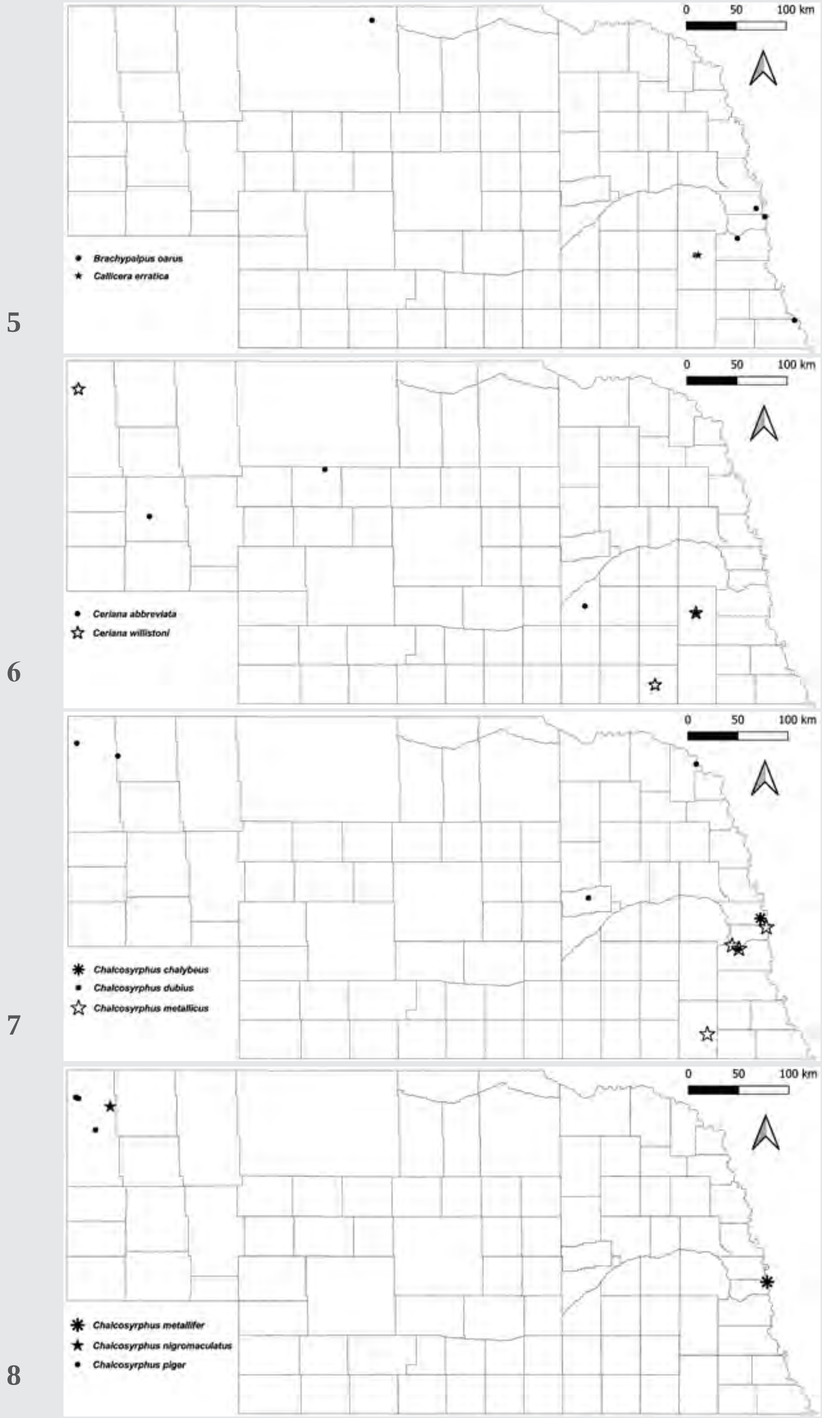
Xylota fraudulosa Loew, 1864 in Jones (1907), Wehr (1924).
Chalcosyrphus nemorum in Skevington et al. (2019a).
= *Xylota anthreas* of Wehr (1924).
All records are from forests. Recorded 18 April–12 September.
Examined material: 87 ♂♂ 21 ♀♀ (CNC, CSU, UNL, WSB); 1 iNaturalist record.

Chalcosyrphus nigromaculatus (Jones, 1917). Map 8 – NEW STATE RECORD.

Examined material: **Sioux Co.**: 2 ♂♂, Fort Robinson SP, Soldier Creek, feeding on ♂ willow catkins, 1240 m asl., 42.69, –103.55, 19.iv.2004, J. & W. van Steenis, wvs11616, pinned (WSB).

Chalcosyrphus piger (Fabricius, 1794). Map 8.

Xylota pigra in Jones (1907), Wehr (1924).
This species is only recorded in Sioux Co. Recorded 9–24 August 1908.
Examined material: 6 ♂♂ 4 ♀♀ (UNL).



Maps 5–8: Localities of Syrphidae species in Nebraska. – **5**: *Brachypalpus oarus* (WALKER) and *Callicera erratica* (WALKER); – **6**: *Ceriana abbreviata* (LOEW) and *C. willistoni* (KAHL); – **7**: *Chalcosyrphus chalybeus* (WIEDEMANN), *C. dubius* (SHANNON), and *C. metallicus* (WIEDEMANN); – **8**: *Chalcosyrphus metallifer* (BIGOT), *C. nigromaculatus* (JONES), and *C. piger* (FABRICIUS).

Genus *Cheilosia* Meigen, 1822

Cheilosia is a genus with many unsolved taxonomic issues in the Nearctic Region (Skevington et al. 2019a).

Cheilosia comosa Loew, 1863. Map 10.

Chilosia comosa in Jones (1907).
Cartosyrphus comosa in Wehr (1924).
Chilosia laevifrons Jones, 1907 in Jones (1907), Wehr (1924). **New synonym**.
All records are from older forests in south eastern and north western Nebraska. Most specimens were visiting flowers. Recorded 16 April–9 May.
Examined material: 2 ♂♂, 18 ♀♀ (UNL, WSB).

The type of *C. laevifrons* is a ♂ with labels "Roca Neb // on W. Straw-B. // May 12 '06" "P. R. Jones // Collector" "Chilosia // laevafrons // ♂ TYPE (JONES)" (UNL). Although the label gives 'laevafrons', the description name is *Chilosia laevifrons*. The type is in good condition. It differs from *Cheilosia comosa* only in the short setae on the frons, which appear to be broken (F. Chris Thompson pers. comm.).

Cheilosia cynoprosopa Hull & Fluke, 1950. Map 10 – NEW STATE RECORD.

All specimens were flower visiting on a *Prunus* species with large white flowers.
Examined material: **Lancaster Co.**: 3 ♀♀, Denton, Spring Creek Prairie, 400 m asl., 40.69, –96.84, 27.iv.2004, W. van Steenis, wvs11632-3, pinned (WSB); 1 ♀, Lincoln, Wilderness Park, 350 m asl., 40.77, –96.71, 26.iv.2004, W. van Steenis, wvs11631, pinned (WSB).

Cheilosia livida Wehr, 1924. Map 10 – NEW STATE RECORD.

Wehr (1924) described this species from Ute Creek, Costilla Co., Colorado in his paper on the Syrphidae of Nebraska.
Examined material: **Sioux Co.**: 1 ♀, Fort Robinson SP, Soldier Creek, 1240 m asl., 42.69, –103.55, 19.iv.2004, J. & W. van Steenis, wvs11634, pinned (WSB).

Cheilosia orilliaensis Curran, 1922. Map 10 – NEW STATE RECORD.

Examined material: **Douglas Co.**: 1 ♂, Omaha, 370 m asl., 41.25, –95.96, 8.ix.1913, L. T. Williams, wvs13532, pinned (UNL). The specimen was unidentified in the UNL collection.

Cheilosia punctulata Hunter, 1897. Map 10.

Chilosia punctulata in Jones (1907), Wehr (1924).
Described by Hunter (1897). The allocation of the types is not known. The type specimens are not in UNL.
Examined material (Jones 1907): **Cuming Co.:** 2 ♀♀, West Point, 9.ix.

Genus *Chrysogaster* Meigen, 1803

Chrysogaster antitheus Walker, 1849. Map 11.

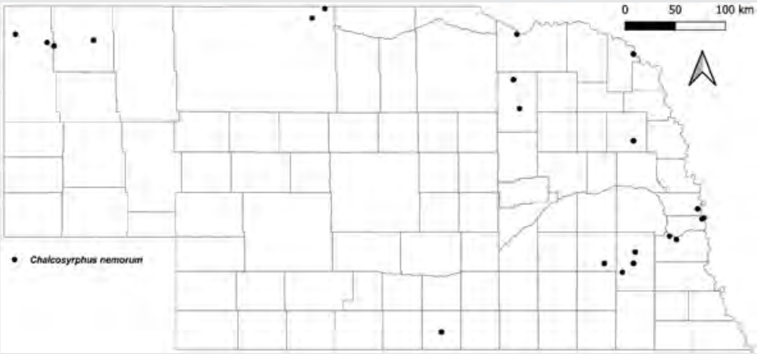
Chrysogaster nigripes Loew, 1863 in Jones (1907), Wehr (1924).
The species was often seen flower visiting. Recorded 27 May–18 June with one specimen from 'April'.
Examined material: 10 ♂♂ 10 ♀♀ (UNL, WSB).

Genus *Chrysotoxum* Meigen, 1803

Chrysotoxum species concepts have long been debated (Skevington, 2019a). Skevington and Sommaggio are revising the genus. Skevington (pers. comm) helped with identification.
The type locality of *Chrysotoxum laterale* Loew, 1864 is 'Nebraska'. The type is presumably lost (Thompson 2004) and the original description is not specific enough to determine what species Loew described. Wehr (1924) only listed part of the specimens of *Chrysotoxum* present in the UNL collection in 1922.

Chrysotoxum integre Williston, 1887. Map 12.

= *Chrysotoxum derivatum* of Jones (1907).
= *Chrysotoxum laterale* of Wehr (1924) (pro parte).



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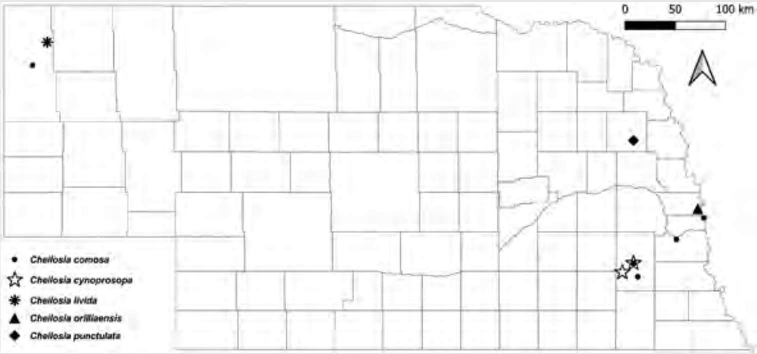

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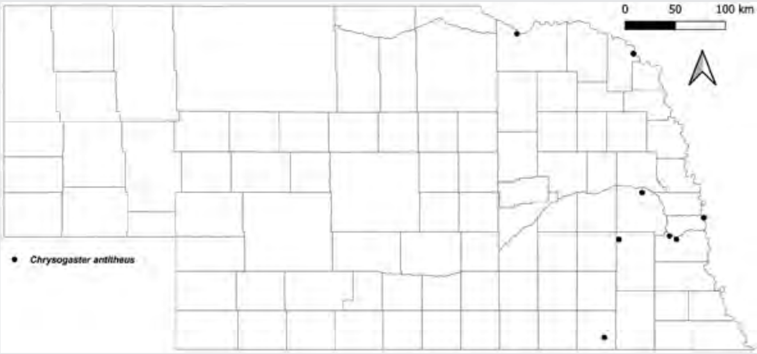

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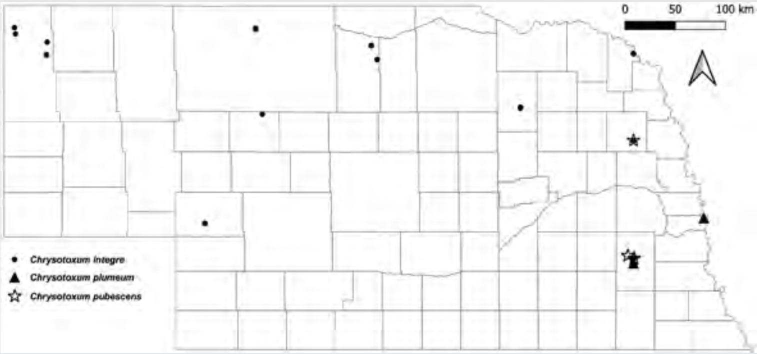

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Maps 9–12: Localities of Syrphidae species in Nebraska. – **9**: *Chalcosyrphus nemorum* (FABRICIUS); – **10**: *Cheilosia comosa* LOEW, *C. cynoprosopa* HULL & FLUKE, *C. livida* WEHR, *C. orilliaensis* CURRAN, and *C. punctulata* HUNTER; – **11**: *Chrysogaster antitheus* WALKER; – **12**: *Chrysotoxum integre* WILLISTON, *C. plumeum* JOHNSON, and *C. pubescens* LOEW.

Not stated by Wehr (1924). However, Jones (1907) reports two localities for *C. derivatum* Walker, 1849. All specimens from those locations belong to *C. integre*. Wehr (1924) identified the species as *C. laterale* Loew, 1864, not listed by Jones (1907). Most of the records are from across northern Nebraska. Recorded 3 June–2 September.
Examined material: 21 ♂♂, 16 ♀♀ (CNC, CSU, INHS, UNL, USNM, WSB)

***Chrysotoxum plumeum* Johnson, 1924**. Map 12 – NEW STATE RECORD.

Examined material: **Lancaster Co.**: 1 ♀, Lincoln, Wilderness Park, 350 m asl., 40.77, –96.71, 8.ix.2003, W. van Steenis, wvs11659, pinned (WSB); **Sarpy Co.**: 3 ♀♀, Bellevue, Fontenelle Forest, 290–370 m asl., 41.17, –95.89, 12.ix.2003, W. van Steenis, wvs11660-2, pinned (WSB).

***Chrysotoxum pubescens* Loew, 1864**. Map 12.

Chrysotoxum pubescens in Jones (1907), Wehr (1924), Skevington et al. (2019a).
Chrysotoxum cuneatum Wehr, 1924 [type in UNL] in Wehr (1924).
Chrysotoxum currani Wehr, 1924 [type in UNL] in Wehr (1924).
= *Chrysotoxum laterale* of Wehr (1924) (pro parte).
Recorded 15 June–11 August.
Examined material: 4 ♂♂ 2 ♀♀ (CNC, UNL); 1 iNaturalist record.

Genus *Copestylum* Macquart, 1846

***Copestylum caudatum* Curran, 1927**. Map 13.

= *Copestylum marginatum* of Wehr (1924).
Early spring specimens, flower visiting on *Prunus* species, are darker than the summer specimens. Recorded 17 April–5 September.
Examined material: 19 ♂♂, 9 ♀♀ (UNL, WSB).

***Copestylum comstocki* (Williston, 1887)**. Map 13 – NEW STATE RECORD.

Copestylum comstocki is restricted to western Nebraska. Most collected specimens were flower visiting on flowering *Prunus*. The species flew in high numbers at Ash Hollow SHP (Garden Co.), together with smaller numbers of *Copestylum caudatum* and *C. vittatum* Thompson, 1976. Other sites produced few specimens. Recorded 16–15 May.
Examined material: 45 ♂♂ 25 ♀♀ (UNL, WSB).

***Copestylum satur* (Osten Sacken, 1877)**. Map 14.

Volucella satur Osten Sacken, 1877 in Jones (1907), Wehr (1924).
All records of this species are from northern Sioux Co. In the Rocky Mountains it is common. Recorded 7 June–19 August.
Examined material: 2 ♂♂, 5 ♀♀ (UNL).

***Copestylum vittatum* Thompson, 1976**. Map 14.

Volucella fasciata Macquart, 1842 in Jones (1907), Wehr (1924).
Copestylum vittatum in Skevington et al. (2019a).
The species is mostly found in the direct proximity of fresh water bodies. Recorded 16 April–6 September.
Examined material: 31 ♂♂ 33 ♀♀ (CSU, UNL, USNM, WSB).

Genus *Daysyrphus* Enderlein, 1938

***Dasysyrphus creper* (Snow, 1895)**. Map 15.

Syrphus creper in Jones (1907), Wehr (1924).
This common species in the Rocky Mountains is only known from two ♂♂ in Nebraska.
Examined material: **Sioux Co.**: 1 ♂, Fort Robinson SP, Soldier Creek, 1,240 m asl., 42.69, –103.55, 19.iv.2004, J. & W. van Steenis, wvs11731, pinned (WSB); 1 ♂, 42.49, –103.72, v, wvs13609, pinned (UNL).

***Dasysyrphus limatus* (Hine, 1922)**. Map 15.

= *Syrphus mentalis* Williston, 1887 of Jones (1907), Wehr (1924).
Examined material: **Sioux Co.**: 1 ♂, Glen, 1360 m asl., 42.58, –103.56, 10.viii.1905, wvs13610, pinned (UNL).

Genus *Didea* Macquart, 1834

Didea fuscipes **Loew, 1863**. Map 15.

= *Didea fasciata* var. *fuscipes* of Wehr (1924).
Recorded 6 June – 22 September.
Examined material: 2 ♂♂ 2 ♀♀ (UNL); 1 iNaturalist record.

Genus *Dioprosopa* Hull, 1949

Dioprosopa clavata **(Fabricius, 1794)**. Map 46.

Baccha clavata in Jones (1907); Wehr (1924).
The Nebraskan records are among the most northern records of the species. Recorded as adults 14 August–25 September.
Examined material: 1 ♂ 1 ♀ (UNL); 6 iNaturalist records (3 adults and 3 larvae).

Genus *Epistrophella* Dušek & Láska, 1967

Epistrophella emarginata **(Say, 1823)**. Map 15.

Xanthogramma emarginata in Wehr (1924).
Xanthogramma felix Osten Sacken, 1875 in Wehr (1924).
Xanthogramma aenea Jones, 1907 in Jones (1907), Wehr (1924).
= *Syrphus opinator* of Wehr (1924) (pro parte).
The type of *Xanthogramma aenea* Jones, 1907 (♀, West Point, Cuming Co., June 1906, P.R. Jones) is not in the UNL collection. Wehr (1924) did not find it, nor did I. Possibly the ♀ from June 190? from West Point, Cuming Co. could be the type. Recorded 18 June–30 August.
Examined material: 7 ♂♂ 4 ♀♀ (CSU, UNL); 2 iNaturalist records.

Genus *Eristalinus* Rondani, 1845

Eristalinus aeneus **(Scopoli, 1763)**. Map 16.

Eristalis aeneus in Jones (1907), Wehr (1924).
This invasive species from the old world was settled in south eastern Nebraska as early as 1901. The first records from western Nebraska are from 2003. Many recent records are from natural sites. Recorded 7 April–3 November.
Examined material: 43 ♂♂ 39 ♀♀ (UNL, WSB); 10 iNaturalist records.

Genus *Eristalis* Latreille, 1804

Eristalis anthophorina **(Fallén, 1817)**. Map 16.

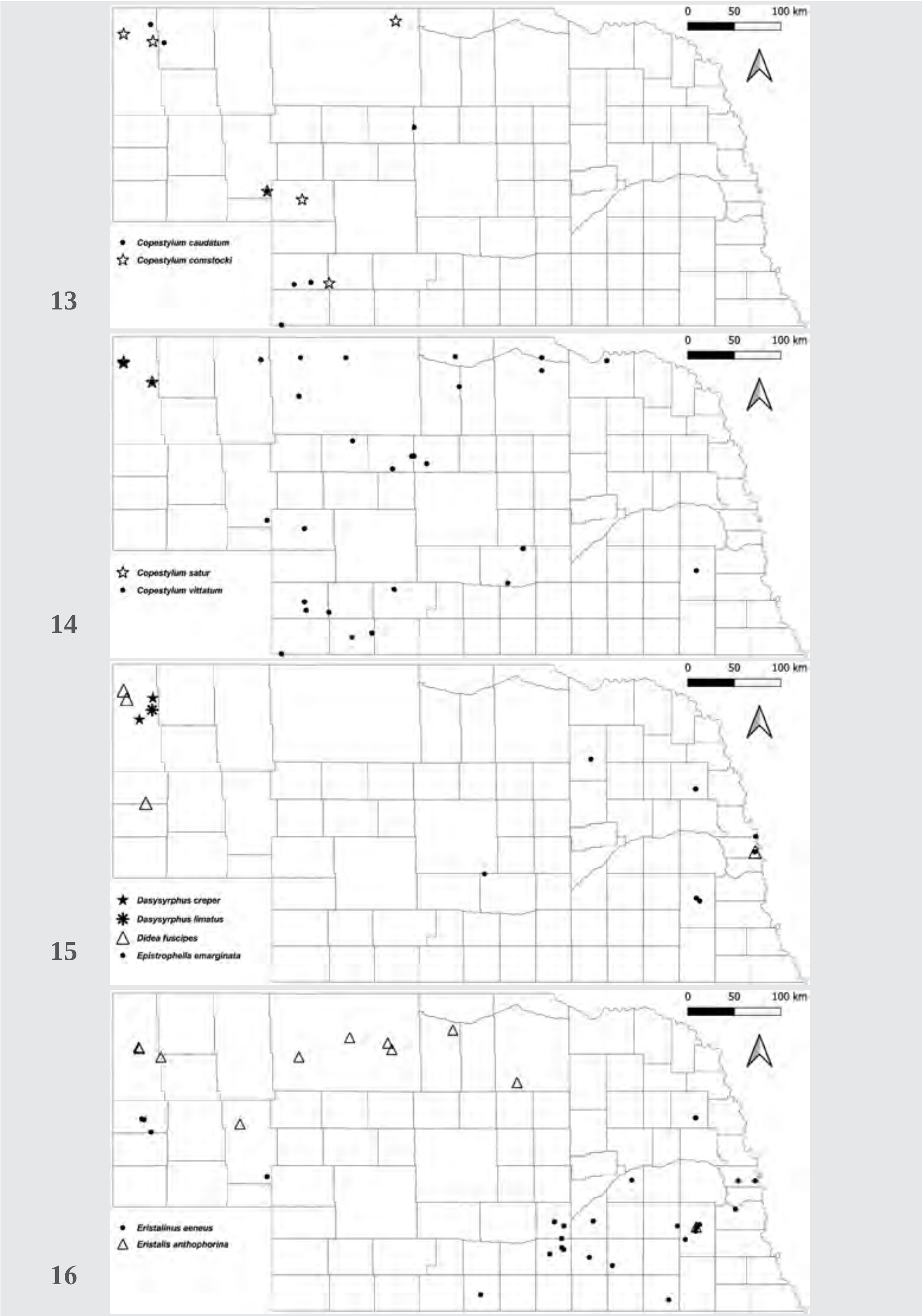
Eristalis montanus Williston, 1882 in Jones (1907), Wehr (1924).
Eristalis anthophorina in Skevington et al. (2019a).
Most records are from the northern half of Nebraska. Recorded 9 May–11 September.
Examined material: 14 ♂♂ 10 ♀♀ (CSU, UNL, USNM, WSB); 1 iNaturalist record.

Eristalis arbustorum **(Linnaeus, 1758)**. Map 17.

Eristalis arbustorum in Skevington et al. (2019a).
= *Eristalis temporalis* of Wehr (1924) (pro parte).
This introduced species is widespread in southern Nebraska. There are only few records from counties bordering the rivers in the (north-)east and some records from the north western counties. Recorded 17 April–20 October.
Examined material: 40 ♂♂ 22 ♀♀ (CSU, INHS, UNL, UNSM, WSB); 13 iNaturalist records.

Eristalis brousii **Williston, 1882**. Map 17.

Eristalis brousii in Skevington et al. (2019a).
= *Eristalis meigenii* of Wehr (1924).
= *Eristalis temporalis* of Wehr (1924) (pro parte).
This species resembles *E. arbustorum*. According to Skevington et al. (2019a) this species “collapsed in North America as *E. arbustorum* spread across the continent. It persists only where *E. arbustorum*



Maps 13–16: Localities of Syrphidae species in Nebraska. – **13**: *Copestylum caudatum* Curran and *C. comstocki* (Williston); – **14**: *Copestylum satur* (Osten Sacken) and *C. vittatum* Thompson; – **15**: *Dasysyrphus creper* (Snow), *D. limatus* (Hine), *Didea fuscipes* Loew and *Epistrophe emarginata* (Say); – **16**: *Eristalinus aeneus* (Scopoli) and *Eristalis anthophorina* (Fallén).

has not yet colonized and possibly in the west where *E. arbustorum* is a recent immigrant". At least until 2003 there were genuine *E. brousii* in north central Nebraska. Recorded 9 May–3 September.
Examined material: 15 ♂♂ 6 ♀♀ (UNL, UNSM, WSB).

Eristalis dimidiata Wiedemann, 1830. Map 18.

Eristalis dimidiatus in Jones (1907), Wehr (1924).
Most records are from forests along Platte River and Missouri River. Often seen flower visiting at *Salix* and *Prunus* species. Recorded 7 April–10 October. Most records are from April.
Examined material: 18 ♂♂ 15 ♀♀ (UNL, WSB); 2 iNaturalist records.

Eristalis flavipes Walker, 1849. Map 18.

Eristalis flavipes in Jones (1907), Wehr (1924), Skevington et al. (2019a).
Recorded 10 April–28 July with single records from 21 August and 11 October.
Examined material: 15 ♂♂ 8 ♀♀ (UNL, WSB); 2 iNaturalist records.

Eristalis hirta Loew, 1866. Map 18.

Eristalis temporalis Thomson, 1869 in Jones (1907), Wehr (1924) (pro parte).
= *Eristalis inornatus* of Jones (1907), Wehr (1924).
All Nebraska records of this western American species are from Sioux Co., where it has been recorded at several sites. Recorded 18 April–19 August.
Examined material: 7 ♂♂ 8 ♀♀ (UNL, WSB).

Eristalis stipator Osten Sacken, 1877. Map 19.

Eristalis latifrons Loew, 1866 in Jones (1907), Wehr (1924).
Eristalis stipator in Skevington et al. (2019a).
One of the most abundant and widespread flower fly species in Nebraska. The map shows the collecting effort more than gaps in distribution of the species. The species is more common at shaded places or close to water. Recorded 17 April–5 November.
Examined material: 147 ♂♂ 221 ♀♀ (CNC, UNL, WSB); 88 iNaturalist records.

Eristalis tenax (Linnaeus, 1758). Map 20.

Eristalis tenax in Jones (1907), Wehr (1924).
This introduced species is widespread in Nebraska. Most records are from cities and other man-made habitats. Recorded 21 April–14 November with most records September – November.
Examined material: 32 ♂♂ 38 ♀♀ (UNL, USNM, WSB); 16 iNaturalist records.

Eristalis transversa Wiedemann, 1830. Map 20.

Eristalis transversus in Jones (1907), Wehr (1924).
Recorded 17 May–26 August.
Examined material: 5 ♂♂ 5 ♀♀ (UNL); 19 iNaturalist records.

Genus *Eumerus* Meigen, 1822

Eumerus funeralis Meigen, 1822. Map 21 – NEW STATE RECORD.

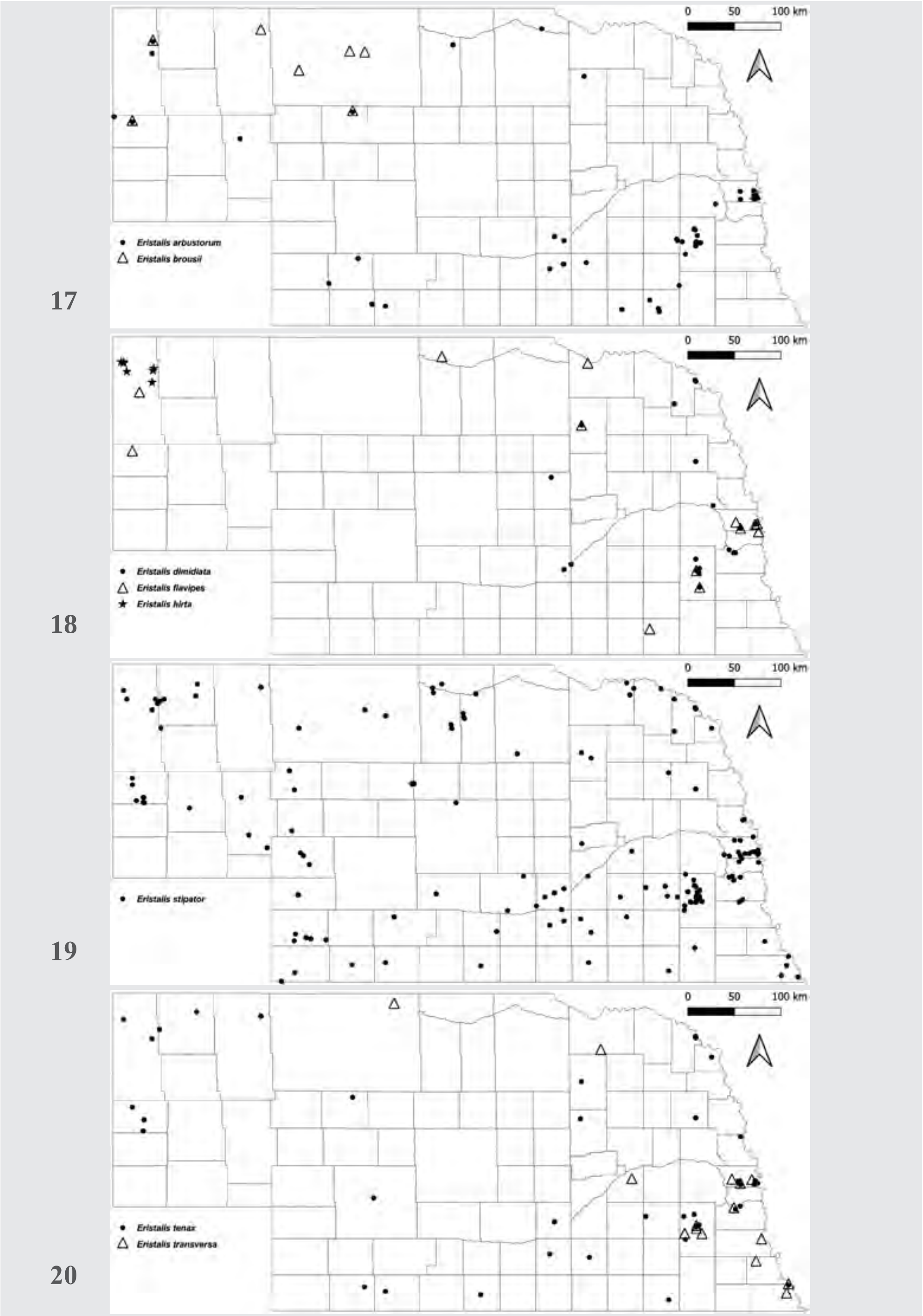
Examined material: **Lancaster Co.**: 1 ♂, Lincoln, 360 m asl., 40.81, –96.702, 22.vii.1949, R. A. Larkin, wvs14136, pinned (UNL); 2 ♂♂, Lincoln, Antelope Park, 360 m asl., 40.79, –96.67, 5.v.2003, W. van Steenis, wvs11890-1, pinned (WSB); 1 ♂, Lincoln, Wilderness Park, 350 m asl., 40.77, –96.71, 5.v.2003, W. van Steenis, wvs11892, pinned (WSB).

Eumerus strigatus (Fallén, 1817). Map 21.

Eumerus strigatus in Skevington et al. (2019a).
Examined material: **Lincoln Co.**: 1 ♂, Sutherland, 41.158611, –101.125556, 4.vi.1961, C. H. Mann, pinned, CNC_Diptera36352 (CNC). Not on the map: 17 ♂♂ 23 ♀♀, "from Holland", 13.xi.1917, pinned (UNL) (probably imported to Lincoln, Lancaster Co., in bulbs from Holland).

Genus Eupeodes Osten Sacken, 1877

There is no recent key to North American *Eupeodes*. Many species are not treated in recent keys. It is possible that other species will be present in the collected specimens.



Maps 17–20: Localities of Syrphidae species in Nebraska. – **17**: *Eristalis arbustorum* (Linnaeus) and *E. brousii* Williston; – **18**: *Eristalis dimidiata* Wiedemann, *E. flavipes* Walker, and *E. hirta* Loew; – **19**: *Eristalis stipator* Osten Sacken; – **20**: *Eristalis tenax* (Linnaeus) and *E. transversa* Wiedemann.

Eupeodes americanus **(WIEDEMANN, 1830)**. Map 22.
Syrphus americanus in JONES (1907), WEHR (1924).
Eupeodes americanus in SKEVINGTON et al. (2019a).
= *Syrphus ribesii* of WEHR (1924) (pro parte).
This common species is widespread in Nebraska. Recorded 1 April–10 October.
Examined material: 78 ♂♂ 107 ♀♀ (CNC, UNL, WSB); 215 iNaturalist records, including records of '*Eupeodes americanus* complex'.

Eupeodes flukei **(JONES, 1917)**. Map 22.
= *Syrphus snowi* WEHR, 1924 of WEHR (1924).
Examined material: **Sioux Co.**: 1 ♂, Harrison, 6 mi. NNE, Gilbert Baker SWMA, Monroe Canyon, 1350 m asl., 42.76, –103.92, 18.iv.2004, J. & W. VAN STEENIS, wvs11997, pinned (WSB); 1 ♀, Monroe Canyon, 1350 m asl., 42.76, –103.92, 16.viii.1912, E. J. TAYLOR, wvs14214, pinned (UNL).

Eupeodes luniger **(MEIGEN, 1822)**. Map 23 – NEW STATE RECORD.
This species is only collected in Knox Co. and Sioux C. ♂♂ and ♀♀ were collected flower visiting *Prunus* species. Recorded 18–20 April.
Examined material: 10 ♂♂ 3 ♀♀ (WSB).

Eupeodes neoperplexus **(CURRAN, 1925)**. Map 23 – NEW STATE RECORD.
Examined material: **Knox Co.**: 1 ♂, Niobrara, 2 mi. NW, Niobrara State Park, 450 m asl., 42.76, –98.07, 20.iv.2004, J. & W. VAN STEENIS, wvs12010, pinned (WSB); **Sioux Co.**: 1 ♂, Fort Robinson SP, Soldier Creek, 1240 m asl., 42.69, –103.55, 26.vi.2003, W. VAN STEENIS, wvs12008, pinned (WSB); 1 ♂, Monroe Canyon, 1350 m asl., 42.76, –103.92, 3.viii.2003, W. VAN STEENIS, wvs12009, pinned (WSB).

Eupeodes perplexus **(OSBURN, 1910)**. Map 24 – NEW STATE RECORD.
All records of this species are from Sioux Co. Recorded 18–26 June, and 6 August.
Examined material: 1 ♂ 7 ♀♀ (WSB).

Eupeodes pomus **(CURRAN, 1921)**. Map 24.
Eupeodes pomus in SKEVINGTON et al. (2019a).
This putative sister species of *E. americanus* is difficult to recognize among the high numbers of *E. americanus.*
Examined material: Sarpy Co.: 1 ♂, Bellevue, Fontenelle Forest, 290–370 m asl., 41.17, –95.89, 18.vi.2003, W. VAN STEENIS, wvs12017, pinned (WSB).

Eupeodes volucris **OSTEN SACKEN, 1877**. Map 24.
Eupeodes volucris in JONES (1907), WEHR (1924), SKEVINGTON et al. (2019a).
One of the most common flower fly species in Nebraska. Recorded 6 April–7 November.
Examined material: 65 ♂♂ 95 ♀♀ (CNC, UNL, WSB); 20 iNaturalist records.

Genus *Eurimyia* BIGOT, 1883

Eurimyia stipata **(WALKER, 1849)**. Map 25.
Helophilus conostomus WILLISTON, 1887 in JONES (1907), WEHR (1924).
Eurimyia stipata is only recorded from the northern part of Nebraska. Most records are from well-vegetated, marshy lake sides. Recorded 28 June–11 September.
Examined material: 6 ♂♂ 8 ♀♀ (UNL, WSB).

Genus *Ferdinandea* RONDANI, 1844

Ferdinandea buccata **(LOEW, 1863)**. Map 25– NEW STATE RECORD.
Examined material: **Holt Co.**: 1 ♂, Spencer, Spencer Dam, 450 m asl., 42.81, –98.65, 15–21.vi.1974, wvs14278, pinned (UNL).

Genus *Helophilus* MEIGEN, 1822

Helophilus fasciatus **WALKER, 1849**. Map 25.
Helophilus similis MACQUART, 1842 in JONES (1907), WEHR (1924).

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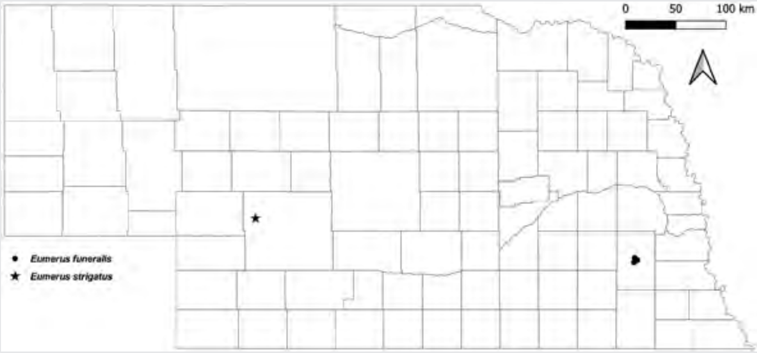

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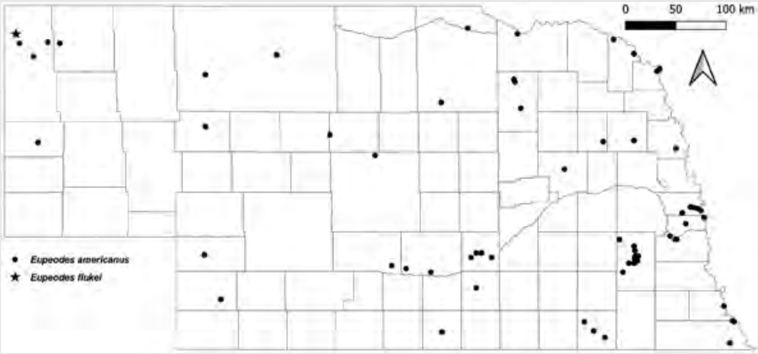

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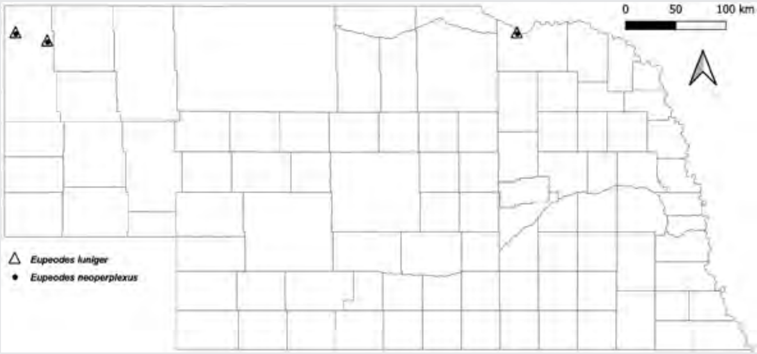

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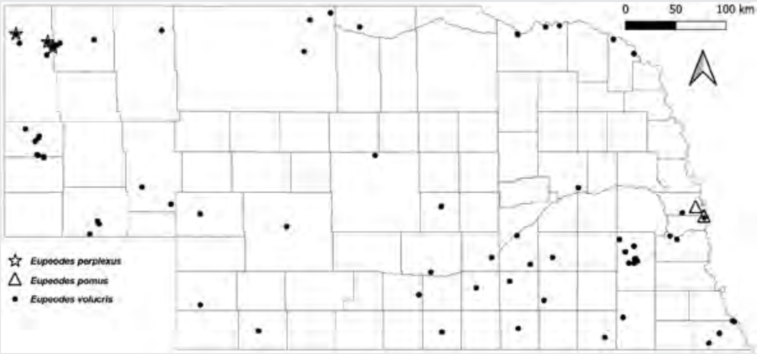


Maps 21–24: Localities of Syrphidae species in Nebraska. – **21**: *Eumerus funeralis* Meigen and *E. strigatus* (Fallén); – **22**: *Eupeodes americanus* (Wiedemann) and *E. flukei* (Jones); – **23**: *Eupeodes luniger* (Meigen) and *E. neoperplexus* (Curran); – **24**: *Eupeodes perplexus* (Osburn), *E. pomus* (Curran), and *E. volucris* Osten Sacken.

A common species in Nebraska. It seems there are more recent records, and the species occurs more to the north now than it used to. The species often occurs in fair numbers even further away from water bodies. Recorded 7 April–24 June with some records 10 September–17 October.
Examined material: 44 ♂♂ 39 ♀♀ (UNL, WSB); 14 iNaturalist records.

Helophilus hybridus **LOEW, 1846**. Map 26 – NEW STATE RECORD.

Examined material: **Lancaster Co.**: 1 ♂, Lincoln, Pioneers Park, 360 m asl., 40.77, –96.77, 2.v.2003, W. VAN STEENIS, wvs12179, pinned (WSB).

Helophilus latifrons **LOEW, 1863**. Map 26.

Helophilus latifrons in JONES (1907), WEHR (1924).
Although there are relatively few recent records, the species is still widespread in Nebraska. Most recent records were single specimens along rivers, creeks and lakes. The type specimens of LOEW (not studied) also come from Nebraska, but without further information. Recorded 20 April–14 October.
Examined material: 61 ♂♂ 63 ♀♀ (UNL, WSB); 10 iNaturalist records.

Genus *Heringia* RONDANI, 1856

Heringia salax **(LOEW, 1866)**. Map 27.

Heringia salax in WEHR (1924).
Examined material: **Cass Co.**: 1 ♂, South Bend, Platte River SP, 320 m asl., 40.98, –96.21, 19.v.2005, W. VAN STEENIS, wvs12199, pinned (WSB). The specimen in WEHR (1924) is a ♀: **Sioux Co.**, Monroe Canyon, 9.viii.1908, L. BRUNER, wvs14399 (UNL). This might be another species of *Heringia*.

Genus *Hiatomyia* SHANNON, 1922

Hiatomyia cyanescens **(LOEW, 1863)**. Map 27 – NEW STATE RECORD.

Examined material: **Nemaha Co.**: 2 ♂♂, Indian Cave SP, on leaves in a sunny spot along a forest trail, 300 m asl., 40.26, –95.56, 4.vi.2003, W. VAN STEENIS, wvs12200-1, pinned (WSB).

Genus *Hypocritanus* MIRANDA, 2020

Hypocritanus fascipennis **(WIEDEMANN, 1830)**. Map 35 – NEW STATE RECORD.

The species occurs in forested areas in eastern Nebraska. They mostly fly at open areas in forests and city parks. Recorded 22 May–14 June and one record 7 October.
Examined material: 4 ♂♂ 6 ♀♀ (UNL, WSB); 2 iNaturalist records.

Hypocritanus lemur **(OSTEN SACKEN, 1877)**. Map 35.

Baccha lemur in WEHR (1924).
All records are from Sioux Co. Recorded 26 June–August.
Examined material: 2 ♂♂ 3 ♀♀ (UNL, WSB).

Genus *Laetodon* REEMER, 2013

Laetodon laetus **(LOEW, 1864)**. Map 27 – NEW STATE RECORD.

Examined material: **Dixon Co.:** 1 ♂, Missouri National Recreation River, Newcastle, 42.71457, –96.94923, 10.vi.2021, STENTHESNAKE (https://www.inaturalist.org/observations/98633314).

Genus *Lapposyrphus* DUŠEK & LÁSKA, 1967

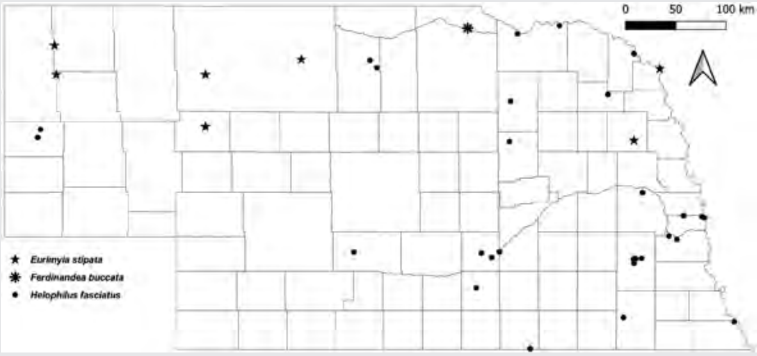
Lapposyrphus lapponicus **(ZETTERSTEDT, 1838)**. Map 27.

= *Syrphus arcuatus* of JONES (1907), WEHR (1924).
This species is only collected in Sioux Co. or nearby, 18 April–20 August.
Examined material: 4 ♂♂ 6 ♀♀ (UNL, WSB).

Genus *Lejota* RONDANI, 1857

Lejota aerea **(LOEW, 1872)**. Map 28.

Chalcomyia aerea in JONES (1907), WEHR (1924).



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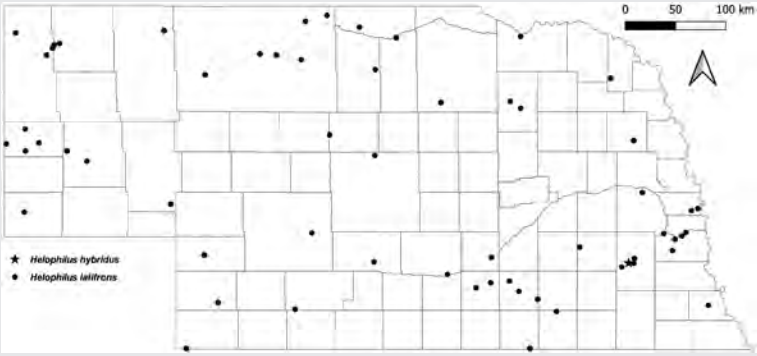

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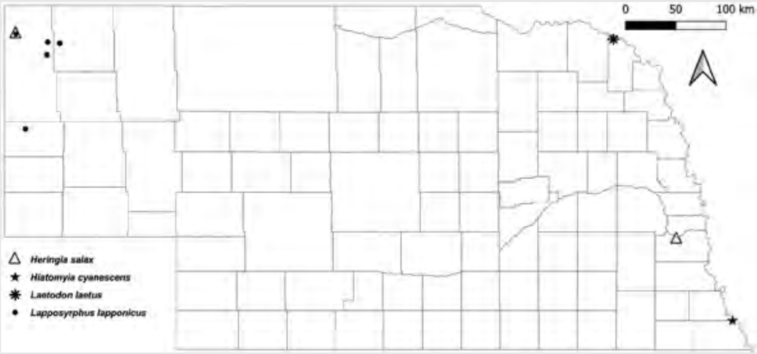

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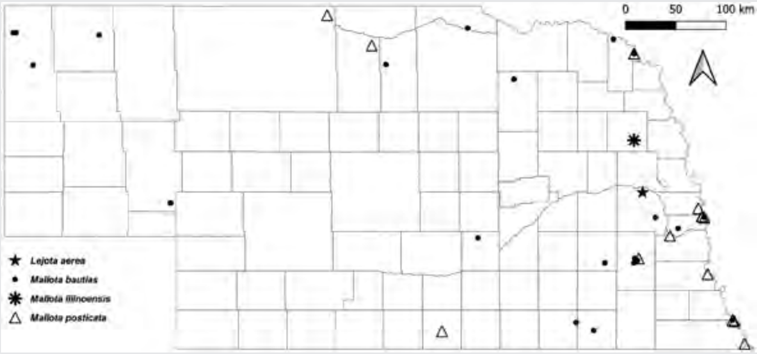

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Maps 25–28: Localities of Syrphidae species in Nebraska. – **25**: *Eurimyia stipata* (Walker), *Ferdinandea buccata* (Loew), and *Helophilus fasciatus* Walker; – **26**: *Helophilus hybridus* Loew and *H. latifrons* Loew; – **27**: *Heringia salax* (Loew), *Hiatomyia cyanescens* (Loew), *Laetodon laetus* (Loew), and *Lapposyrphus lapponicus* (Zetterstedt); – **28**: *Lejota aerea* (Loew), *Mallota bautias* (Walker), *M. illinoensis* Robertson, and *M. posticata* (Fabricius).

Examined material: **Saunders Co.**: 1 ♀, Cedar Bluffs, 400 m asl., 41.39, –96.61, iv, wvs14408, pinned (UNL).

Genus *Mallota* MEIGEN, 1822

***Mallota bautias* (WALKER, 1849)**. Map 28.
Mallota bipartita (WALKER, 1849) in JONES (1907).
Mallota fascialis HUNTER, 1896 in JONES (1907), WEHR (1924).
= *Mallota cimbiciformis* of JONES (1907), WEHR (1924).
A typical species of old trees. Most records are from mature riverine forests in eastern Nebraska. Recorded (as adults) 22 April–10 July. On 4 October 2003 Mr. P. MONK collected six larvae 6 km north of Cairo, Hall Co., in a rotten *Populus deltoides*. One of the larvae died, another one is preserved in alcohol. The four remaining larvae were kept in a small plastic box with 0.5 litre of the original substrate. The box was stored in a shed with temperature and light regime comparable to those outside. They survived freezing to minus 20 °C over two weeks. One ♂ pupated on 4 April 2004. The fly emerged on 20 April 2004. The other three larvae were ♀♀. They pupated on 11 April 2004 (one specimen) and 12 April 2004 (two specimens). Two ♀♀ emerged on 27 April 2004, the other on 29 April 2004.
Examined material: 16 ♂♂, 17 ♀♀ (UNL, WSB); 5 iNaturalist records.

***Mallota illinoensis* ROBERTSON, 1901**. Map 28.
Mallota illinoisensis misspelling in JONES (1907), WEHR (1924).
Examined material: **Cuming Co.**: 1 ♀, West Point, 410 m asl., 41.84, –96.71, 22.vi, P.R. JONES, wvs14427, pinned (UNL).

***Mallota posticata* (FABRICIUS, 1805)**. Map 28.
Eristalis posticatus in JONES (1907), WEHR (1924).
Most records of this species are from riverine forests at the eastern border of Nebraska. Recorded 25 May–11 July and 14 September.
Examined material: 9 ♂♂ 6 ♀♀ (CSU, UNL, WSB); 2 iNaturalist records.

Genus *Melanostoma* SCHINER, 1860

***Melanostoma mellinum* (LINNAEUS, 1758)**. Map 29.
Melanostoma mellinum in JONES (1907), WEHR (1924).
Remarkably few records of this widespread species. Recorded 5 May–9 August.
Examined material: 1 ♂ 6 ♀♀ (UNL, WSB).

Genus *Meligramma* FREY, 1946

***Meligramma triangulifera* (ZETTERSTEDT, 1843)**. Map 29 – NEW STATE RECORD.
= *Syrphus ribesii* of WEHR (1924) (pro parte).
The species is collected along the eastern, northern and north western borders of Nebraska. The ♀ from Niobrara, Knox Co. was flying two meters high in a flowering, dense, 8 m high willow *Salix* shrub. Recorded 19 April–9 May.
Examined material: 2 ♂♂ 2 ♀♀ (UNL, WSB).

Genus *Microdon* MEIGEN, 1803

There is a *Microdon* larva in the collection of the University of Nebraska State Museum, collected by N. BRAASCH at Louisville, Cass Co. on 7 April 1959. Identification to species level was not possible due to lack of keys, descriptions and reference material.

***Microdon cothurnatus* BIGOT, 1884**.
Microdon cothurnatus in SKEVINGTON et al. (2019a).
There is a listing of two pupae from Nebraska in the CNC dataset: USNM_ENT247054 (USNM). The handwritten label is partly illegible: Nebraska, BRUNNER and something like 'Meso point'. There is no date or other information. Because this species is known only from the state level, no map is provided.

***Microdon globosus* (FABRICIUS, 1805)**. Map 29.
= *Microdon fuscipennis* of WEHR (1924).

The specimen in Wehr (1924) under the name *M. fuscipennis* (Macquart, 1834) is probably lost. Recorded 22 June, 26 June, 4 and 14 September.
Examined material: 4 ♂♂ 1 ♀ (CSU, UNL, WSB)

Microdon lanceolatus **Adams, 1903**. Map 30.

Microdon lanceolatus in Jones (1907), Wehr (1924).
The record in Jones (1907) and Wehr (1924) is according to the description correctly identified. F.C. Thompson (pers. comm.) agreed with the identification. The specimen is probably lost.
Examined material: **Sioux Co.**: 1 ♀, Warbonnet Canyon, 1460 m asl., 42.77, –103.95, 1901, M. A. Carriker (lost?).

Microdon megalogaster **Snow, 1892**. Map 30 – NEW STATE RECORD.

Examined material: **Dixon Co.**: 1 ♂, Ponca, Ponca SP, 400 m asl., 42.59, –96.71, 11.vi.2003, W. van Steenis, wvs12226, pinned (WSB); **Sarpy Co.**: 1, Bellevue, Fontenelle Forest, 41.1798, –95.9178, 13.v.2012, Loren & Babs Padelford, photograph, CNC1779659 (BugGuide).

Microdon ruficrus **Williston, 1887**. Map 30.

Microdon tristis var. *ruficrus* in Jones (1907).
= *Microdon tristis* of Wehr (1924) (pro parte).
Jones (1907) listed one ♀ specimen of *Microdon tristis* var. *ruficrus*. The specimen is lost. The specimen is, based on information in Jones (1907), probably correctly identified.
Examined material: **Cuming Co.**: 1 ♂, West Point, 410 m asl., 41.84, –96.71, 27.vi.1906, P. R. Jones (lost?).

Microdon tristis **Loew, 1864**. Map 30.

Microdon tristis in Jones (1907), Wehr (1924) (pro parte).
Jones (1907) and Wehr (1924) list the species based on a ♂. This specimen is probably lost. The other specimen in Wehr (1924) is probably *M. ruficrus* (see there). Recorded 9–21 June with one ♀ labelled 14–19 July 1992.
Examined material: 2 ♂♂ 5 ♀♀ (UNL, WSB).

Genus *Milesia* Latreille, 1804

Milesia virginiensis **(Drury, 1773)**. Map 31.

Milesia virginiensis in Jones (1907), Wehr (1924).
All records are from the eastern border of Nebraska in old riverine forests. Recorded 27 June–31 July.
Examined material: 1 ♂, 4 ♀♀ (UNL, WSB).

Genus *Mixogaster* Macquart, 1842

Mixogaster breviventris **Kahl, 1897**. Map 31 – NEW STATE RECORD.

Examined material: **Lancaster Co.**: 1 ♀, Lincoln, 27.xiii.2018, 40.83837, –96.81578, Stenthesnake (https://www.inaturalist.org/observations/67231187).

Genus *Myolepta* Newman, 1838

Myolepta nigra **(Loew, 1872)**. Map 32.

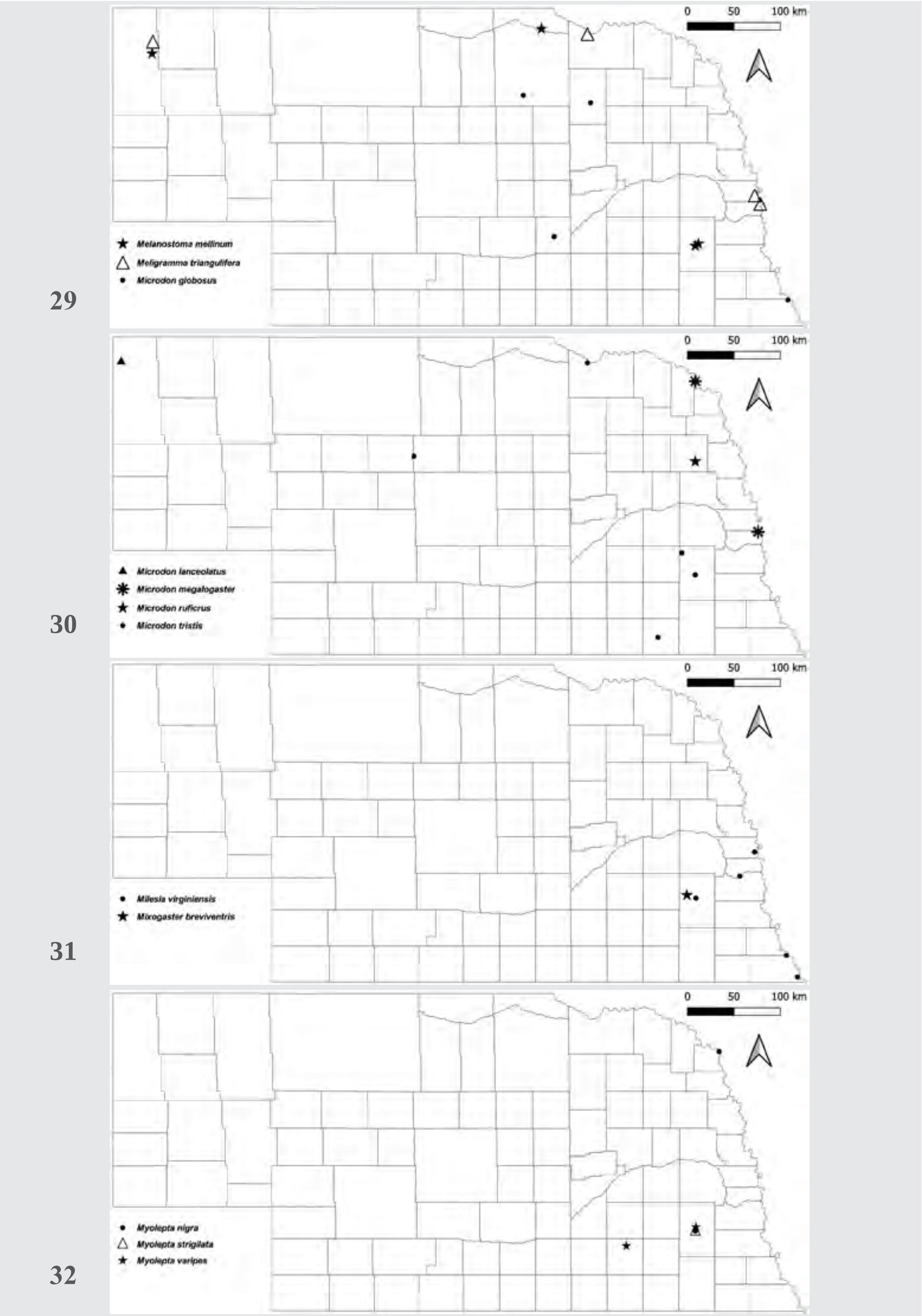
Myiolepta nigra in Wehr (1924).
♂♂ sit on shaded leaves in shrubs in a dense forest edge. They make short flights from leaf to leaf, every now and then hovering for a few seconds. The records are from forests in eastern Nebraska. Besides the two collected specimens, a picture was made of a ♂ at Ponca SP, Dixon Co. on 11 June 2003. Recorded 5 June–22 July.
Examined material: 1 ♂ 1 ♀ (UNL, WSB).

Myolepta strigilata **(Loew, 1872)**. Map 32 – NEW STATE RECORD.

All specimens were flower visiting on abundant flowering *Prunus*.
Examined material: **Lancaster Co.**: 6 ♂♂ 11 ♀♀, Lincoln, Wilderness Park, 350 m asl., 40.77, –96.71, 17.iv.2004, J. & W. van Steenis, wvs12232-38, pinned (WSB).

Myolepta varipes **(Loew, 1869)**. Map 32.

Myiolepta varipes in Jones (1907), Wehr (1924).
Recorded 8 May–16 June.
Examined material: 2 ♂♂ (UNL).



Maps 29–32: Localities of Syrphidae species in Nebraska. – **29**: *Melanostoma mellinum* (LINNAEUS), *Meligramma triangulifera* (ZETTERSTEDT), and *Microdon globosus* (FABRICIUS); – **30**: *Microdon lanceolatus* ADAMS, *M. megalogaster* SNOW, *M. ruficrus* WILLISTON, and *M. tristis* LOEW; – **31**: *Milesia virginiensis* (DRURY) and *Mixogaster breviventris* KAHL; – **32**: *Myolepta nigra* (LOEW), *M. strigilata* (LOEW), and *M. varipes* (LOEW).

Genus *Neoascia* Williston, 1887

Although there are only few records of *Neoascia* in Nebraska, J. & W. van Steenis collected all three Nebraskan species at one site on a single day: Sioux Co., Fort Robinson SP, Soldier Creek, 19 April 2004.

***Neoascia globosa* (Walker, 1849)**. Map 33.
Neoascia globosa in Skevington et al. (2019a).
Recorded 19 April–2 June.
Examined material: 7 ♂♂ 12 ♀♀ (USNM, WSB).

***Neoascia metallica* (Williston, 1882)**. Map 33.
Neoascia globosa var. *metallica* in Wehr (1924).
Neoascia metallica in Skevington et al. (2019a).
One old record (1908) is from eastern Nebraska: Bellevue, Sarpy Co. The other records are scattered over western Nebraska. Most specimens were collected flower visiting close to water. Recorded 19 April–5 August.
Examined material: 12 ♂♂ 13 ♀♀ (CSU, UNL, UNSM, WSB).

***Neoascia sandsi* Skevington, Young & Thompson, 2023**. Map 33.
Neoascia undescribed species in Skevington et al. (2019a).
Examined material: paratypes: **Keya Paha Co.**: 1 ♂, Springview, 8 mi. W, Cub Creek lake, 730 m asl., 42.82, –99.91, 20.iv.2004, J. & W. van Steenis, wvs12278, pinned (WSB); **Sioux Co.**: 1 ♂ 1 ♀, Fort Robinson SP, Soldier Creek, 1240 m asl., 42.69, –103.55, 19.iv.2004, J. & W. van Steenis, pinned, wvs12276-7 (WSB).

Genus *Neocnemodon* Goffe, 1944

The genus is in need of revision. Only ♂♂ are identifiable. Besides the ♂♂ there are also nine records of ♀♀ of *Neocnemodon* (Map 34).

***Neocnemodon calcarata* (Loew, 1866)**. Map 34.
Cnemodon calcarata in Wehr (1924).
= *Pipiza pisticoides* of Jones (1907).
Recorded April–25 July.
Examined material: 2 ♂♂ (UNL, WSB).

***Neocnemodon longiseta* (Curran, 1921)**. Map 34 – NEW STATE RECORD.
Examined material: **Lancaster Co.**: 1 ♂, Lincoln, Wilderness Park, 350 m asl., 40.77, –96.71, 14.vi.2003, W. van Steenis, wvs12281, pinned (WSB); 1 ♂, same locality, 11.vii.2003, W. van Steenis, wvs12282, pinned (WSB).

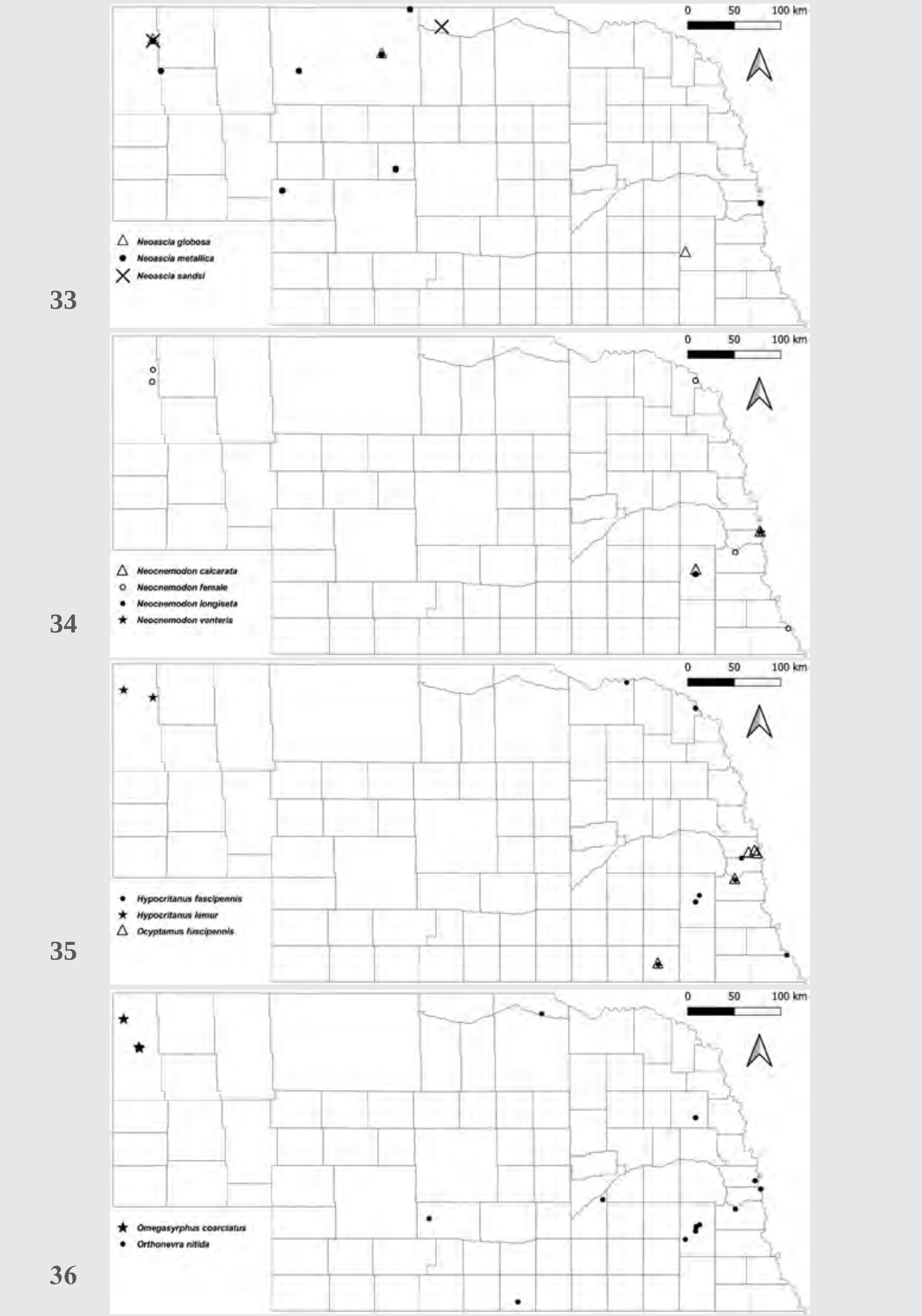
***Neocnemodon venteris* (Curran, 1921)**. Map 34 – NEW STATE RECORD.
Examined material: **Sarpy Co.**: 2 ♂♂, Bellevue, Fontenelle Forest, 290–370 m asl., 41.17, –95.89, 22.iv.2004, J. & W. van Steenis, wvs12290-1, pinned (WSB).

Genus *Ocyptamus* Macquart, 1834

***Ocyptamus fuscipennis* (Say, 1823)**. Map 35.
Baccha fuscipennis in Wehr (1924).
Five of 7 specimens, listed by Wehr (1924), are not in UNL. All records are from the eastern and south eastern border of Nebraska. Recorded 12 June–20 August.
Examined material: 5 ♂♂ 4 ♀♀ (UNL, WSB); 2 iNaturalist records.

Genus *Omegasyrphus* Giglio-Tos, 1891

***Omegasyrphus coarctatus* (Loew, 1864)**. Map 36.
Microdon coarctatus in Jones (1907), Wehr (1924).
Omegasyrphus coarctatus in Skevington et al. (2019a).
= *Microdon* (*Omegasyrphus*) *baliopterus* Loew, 1872 in Thompson (1981).



Maps 33–36: Localities of Syrphidae species in Nebraska. – **33**: *Neoascia globosa* (Walker), *N. metallica* (Williston), and *N. sandsi* Skevington, Young & Thompson; – **34**: *Neocnemodon calcarata* (Loew), *N. longiseta* (Curran), *N. venteris* (Curran), and *Neocnemodon* spp. Goffe ♀♀; – **35**: *Hypocritanus fascipennis* (Wiedemann), *H. lemur* (Osten Sacken), and *Ocyptamus fuscipennis* (Say); – **36**: *Omegasyrphus coarctatus* (Loew) and *Orthonevra nitida* (Wiedemann).

Only old records exist (1911 or older). Recorded July.
Examined material: 4 ♂♂ 1 ♀ (UNL, USNM).

Genus *Orthonevra* Macquart, 1829

Orthonevra nitida (Wiedemann, 1830). Map 36.
Chrysogaster nitidus in Jones (1907), Wehr (1924).
Orthonevra nitida in Skevington et al. (2019a).
Mostly collected close to water. Recorded 22 April–12 September.
Examined material: 16 ♂♂ 11 ♀♀ (CNC, UNL, USNM, WSB); 1 iNaturalist record.

Orthonevra parva (Shannon, 1916). Map 37.
= *Chrysogaster lata* of Jones (1907).
= *Chrysogaster robusta* of Wehr (1924).
The older records (before 1970) are from the north western corner of Nebraska. The recent records are from Springview, Keya Paha Co. These flies were visiting flowers of small *Prunus* shrubs in an open grassland habitat approximately one km from a small lake. Recorded 20 April–11 June.
Examined material: 3 ♂♂ 5 ♀♀ (UNL, WSB).

Orthonevra pictipennis (Loew, 1863). Map 37.
Chrysogaster pictipennis in Jones (1907), Wehr (1924).
Orthonevra pictipennis in Skevington et al. (2019a).
This is a rare but widespread species in Nebraska. Most specimens were collected close to water. Recorded 20 April–28 August.
Examined material: 19 ♂♂ 16 ♀♀ (UNL, UNSM, WSB).

Genus *Palpada* Macquart, 1834

Palpada furcata (Wiedemann, 1819). Map 38.
Palpada furcata in Wehr (1924).
Skevington et al. (2019a: 33) state that North American *Palpada furcata* specimens might belong to an undescribed species, based on DNA. However, there are no morphological characters to separate the two species and Skevington now has unpublished DNA evidence that refutes this and supports *furcata* as a single widely distributed species (see Skevington et al. 2023: 78).
Examined material: **Lancaster Co.**: 1 ♀, Lincoln, 360 m asl., 40.81, –96.702, vi, wvs14507, pinned (UNL).

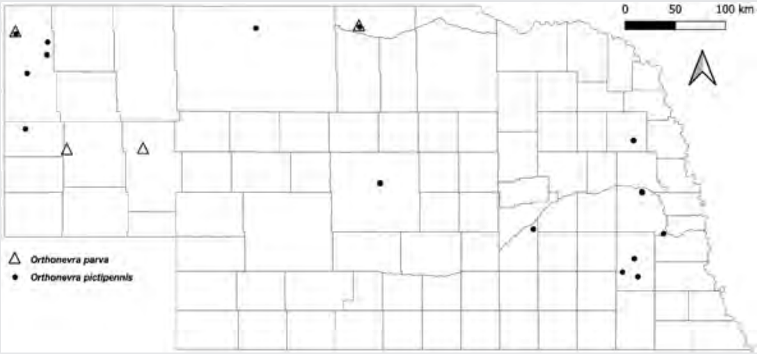
Palpada vinetorum (Fabricius, 1798). Map 38 – NEW STATE RECORD.
The first record dates back to 1993. Since then, the species has spread over the state. Four of the six records have been since 2018. Recorded 23 July–11 October.
Examined material: 1 ♂ 1 ♀ (UNL,WSB); 4 iNaturalist records.

Genus *Paragus* Latreille, 1804

Vockeroth (1986, 1992) states that the only characters to separate the species are the ♂ genitalia. However, for the specimens collected in Nebraska it appeared possible to combine the ♀♀ by matching with ♂♂ size and colour patterns.

Paragus angustifrons Loew, 1863. Map 40.
Paragus angustifrons in Wehr (1924), Vockeroth (1986).
= *Paragus bicolor* of Wehr (1924) (pro parte).
The ♀♀ of this species in Nebraska are small, with a black abdomen. The two ♀♀ referred to by Wehr (1924) are not in UNL. So the identity of these specimens (Roca, Lancaster Co., 29 April 1905 and Omaha, Douglas Co., 16 August 1913) is unresolved. Recorded 21 April–8 September.
Examined material: 14 ♂♂ 7 ♀♀ (CSU, UNL, WSB).

Paragus bispinosus Vockeroth, 1986. Map 40.
Paragus bispinosus in Vockeroth (1986), Skevington et al. (2019a).
= *Paragus bicolor* of Wehr (1924) (pro parte).
= *Paragus bicolor* var. *testaceus* of Jones (1907).



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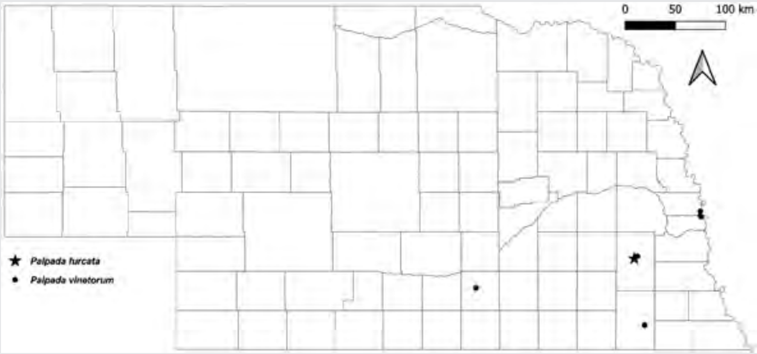

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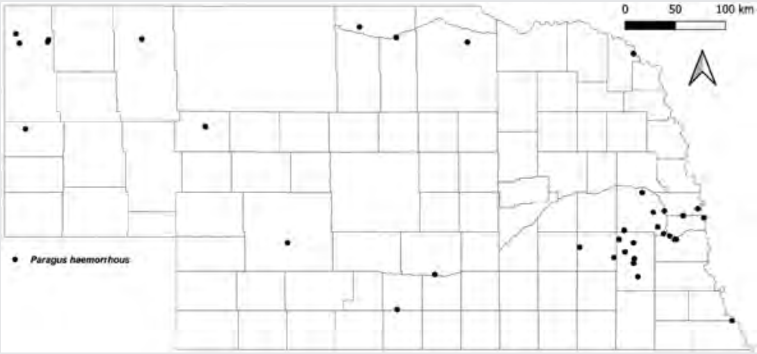

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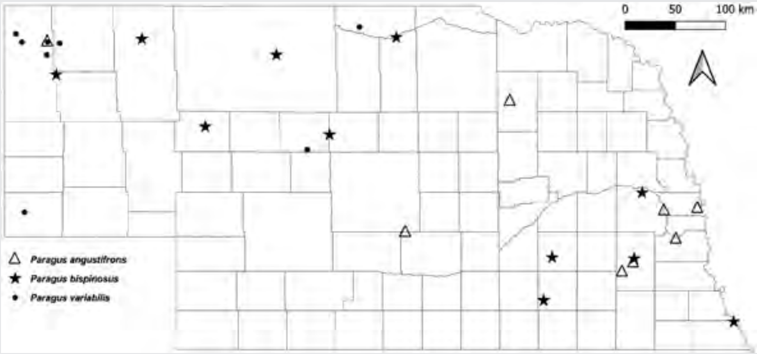

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Maps 37–40: Localities of Syrphidae species in Nebraska. – **37**: *Orthonevra parva* (SHANNON) and *O. pictipennis* (LOEW); – **38**: *Palpada furcata* (WIEDEMANN) and *P. vinetorum* (FABRICIUS); – **39**: *Paragus haemorrhous* MEIGEN; – **40**: *Paragus angustifrons* LOEW, *P. bispinosus* VOCKEROTH, and *P. variabilis* VOCKEROTH.

The ♀♀ of this species in Nebraska are rather large for *Paragus*, with dark reddish abdominal segments and a coppery shine. The older records are widespread over north western and south eastern Nebraska. In 2003 the species was only collected in small marshes protected as Federal Waterfowl Production Areas. If that is the habitat for the species, the three year drought might be an explanation for the low number of records in 2003. Recorded April–12 September.
Examined material: 12 ♂♂ 9 ♀♀ (CNC, UNL, WSB).

Paragus haemorrhous Meigen, 1822. Map 39.

Paragus haemorrhous in Vockeroth (1986), Skevington et al. (2019a).
Paragus dimidiatus Loew, 1863 in Wehr (1924).
Paragus tibialis var. *haemorrhous* in Jones (1907).
Paragus tibialis (Fallén, 1817) in Wehr (1924).
The ♀ is easy to recognise since it belongs to the subgenus *Pandasyophthalmus* Stuckenberg, 1954. The species is widespread in Nebraska. It is one of the few species also recorded in the dry areas of Nebraska. Most of the records are from grassland habitats. Recorded 19 April–12 September.
Examined material: 51 ♂♂ 23 ♀♀ (CNC, UNL, WSB); 1 iNaturalist record.

Paragus variabilis Vockeroth, 1986. Map 40.

Paragus variabilis in Vockeroth (1986).
= *Paragus bicolor* of Wehr (pro parte).
Females of this species in Nebraska are rather large with most abdominal segments orange red. The species is restricted to western Nebraska with two central Nebraska records. Recorded 19–20 April and 6 August–12 September.
Examined material: 7 ♂♂ 4 ♀♀ (CSU, UNL, WSB).

Genus *Parhelophilus* Girschner, 1897

Parhelophilus integer (Loew, 1863). Map 41 – NEW STATE RECORD.

The specimens identified by Wehr (1924) as *Parhelophilus integer* all belong to *P. laetus* (Loew, 1863). *Parhelophilus integer* is recorded from Belleview, Sarpy Co.; Fremont, Dodge Co. and Lincoln, Lancaster Co. Recorded 21–25 July.
Examined material: 1 ♂ (WSB); 2 iNaturalist records

Parhelophilus laetus (Loew, 1863). Map 41.

Helophilus laetus in Jones (1907), Wehr (1924).
= *Helophilus integer* of Jones (1907), Wehr (1924).
A widespread species in Nebraska. Most records are from wet areas along creeks, rivers and lakes. Recorded 22 May–10 September.
Examined material: 37 ♂♂ 2 ♀♀ (CSU, UNL, WSB); 1 iNaturalist record.

Genus *Pipiza* Fallén, 1810

Pipiza cribbeni Coovert, 1996. Map 42– NEW STATE RECORD.

Examined material: **Cass Co.**: 1 ♀, South Bend, Platte River SP, 320 m asl., 40.98, –96.21, 23.iv.2004, W. van Steenis, wvs12428, pinned (WSB); **Lancaster Co.**: 1 ♀, Denton, Spring Creek Prairie, 400 m asl., 40.69, –96.84, 27.iv.2004, W. van Steenis, wvs12429, pinned (WSB).

Pipiza femoralis Loew, 1866. Map 42.

Pipiza femoralis in Jones (1907), Wehr (1924).
= *Pipiza festiva* of Jones (1907).
Most records are from forests in the Lincoln/Omaha area. Recorded March–8 June.
Examined material: 31 ♂♂ 8 ♀♀ (UNL, WSB).

Genus *Platycheirus* Lepeletier & Serville, 1828

iNaturalist has 6 records, but their identification from photos was not possible.

Platycheirus coerulescens (Williston, 1887). Map 43 – NEW STATE RECORD.

Platycheirus coerulescens is restricted to the panhandle of western Nebraska. Most of the collected specimens were flower visiting on *Prunus*, some on *Salix* sp. Recorded 17 April–19 April.
Examined material: 7 ♂♂ 4 ♀♀ (WSB).

Platycheirus hyperboreus **(STAEGER, 1845)**. Map 43.
Platychirus hyperboreus in WEHR (1924).
Platycheirus hyperboreus in VOCKEROTH (1990), YOUNG et al. (2016).
Recorded: 20 April–13 June.
Examined material: 2 ♂♂ (UNL, WSB); 1 ♀ in WEHR (1924).

Platycheirus immarginatus **(ZETTERSTEDT, 1849)**. Map 44.
Platycheirus immarginatus in VOCKEROTH 1990.
= *Platychirus chaetopodus* of WEHR (1924) (pro parte).
Collected 9 May (Lincoln, Lancaster Co.) and 5–23 August (north western Nebraska).
Examined material: 10 ♂♂ 1 ♀ (UNL, WSB).
VOCKEROTH (1990) maps additional records in the north western part of Nebraska, probably in Cherry, Scotts Bluff, Sioux, and Sheridan Counties.

Platycheirus pictipes **(BIGOT, 1884)**. Map 44.
Melanostoma concinnum SNOW, 1895 in WEHR (1924).
Platycheirus concinnus in VOCKEROTH (1990).
Examined material: **Sioux Co.**: 1 ♂, Monroe Canyon, 1350 m asl., 42.76, –103.92, 9.viii.1908, L. BRUNER, wvs14605, pinned (UNL).

Platycheirus quadratus **(SAY, 1823)**. Map 45.
Platychirus quadratus in JONES (1907), WEHR (1924).
Platycheirus quadratus in VOCKEROTH (1990).
This species is one of the most common flower flies in Nebraska. The species prefers wet grasslands, reed beds and bulrush vegetations.
Among the abundant *Platycheirus quadratus* it can be difficult to distinguish other orange *Platycheirus* species, especially ♀♀. WEHR (1924) lists 32 ♀♀, these are not in UNL. Recorded 15 April–14 October.
Examined material: 135 ♂♂ 143 ♀♀ (CSU, UNL, WSB).

Platycheirus scambus **(STAEGER, 1843)**. Map 44.
Platychirus chaetopodus WILLISTON, 1887 in JONES (1907), WEHR (1924) (pro parte).
Platycheirus scambus in VOCKEROTH (1990), SKEVINGTON et al. (2019a).
Examined material: **Sioux Co.**: 1 ♂, 42.49, –103.72, J.M. ALDRICH Collection, pinned, USNM_ENT248128 (USNM); 2 ♂♂, 42.49, –103.72, wvs14678-9, pinned (UNL).

Platycheirus stegnus **(SAY, 1829)**. Map 45.
Platycheirus stegnus in VOCKEROTH (1990) (map record).
The species is restricted to the western half of North America (YOUNG et al. 2016). The records from Nebraska are the most eastern records of the species. Recorded 18 April–23 June.
Examined material: 3 ♂♂ 2 ♀♀ (WSB).

Genus *Polydontomyia* WILLISTON, 1896

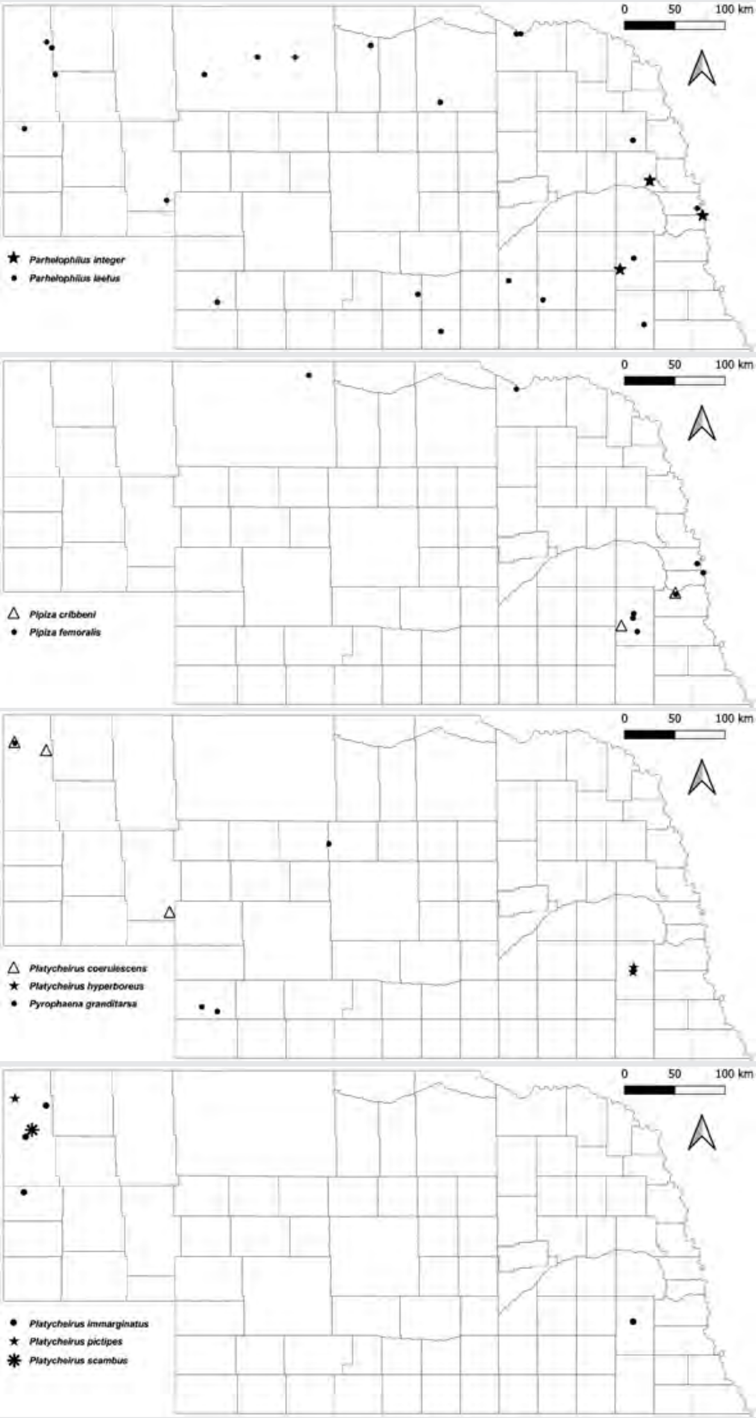
Polydontomyia curvipes **(WIEDEMANN, 1830)**. Map 46.
Triodonta curvipes in JONES (1907).
Polydontomyia curvipes in WEHR (1924).
This is a rare fly throughout Nebraska. Recorded 23 June–3 September.
Examined material: 4 ♂♂ 7 ♀♀ (UNL, WSB); 3 iNaturalist records.

Genus *Pseudoscaeva* VOCKEROTH, 1969

Pseudoscaeva diversifasciata **(KNAB, 1914)**. Map 46 – NEW STATE RECORD.
A ♀ was flying through dense, high willow *Salix* shrubs in the floodplain of the Niobrara River.
Examined material: **Knox Co.**: 1 ♀, Niobrara, 2 mi. NW, Niobrara State Park, 450 m asl., 42.76, –98.07, 20.iv.2004, J. & W. VAN STEENIS, wvs12631, pinned (WSB).

Genus *Pterallastes* LOEW, 1863

Pterallastes thoracicus **LOEW, 1863**. Map 47.
Pterallastes thoracicus in WEHR (1924), SKEVINGTON et al. (2019a).



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Maps 41–44: Localities of Syrphidae species in Nebraska. – **41**: *Parhelophilus integer* (Loew) and *P. laetus* (Loew); – **42**: *Pipiza cribbeni* Coovert and *P. femoralis* Loew; – **43**: *Platycheirus coerulescens* (Williston), *P. hyperboreus* (Staeger), and *Pyrophaena granditarsis* (Forster); – **44**: *Platycheirus immarginatus* (Zetterstedt), *P. pictipes* (Bigot), and *P. scambus* (Staeger).

Most specimens were collected in forests in the Missouri Valley. Collected 26 May–September.
Examined material: 11 ♂♂ (UNL, WSB); 3 iNaturalist records.

Genus *Pyrophaena* Schiner, 1860

***Pyrophaena granditarsa* (Forster, 1771)**. Map 43.
Pyrophaena ocymi (Fabricius, 1794) in Wehr (1924).
Platycheirus granditarsis in Vockeroth (1990), Young et al. (2016).
Pyrophaena granditarsa is an uncommon species in northern and western Nebraska. Recorded 19 June–7 August.
Examined material: 3 ♂♂ 2 ♀♀ (UNL, WSB).

Genus *Rhingia* Scopoli, 1763

***Rhingia nasica* Say, 1823**. Map 47.
Rhingia nasica in Jones (1907), Wehr (1924).
Rhingia nasica is only collected in 1905. Recorded 29 April–29 May.
Examined material: 10 ♂♂ 5 ♀♀ (UNL, WSB).

Genus *Scaeva* Fabricius, 1805

***Scaeva affinis* Say, 1823**. Map 48.
= *Lasiopthicus pyrastri* of Jones (1907).
= *Scaeva pyrastri* of Wehr (1924).
Recorded in the eastern and western parts of Nebraska. Recorded May–September.
Examined material: 5 ♂♂ 4 ♀♀ (UNL, WSB).

Genus *Sericomyia* Meigen, 1803

***Sericomyia lata* (Coquillett, 1907)**. Map 48.
Condidea lata in Jones (1907), Wehr (1924).
Examined material: **Sioux Co.**: 1 ♀, Jim Creek, 1110 m asl., 42.91, –103.74, 22.vi.1901, M. Cary, wvs14711, pinned (UNL); 1 ♀, Warbonnet Canyon, 1460 m asl., 42.77, –103.95, 22.vi.1901, C. Crawford, wvs14710, pinned (UNL).

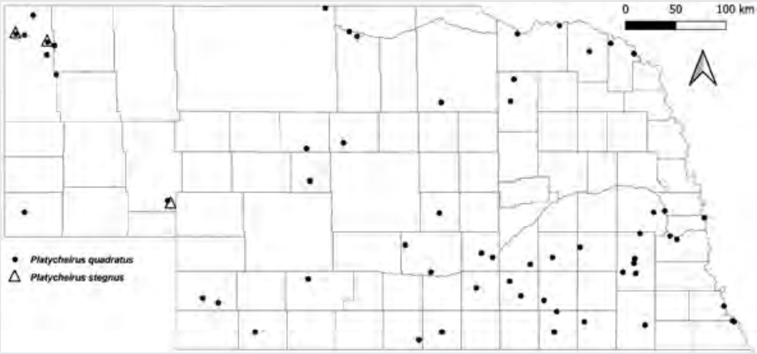
Genus *Somula* Macquart, 1847

***Somula decora* Macquart, 1847**. Map 48.
Somula decora in Jones (1907), Wehr (1924), Skevington et al. (2019a).
Recorded from older forests along Missouri and Platte Rivers and one ♂ from Wilderness Park, Lincoln, Lancaster Co. Recorded 5 May–4 July.
Examined material: 12 ♂♂ 1 ♀ (UNL, WSB).

Genus *Sphaerophoria* Lepeletier & Serville, 1828

***Sphaerophoria contigua* Macquart, 1847**. Map 49.
Sphaerophoria cylindrica (Say, 1824) in Jones (1907), Wehr (1924).
Sphaerophoria contigua in Knutson (1973), Skevington et al. (2019a).
= Allograpta fracta of Jones (1907)
Sphaerophoria contigua is one of the most widespread and abundant flower flies in Nebraska. It occurs in all open, grassy or marshy habitats except for the driest parts. Recorded 15 April–14 October.
Examined material: 176 ♂♂ 79 ♀♀ (CNC, CSU, MCZ, UNL, WSB); 7 iNaturalist records.

***Sphaerophoria philanthus* (Meigen, 1822)**. Map 50.
Sphaerophoria philanthus in Knutson (1973)
= *Sphaerophoria scripta* of Wehr (1924)
= *Sphaerophoria sulphuripes* of Jones (1907).
A widespread species in eastern and northern Nebraska. Most specimens were collected in the vicinity of rivers and lakes. The species is more confined to wet grasslands than *S. contigua*. ♀♀ are recorded



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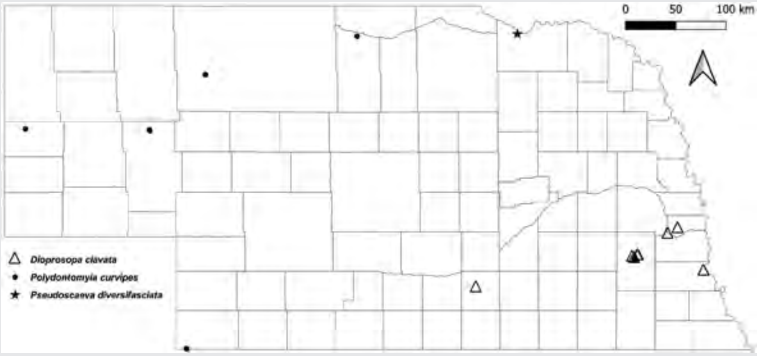

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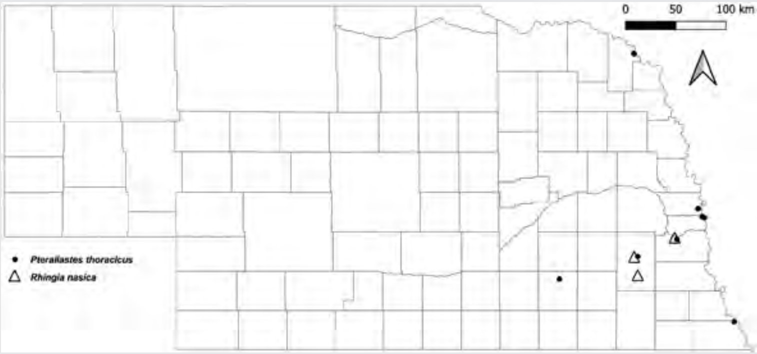

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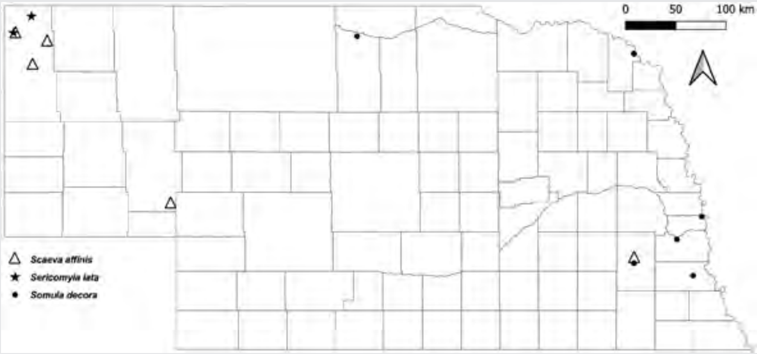

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Maps 45–48: Localities of Syrphidae species in Nebraska. – **45**: *Platycheirus quadratus* (Say) and *P. stegnus* (Say); – **46**: *Polydontomyia curvipes* (Wiedemann), *Dioprosopa clavata* (Fabricius), and *Pseudoscaeva diversifasciata* (Knab); – **47**: *Pterallastes thoracicus* Loew and *Rhingia nasica* Say; – **48**: *Scaeva affinis* Say, *Sericomyia lata* (Coquillett), and *Somula decora* Macquart.

separately on the map, since it is not possible to separate them from several closely related species, that are not yet recorded in Nebraska. Recorded 15 April–11 June (♀♀ 13 April–31 August).
Examined material: 26 ♂♂ 10 ♀♀ (UNL, WSB).

***Sphaerophoria pyrrhina* BIGOT, 1884**. Map 49.
Sphaerophoria pyrrhina in SKEVINGTON et al. (2019a).
Examined material: **Cherry Co.**: 1 ♂, Snake River, 42.555948, –101.892799, 2.vi.1969, W. W. WIRTH, pinned, USNM_ENT247280 (USNM); **Douglas Co.:** Omaha, Karen Street, 41.21327, –96.1464, 31.v.2020, Rachel Hall (https://www.inaturalist.org/observations/48124117).

Genus *Sphecomyia* LATREILLE, 1829

***Sphecomyia vittata* (WIEDEMANN, 1830)**. Map 51.
Sphecomyia vittata in WEHR (1924).
All records are from old growth forests. Recorded 17 May–20 June.
Examined material: 2 ♂♂ 2 ♀♀ (UNL); 1 iNaturalist record.

Genus *Sphegina* MEIGEN, 1822

***Sphegina campanulata* ROBERTSON, 1901**. Map 51 – NEW STATE RECORD.
Examined material: **Cass Co.**: 2 ♂♂ 1 ♀, South Bend, Platte River SP, 320 m asl., 40.98, –96.21, 22.v.2003, W. VAN STEENIS, wvs12823 12825 13414, pinned (WSB); **Lancaster Co.**: 3 ♂♂ 1 ♀, Denton, Spring Creek Prairie, on flowering *Prunus*, 400 m asl., 40.69, –96.84, 27.iv.2004, W. VAN STEENIS, wvs12824, 12826-7, pinned (WSB).

***Sphegina flavimana* MALLOCH, 1922**. Map 52.
= *Sphegina latimana* of WEHR (1924).
The species is recorded along the northern and eastern edges of Nebraska. The Sioux Co. records are the most western records of the species in North America. Most specimens were flying low through the vegetation along small creeks with a lustrous understory and a dense cover of trees. Recorded 27 May–3 August.
Examined material: 7 ♂♂ 15 ♀♀ (UNL, WSB).

***Sphegina keeniana* WILLISTON, 1887**. Map 52 – NEW STATE RECORD.
The ♂ flew together with two ♂♂ and a ♀ of *Sphegina campanulata*, the ♀ with a ♀ *S. flavimana*.
Examined material: **Cass Co.**: 1 ♂, South Bend, Platte River SP, 320 m asl., 40.98, –96.21, 22.v.2003, W. VAN STEENIS, wvs12846, pinned (WSB); 1 ♀, same locality, 6.vi.2003, W. VAN STEENIS, wvs12845, pinned (WSB).

Genus *Spilomyia* MEIGEN, 1803

***Spilomyia alcimus* (WALKER, 1849)**. Map 53 – NEW STATE RECORD.
Spilomyia alcimus is a species of older forests in eastern Nebraska. ♀♀ were seen flying fast through flowering *Cornus*, resting only very briefly on the flowers. Recorded 5–26 June.
Examined material: 2 ♂♂, 5 ♀♀ (UNL, WSB); 6 iNaturalist records.

***Spilomyia longicornis* LOEW, 1872**. Map 53.
Spilomyia longicornis in WEHR (1924).
Recorded 28 August–14 October.
Examined material: 2 ♂♂ (UNL, WSB); 6 iNaturalist records.

***Spilomyia sayi* GOOT, 1964**. Map 53.
Spilomyia quadrifasciatus Say, 1824 in JONES (1907), WEHR (1924).
Most records are a century old. The species is recorded in the eastern river valleys and the northern borders of Nebraska. Recorded 14 August–22 September.
Examined material: 5 ♂♂ 15 ♀♀ (UNL, WSB); 1 iNaturalist record.

Genus *Syritta* Lepeletier & Serville, 1828

***Syritta flaviventris* Macquart, 1842**. Map 54– NEW STATE RECORD.

Syritta flaviventris is a recently established species in North America (Thompson et al. 1990). In Nebraska it is now recorded from Buffalo, Douglas, and Lancaster Counties. Recorded 19 August–19 October.
Examined material: 2 ♂♂ (WSB); 2 iNaturalist records.

***Syritta pipiens* (Linnaeus, 1758)**. Map 54.

Syritta pipiens in Jones (1907), Wehr (1924), Skevington et al. (2019a).
A common species throughout Nebraska except for the driest parts. Recorded 15 April–25 October.
Examined material: 117 ♂♂ 101 ♀♀ (CSU, UNL, WSB); 16 iNaturalist records.

Genus *Syrphus* Fabricius, 1775

***Syrphus currani* Fluke, 1939**. Map 55 – NEW STATE RECORD.

= *Syrphus ribesii* of Wehr (1924) (pro parte).
Examined material: **Douglas Co.**: 1 ♀, Omaha, 370 m asl., 41.25, –95.96, 3.vii.1913, L. T. Williams, wvs14043, pinned (UNL); **Sioux Co.**: 1 ♀, Bad Lands, 1360 m asl., 42.77, –103.92, 10.viii.1908, R. W. Dawson, wvs14042, pinned (UNL); 1 ♀, Glen, 1360 m asl., 42.58, –103.56, 8.viii.1905, wvs14041, pinned (UNL).

***Syrphus intricatus* Vockeroth, 1983**. Map 55 – NEW STATE RECORD.

= *Syrphus ribesii* of Wehr (1924) (pro parte).
This western species is collected in the western panhandle of Nebraska, probably the most eastern records of this species in North America. All characters fit with the keys and description of Vockeroth (1983, 1992), except for the completely yellow femora in the ♀. In his species descriptions Vockeroth (1983, 1992) states: "legs … as in male" [= "Fore and mid femora black on about basal 1/3, hind femur black with up to apical 1/3 yellow"]. But in the keys in both publications the ♀ has "Hind femur yellow, at most very obscurely darkened preapically". So probably the ♀♀ may have completely yellow femora. Recorded 18–19 April with one record 11 July.
Examined material: 5 ♂♂ 7 ♀♀ (UNL, WSB).

***Syrphus knabi* Shannon, 1916**. Map 55 – NEW STATE RECORD.

= *Syrphus ribesii* of Wehr (1924) (pro parte).
Most records are from eastern Nebraska, mostly in riverine forests along the Missouri River. Some of the specimens are reared as larvae, feeding on "ashplant lice". Recorded 21 April–29 August.
Examined material: 10 ♂♂ 11 ♀♀ (UNL, WSB); 1 iNaturalist record.

***Syrphus opinator* Osten Sacken, 1877**. Map 56.

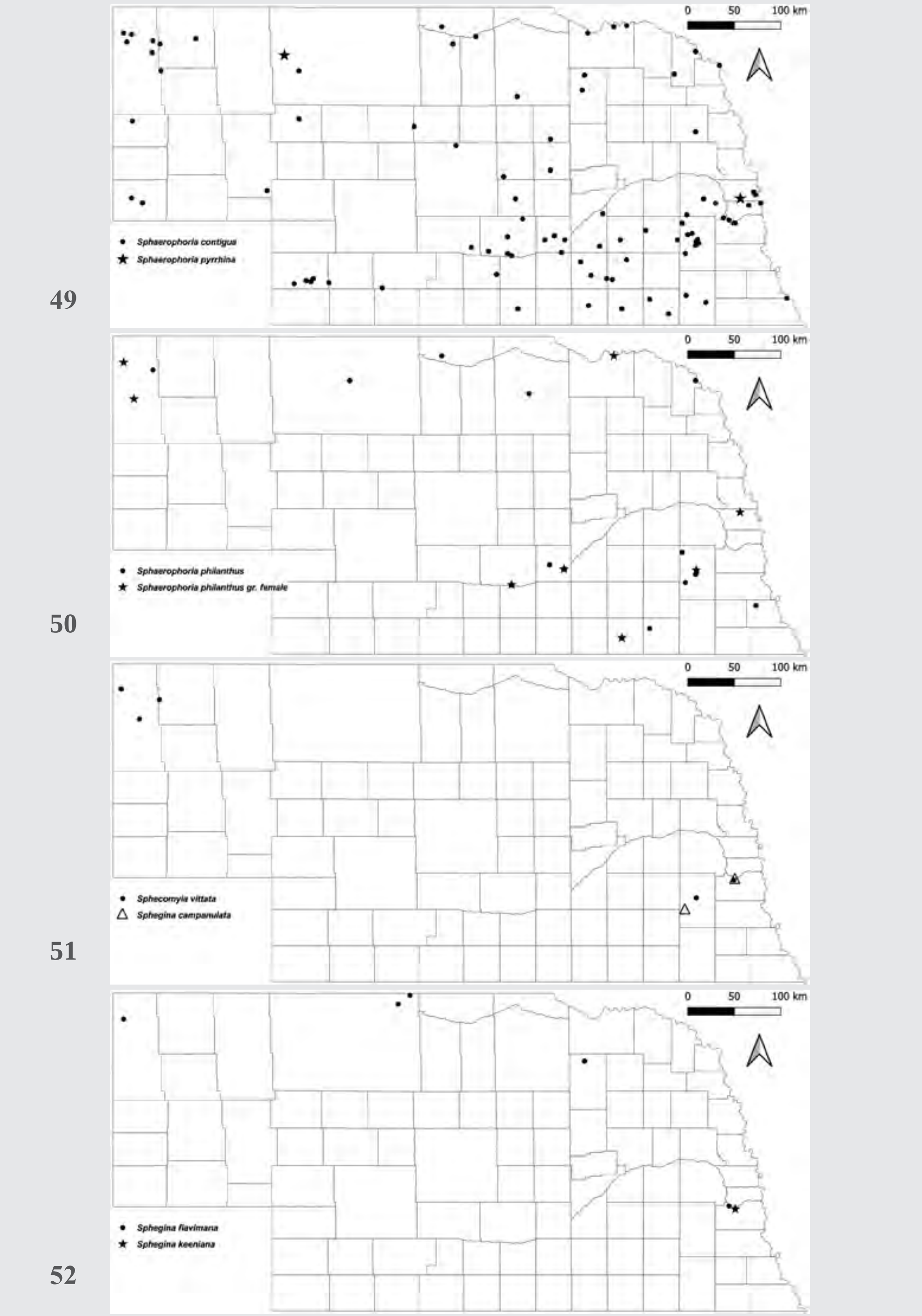
Syrphus opinator in Wehr (1924) (pro parte).
All records are from Sioux Co. Recorded 6–20 August.
Examined material: 1 ♂ 5 ♀♀ (UNL).

***Syrphus rectus* Osten Sacken, 1875**. Map 56.

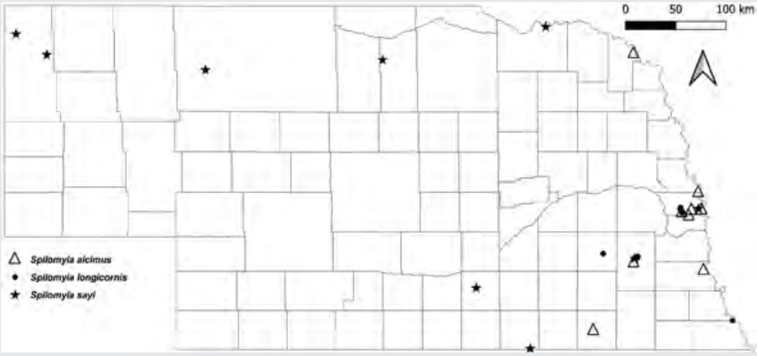
= *Syrphus ribesii* of Wehr (1924) (pro parte).
The records are confined to a small area around the larger cities in eastern Nebraska: Lincoln, Lancaster Co., Omaha, Douglas Co., and Fontenelle Forest, Sarpy Co. The ♂♂ are difficult to separate from ♂♂ of *S. vitripennis* Meigen, 1822. Two ♂♂ were collected before 1920. Since the first record of *Syrphus vitripennis* from Nebraska is from 2003, the two old ♂♂ probably belong to *S. rectus*.
Recorded 28 June–5 October. One ♂ was collected 13 April.
Examined material: 2 ♂♂ 5 ♀♀ (UNL, WSB); 1 iNaturalist record.

***Syrphus ribesii* (Linnaeus, 1758)**. Map 57.

Syrphus ribesii in Jones (1907), Wehr (1924) (pro parte).
Most specimens listed by Wehr (1924) as *Syrphus ribesii* in the UNL collection belong to other species of *Syrphus*. *Syrphus ribesii* is widely distributed in eastern and north western Nebraska. Most specimens were found flower visiting in open forests, forest edges, and small woodland patches. Recorded 10 April–8 September.
Examined material: 16 ♂♂ 19 ♀♀ (UNL, WSB).



Maps 49–52: Localities of Syrphidae species in Nebraska. – **49**: *Sphaerophoria contigua* MACQUART and *S. pyrrhina* BIGOT; – **50**: *Sphaerophoria philanthus* (MEIGEN); – **51**: *Sphecomyia vittata* (WIEDEMANN) and *Sphegina campanulata* ROBERTSON; – **52**: *Sphegina flavimana* MALLOCH and *S. keeniana* WILLISTON.



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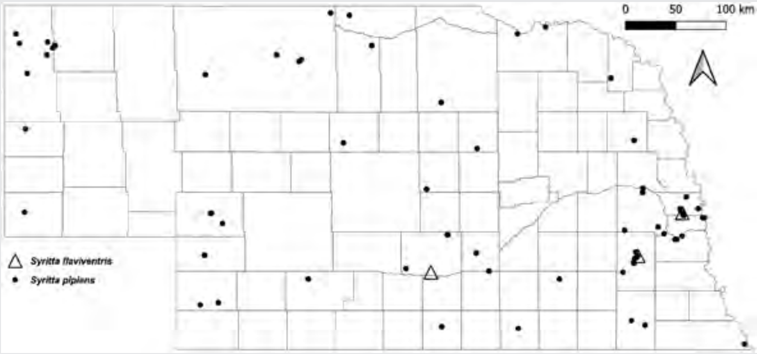

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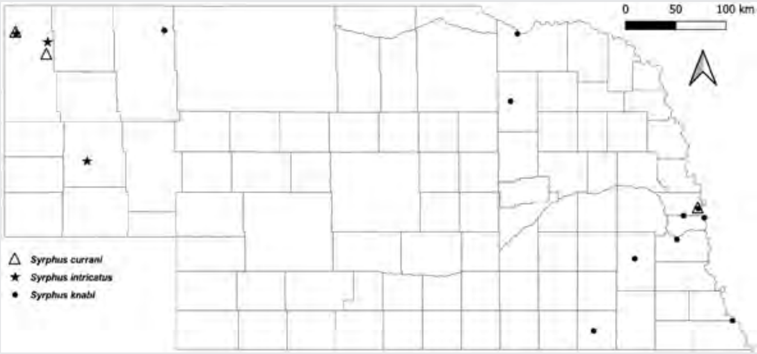

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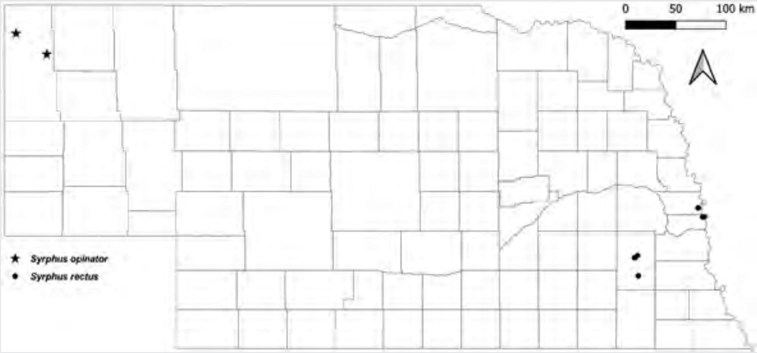

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Maps 53–56: Localities of Syrphidae species in Nebraska. – **53**: *Spilomyia alcimus* (Walker), *S. longicornis* Loew, and *S. sayi* Goot; – **54**: *Syritta flaviventris* Macquart and *S. pipiens* (Linnaeus); – **55**: *Syrphus currani* Fluke, *S. intricatus* Vockeroth, and *S. knabi* Shannon; – **56**: *Syrphus opinator* Osten Sacken and *S. rectus* Osten Sacken.

***Syrphus sonorensis* VOCKEROTH, 1983**. Map 58 – NEW STATE RECORD.

= *Syrphus ribesii* of WEHR (1924) (pro parte).
The only specimen of this western species completely fits the descriptions of VOCKEROTH (1983, 1992).
Examined material: **Sioux Co.**: 1 ♀, Harrison, 1480 m asl., 42.68, –103.88, 9.viii.1908, C. H. GABLE, wvs15084 pinned (UNL).

***Syrphus torvus* OSTEN SACKEN, 1875**. Map 58.

Syrphus torvus in WEHR (1924).
A widespread species in Sioux Co. One record is from Knox Co. The ♂♂ were flower visiting on *Prunus*. Recorded 18 April–18 August.
Examined material: 7 ♂♂ 3 ♀♀ (UNL, WSB).

***Syrphus vitripennis* MEIGEN, 1822**. Map 58 – NEW STATE RECORD.

The first record of *Syrphus vitripennis* in Nebraska is from 2003. The records are from the eastern and north western borders of the state. The ♂♂ are difficult to separate from those of *S. rectus*. Since *S. rectus* is an eastern species the only western ♂, from Sioux Co., probably belongs to *S. vitripennis*. Recorded 18–27 June.
Examined material: 1 ♂ 7 ♀♀ (UNL, WSB).

Genus *Temnostoma* LEPELETIER & SERVILLE, 1828

The old specimen(s?) of *Temnostoma* are lost. The only record under *Temnostoma* in WEHR (1924) is a ♀. Based on information of F. C. THOMPSON this was a ♀ *T. balyras* (WALKER, 1849). In iNaturalist there are two records that cannot be identified to species.

***Temnostoma balyras* (WALKER, 1849)**. Map 59.

= *Temnostoma bombylans* of WEHR (1924), according to THOMPSON (pers. comm.).
The Niobrara State Park, Knox Co. ♀ was collected together with a ♂ and a ♀ of *T. barberi* while sunning on leaves in the forest edge close to the riverside of the Missouri River.
Examined material: **Antelope Co.**: 1 ♀, Neligh, 536 m asl., 42.12, –98.03, 22.vi, W. THOMPSON [in WEHR (1924), lost]; **Knox Co.**: 1 ♀, Niobrara, 2 mi. NW, Niobrara State Park, 450 m asl., 42.76, –98.07, 12.vi.2003, W. VAN STEENIS, wvs12933, pinned (WSB).

***Temnostoma barberi* CURRAN, 1939**. Map 59.

Temnostoma barberi in SKEVINGTON et al. (2019a).
Most were seen sunning on leaves of shrubs in the forest edge close to the riverside of the Missouri River. Recorded 2–12 June.
Examined material: 2 ♂♂ 2 ♀♀ (USNM, WSB).

Genus *Toxomerus* MACQUART, 1855

***Toxomerus geminatus* (SAY, 1823)**. Map 60.

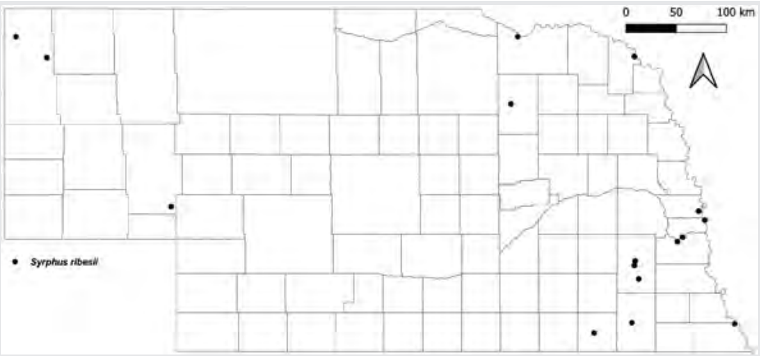
Mesogramma geminata in JONES (1907).
Toxomerus geminatus in WEHR (1924).
A widespread species in eastern Nebraska, mostly found in moist grasslands with flowering plants. In the western United States *T. geminatus* is replaced by *T. occidentalis* CURRAN, 1922, a closely related species. Recorded 22 April–10 September.
Examined material: 110 ♂♂ 22 ♀♀ (UNL, WSB); 15 iNaturalist records.

***Toxomerus marginatus* (SAY, 1823)**. Map 61.

Mesogramma marginata in JONES (1907), WEHR (1924).
Toxomerus marginatus in SKEVINGTON et al. (2019a).
This is the most common species in Nebraska. On hot days in the central and western grasslands this is the only active flower fly species. Recorded 17 April–14 October.
Examined material: 299 ♂♂ 249 ♀♀ (CNC, CSU, UNL, USNM, WSB); 132 iNaturalist records.

***Toxomerus politus* (SAY, 1823)**. Map 60.

Mesogramma polita in JONES 1907, WEHR (1924).



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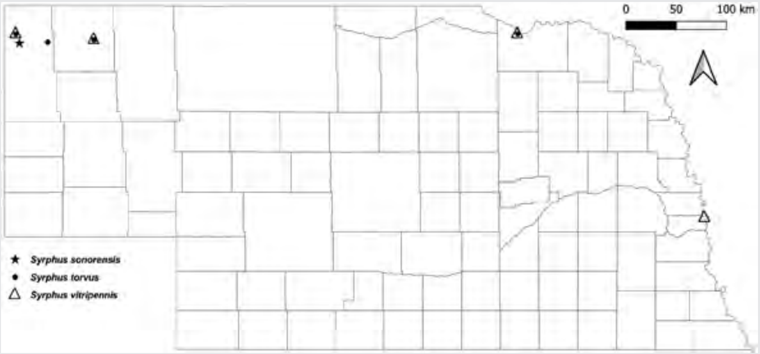

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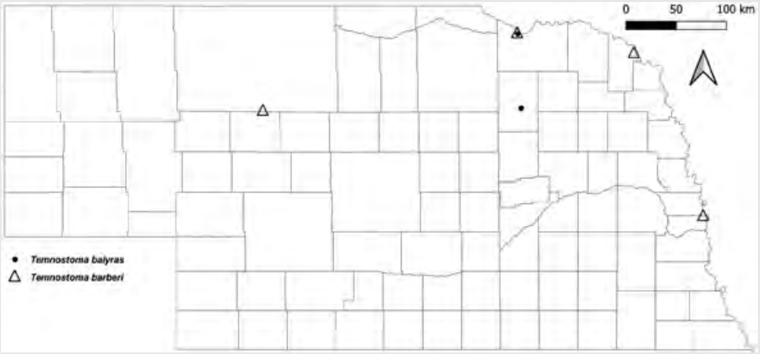

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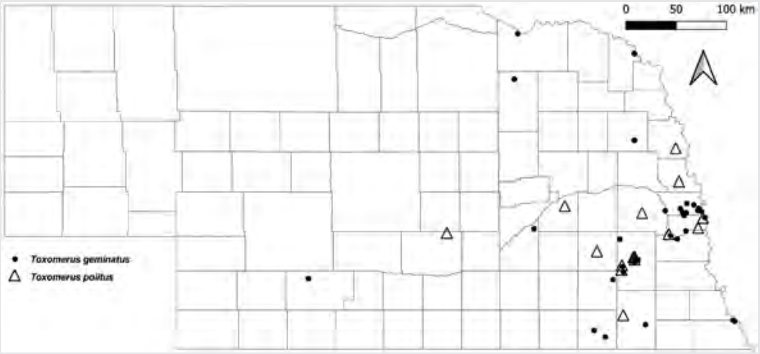

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Maps 57–60: Localities of Syrphidae species in Nebraska. – **57**: *Syrphus ribesii* (Linnaeus); – **58**: *Syrphus sonorensis* Vockeroth, *S. torvus* Osten Sacken, and *S. vitripennis* Meigen; – **59**: *Temnostoma balyras* (Walker) and *T. barberi* Curran; – **60**: *Toxomerus geminatus* (Say) and *T. politus* (Say).

Most records are from eastern Nebraska. Recorded 23 July–24 September.
Examined material: 3 ♂♂ 2 ♀♀ (UNL); 14 iNaturalist records.

Genus *Trichopsomyia* WILLISTON, 1888

Trichopsomyia apisaon (WALKER, 1849). Map 62 – NEW STATE RECORD.

All records of *Trichopsomyia apisaon* are single specimens from southern Nebraska. One ♀ is damaged, but probably also belongs to this species. It is included in the numbers below and the map. Recorded 25 May–24 July with the damaged ♀ on 7 September.
Examined material: 1 ♂ 3 ♀♀ (UNL, WSB).

Trichopsomyia banksi (CURRAN, 1921). Map 62 – NEW STATE RECORD.

This species has a south eastern distribution. There are a slightly different ♂ and ♀ from north central Nebraska. The ♂ has very swollen metabasitarsi. The ♀ has less microtrichose wings. Recorded 15 June–20 October.
Examined material: 7 ♂♂ 1 ♀ (WSB); 1 iNaturalist record.
Examined material (slightly different specimens): Brown Co.: 1 ♀, Keller Park SRA, 686 m asl., 42.66, –99.77, 13.vi.2000, B. KONDRATIEFF & R. ZUELLIG, pinned (WSB); **Thomas Co.**: 1 ♂, Hwy 83, Dismal R., 870 m asl., 41.77, –100.53, 12.vi.2000, B. KONDRATIEFF & R. ZUELLIG, pinned (WSB).

Trichopsomyia pubescens (LOEW, 1863). Map 62.

Trichopsomyis pubescens in SKEVINGTON et al. (2019a).
= *Pipizella pulchella* of WEHR (1924).
Recorded 12 June–20 August.
Examined material: 1 ♂ 3 ♀♀ (CNC, UNL, WSUC).

Trichopsomyia recedens (WALKER, 1852). Map 62.

Trichopsomyia recedens in SKEVINGTON et al. (2019a).
Examined material: **Sioux Co.**: 1 ♀, 7 mi. N. Harrison, collected on *Helianthus*, 42.788494, –103.882753, 13.viii.1962, J. G. & B. L. ROZEN, pinned, Jeff_SKEVINGTON_Specimen26684 (AMNH).

Genus *Tropidia* MEIGEN, 1822

Tropidia albistylum MACQUART, 1847. Map 63 – NEW STATE RECORD.

There are two iNaturalist records of ♀♀ of this species, both from Lincoln, Lancaster Co. Recorded 18 July–19 September.
Examined material: 2 iNaturalist records.

Tropidia mamillata LOEW, 1861. Map 63.

Tropidia mamillata in JONES (1907), WEHR (1924), SKEVINGTON et al. (2019a).
There is one record of four specimens. WEHR (1924) listed three ♂♂ and a ♀. In UNL there are 3 ♂♂ and in USNM there is one ♂.
Examined material: **Saunders Co.**: 3 ♂♂, Cedar Bluffs, 400 m asl., 41.39 , –96.61, iv, wvs15395-6, pinned (UNL); 1 ♂, same locality, pinned, USNM_ENT248542 (USNM).

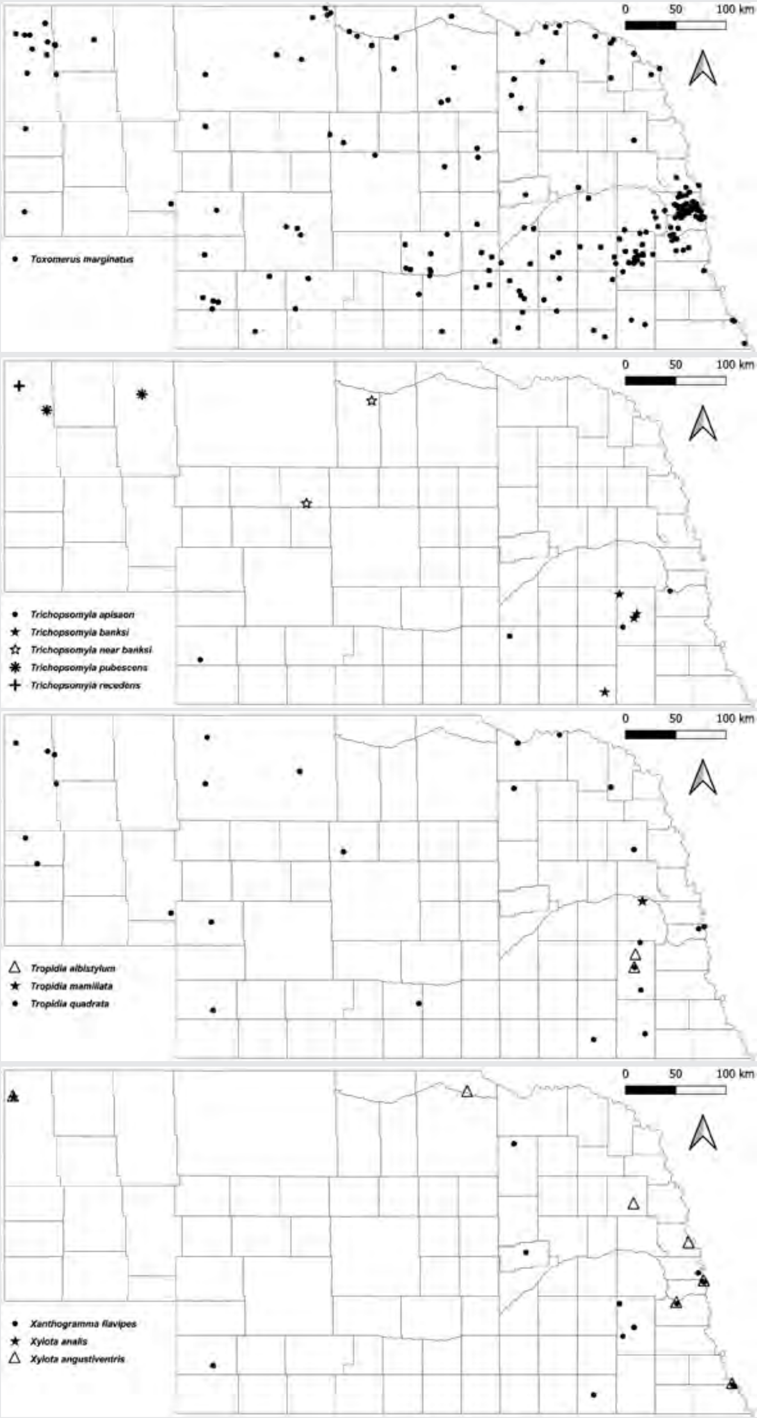
Tropidia quadrata (SAY, 1824). Map 63.

Tropidia quadrata in JONES (1907), WEHR (1924), SKEVINGTON et al. (2019a).
Recorded all over Nebraska in wet grasslands and marshlands such as reedbeds and areas dominated by sedges and rushes. Recorded 1 May–16 September.
Examined material: 67 ♂♂, 25 ♀♀ (CSU, UNL, USNM, WSB); 3 iNaturalist records.

Genus *Xanthogramma* SCHINER, 1860

Xanthogramma flavipes (LOEW, 1863). Map 64.

Xanthogramma flavipes in WEHR (1924).
Most records are from south eastern Nebraska. The ♂ and ♀ from Frenchman Creek, Chase Co., 7.viii.2003, could be the western most records in North America. Most records are from forests. It is one of few species that can be found in dense forests, hovering in small sunny spots. Probably the species is more widespread now than it used to be. Recorded 22 April–14 September.
Examined material: 28 ♂♂ 25 ♀♀ (CSU, UNL, WSB); 1 iNaturalist record.



Maps 61–64: Localities of Syrphidae species in Nebraska. – **61**: *Toxomerus marginatus* (SAY); – **62**: *Trichopsomyia apisaon* (WALKER), *T. banksi* (CURRAN), *T. pubescens* (LOEW), and *T. recedens* (WALKER); – **63**: *Tropidia albistylum* MACQUART, *T. mamillata* LOEW, and *T. quadrata* (SAY); – **64**: *Xanthogramma flavipes* (LOEW), *Xylota analis* WILLISTON and *X. angustiventris* LOEW.

Genus *Xylota* Meigen, 1822

***Xylota analis* Williston, 1887**. Map 64.

Xylota analis in Jones (1907), Wehr (1924).
Examined material: **Sioux Co.**: 1 ♂, Warbonnet Canyon, 1460 m asl., 42.77, –103.95, wvs15437, pinned (UNL).

***Xylota angustiventris* Loew, 1866**. Map 64.

Xylota angustiventris in Jones (1907), Wehr (1924).
There are two old records from the north and north western part of Nebraska. Recent records are from riverine forests along the Missouri and Platte River in eastern Nebraska. These specimens were sitting on leaves at sunny spots along forest trails. Some sat as high as three meters. Recorded 4 June–12 September.
Examined material: 5 ♂♂ 4 ♀♀ (UNL, WSB); 1 iNaturalist record.

***Xylota appalachia* Skevington, Young & Thompson, 2023**. Map 65.

= *Xylota* undescribed species 78-1 in Skevington et al. (2019a).
Examined material: Paratypes: **Cass Co.:** 3 ♀♀, South Bend, Platte River State Park, 320 m asl., 40.98 , –96.21, 6.vi.2003, W. van Steenis, wvs13411-wvs14313, pinned (WSB).

***Xylota flavitibia* Bigot, 1884**. Map 40.

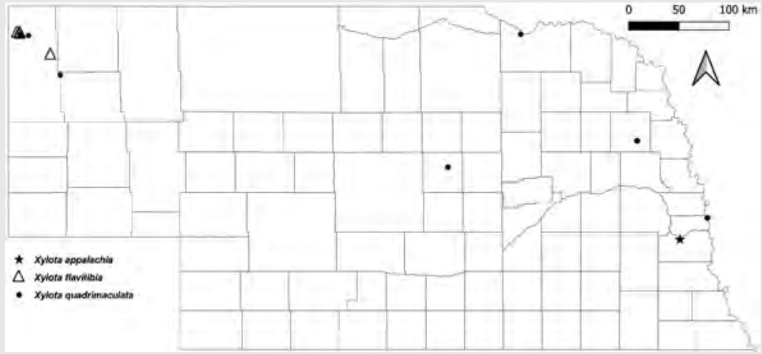
Xylota flavitibia in Jones (1907), Wehr (1924).
= *Xylota bicolor* of Wehr (1924).
The species occurs in northern Sioux Co. Recorded 28 May–12 July.
Examined material: 7 ♂♂ 2 ♀♀ (UNL, WSB).

***Xylota quadrimaculata* Loew, 1866**. Map 40.

= *Xylota ejuncida* of Jones (1907), Wehr (1924).
The species is recorded in eastern and northern Nebraska. Most records are from areas with older trees near water. Recorded 12–20 August.
Examined material: 7 ♂♂ 4 ♀♀ (CSU, UNL, WSB).

Doubtful Nebraskan species

The great majority of material in UNL was collected in Nebraska. There are two species in the collection with labels without proper localities. Since they probably come from Nebraska, I list them here as doubtful Nebraskan records. There is a ♀ *Epistrophe grossulariae* (Meigen, 1822) in UNL. The specimen has no labels except for an identification label. Two specimens of *Parhelophilus divisus* (Loew, 1863) in UNL have labels with only a number. One ♂ is labelled '583', the other '3409'.



65

Map 65: Localities of *Xylota appalachia* Skevington, Young & Thompson, *X. flavitibia* Bigot, and *X. quadrimaculata* Loew in Nebraska.

Furthermore, there is a dot on the map for *Platycheirus obscurus* (Say, 1824) in Skevington et al. (2019a). However, the record is not in the CNC database, nor is it in any recent *Platycheirus* revision (Vockeroth 1990, 1992; Young et al. 2016). Either the Nebraska specimen was misidentified or the coordinates were recorded incorrectly in the database and they have now been updated (J. H. Skevington in e-mail 2 April 2022).

Discussion

The number of flower fly species recorded in Nebraska is now 160. Many species show a clear distribution: either western of eastern. Only 62 species were collected both in the western and the eastern part of the state. Sixty-two species were only found in the eastern half, 32 only in the western half, of which 20 were only in the upper north east corner, Sioux Co. Four species were only collected in the central part of Nebraska.

This fits with the distribution of the species in North America. For 135 of our species Skevington et al. (2019a) give distribution maps. The eastern part of Nebraska is on the western distribution limit of 25 of the Nebraskan species, and for another eight species, the records from Nebraska are more western than in Skevington et al. (2019a). For 21 western species, there are no maps in Skevington et al. (2019). Most of them are mountain species listed for Colorado, among other states (Thompson, 2004). *Asemosyrphus polygrammus* is only recorded further to the west, except for one North Dakota record (Miranda et al. 2013).

For some species the records in Nebraska are among the most northern records: *Dioprosopa clavata* and *Syrphus sonorensis*. Both species are also recorded around 1910, so they are not the result of recent climate change. The reason for records so far to the north of these southern species could be the dry and warm climate in the Great Plains area. Conversely, for *Sericomyia lata* Nebraska is by far the most southern part of its distribution.

The total number of 160 species known from Nebraska is not that high, compared to the number of North American species (812, Miranda et al. 2013) and the number of species in north eastern North America (413, Skevington et al. 2019a). Probably with more collecting effort, many species could be added to the list. Several species are now only collected once or a few times. Twenty-three species (15 %) have only been collected once, 39 species (25 %) have only 2–4 collected specimens. So 40 % of the species of Nebraska have been collected fewer than five times.

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Brett Ratcliffe gave me the opportunity to work in the museum and provided me with everything necessary for conducting the work. Matt Paulsen, MaryLiz Jameson, Fede Ocampo, Andrew Smith, Alexander Riedel, and the graduate students were great company at the Museum. Matt joined me on some collecting trips. Jeroen van Steenis joined me for a week of intensive collecting in April 2004. Chris Thompson assisted in getting the right names for the species and added a lot of additional information. He was so kind as to have me over at the Smithsonian Institution in Washington to study their Syrphidae collection. The Samuel Wendell Williston Diptera Research Fund provided me with a grant to travel to Washington D.C.

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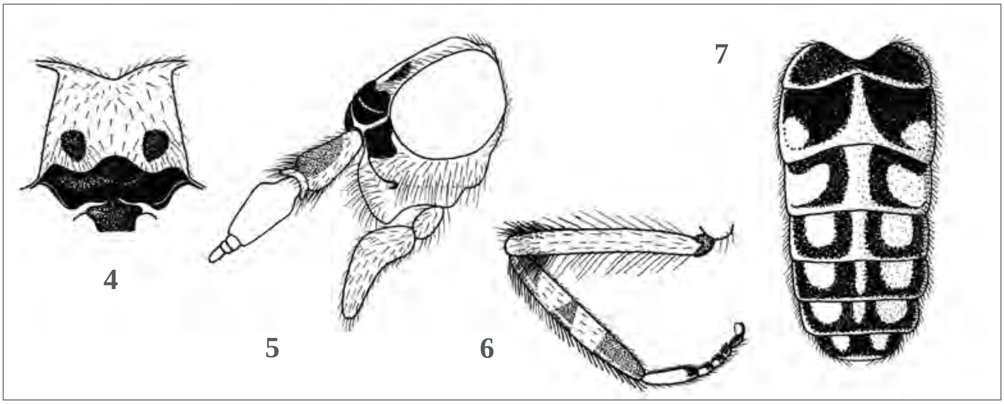
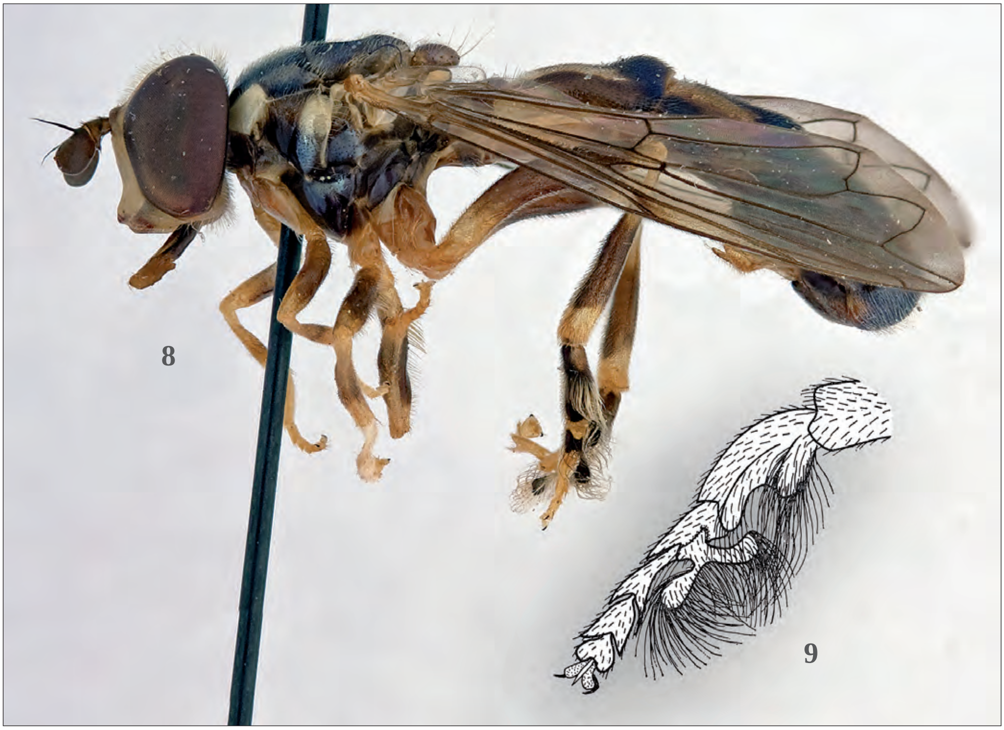
Selected species described by F. Christian THOMPSON. III.

Ximo MENGUAL

In 1977 Chris described a new species of horse fly (Diptera: Tabanidae) from Nepal and named it after Alan STONE, an eminent dipterist and an authority on the families Culicidae, Tabanidae, and Simulidae. The new tabanid species, *Haematopota stonei* THOMPSON, 1977, was collected by John SEIDENSTICKER during the Smithsonian's Nepal Tiger Ecology Project.

The same year, Chris published a new flower fly genus and species from Chile, *Austroascia segersi* THOMPSON & MARNEF, 1977. As stated in the original publication, *Austroascia* THOMPSON & MARNEF, 1977 has unique structures of the male hind leg and genitalia, together with a complete postmetacoxal bridge, and long hairs on the anterior anepisternum.





Figs 4–9: Selected species described by F. Christian THOMPSON. – **4–7**: *Haematopota stonei* THOMPSON, 1977; – **4**: Female frons; – **5**: Female head, lateral view; – **6**: Hind leg, lateral view; – **7**: Female abdomen, dorsal view; – **8, 9**: Male of *Austroascia segersi* THOMPSON & MARNEF, 1977; – **8**: Holotype, lateral view; – **9**: Hind tarsus, lateral view. Drawings from the original publication. Photo: X. MENGUAL.

The identity of *Neocnemodon calcarata* (LOEW) (Diptera: Syrphidae), a specialized flower fly predator of Woolly Apple Aphid

[Die Identität von *Neocnemodon calcarata* (LOEW) (Diptera: Syrphidae),
einer Schwebfliege, die als Prädator auf die Wollige Apfellaus spezialisiert ist]

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Abstract

The names and identities of the specialized flower fly predators of the Woolly Apple Aphid, *Eriosoma lanigerum* (HAUSMANN, 1802) are fixed. These predators, *Neocnemodon calcarata* (LOEW, 1866) and *Neocnemodon vitripennis* (MEIGEN, 1822), are important biological control agents as they prey on both arboreal and root colonies of the aphid. A lectotype is designated for *Pipiza calcarata* LOEW, 1866, and type notes of *N. calcarata* and *N. vitripennis* are provided.

Key words: *Eriosoma lanigerum, Malus domestica,* Aphididae, biological control agent

Zusammenfassung

Die Namen und Identitäten der in ihren prädatorischen Aktivitäten auf die Wollige Apfelblattlaus, *Eriosoma lanigerum* (HAUSMANN, 1802) spezialisierten Schwebfliegenarten werden geklärt. Die beiden Schwebfliegenarten *Neocnemodon calcarata* (LOEW, 1866) und *N. vitripennis* (MEIGEN, 1822), erweisen sich als wichtige Gegenspieler der Wolligen Apfelblattlaus, da sie sowohl Baum- als auch Wurzelkolonien des Schädlings erbeuten. Für *Pipiza calcarata* LOEW, 1866, wurde ein Lectotypus festgelegt und zu den Typen von *N. calcarata* und *N. vitripennis* werden Informationen gegeben.

Stichwörter: *Eriosoma lanigerum, Malus domestica*, Aphididae, natürlicher Gegenspieler zur biologischen Schädlingsbekämpfung

Introduction

Flower flies of the subfamily Pipizinae (Diptera: Syrphidae) include species with larvae that prey on woolly aphids (Hemiptera: Aphididae: Eriosomatinae) and other sternorrhynchan hemipterans that produce waxy exudates, including Adelgidae, Phylloxeridae, and Psyllidae (ROJO et al. 2003; MENGUAL et al. 2015). Encompassing eight genera and ca. 180 species, Pipizinae are dark pigmented (presumed non-mimetic) syrphids with a cosmopolitan distribution, excluding the Afrotropical Region. The monophyletic Pipizinae is sister to the species-rich Syrphinae, whose clade encompasses mainly predatory larvae that feed on hemipterans. The mainly saprophagous Eristalinae is a paraphyletic grade to this group (Pipizinae + Syrphinae), and the whole taxon is sister to the myrmecophagous Microdontinae (MENGUAL et al. 2015; YOUNG et al. 2016; PAULI et al. 2018; MORAN et al. 2021). Within the Holarctic Region Pipizinae exhibits the greatest species diversity, and includes ca. 35 species in the genus

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Neocnemodon Goffe, 1944. In North America and Europe, respectively, *Neocnemodon calcarata* (Loew, 1866) and *Neocnemodon vitripennis* (Meigen, 1822) are notable as specialist predators of the economically important Woolly Apple Aphid (WAA), *Eriosoma lanigerum* (Hausmann, 1802) (Hemiptera: Aphididae: Eriosomatinae).

WAA is a cosmopolitan pest of apple trees, *Malus domestica* Borkhausen, 1803 (Baker 1915), colonizing both the roots and arboreal parts of the plant (Brown et al. 1991). In 2000, a major and widespread outbreak of WAA occurred in many orchards in the Mid-Atlantic region of the U.S.A., likely in response to cancellation of the registration of methyl parathion in 1999. Previously, methyl parathion had been widely used in commercial apple production, due to its broad-spectrum activity against many orchard pests, including WAA. During the outbreak in 2000, JCB observed many WAA colonies being predated by syrphid larvae, and raised some of these larvae to the adult stage. Subsequently, JCB learned that FCT was located in Washington, D.C., close to his workplace in northwestern Virginia, and was delighted that FCT was very interested in the findings and specimens. FCT quickly identified one of the most common species attacking the aphids as *Neocnemodon calcarata* (but see below), which piqued his interest further, given his counsel that it was a member of the Pipizinae, which in his opinion at that time, needed further research and taxonomic revision.

Shortly after FCT became involved with our work, BDS joined JCB's laboratory as a Masters student, and was tasked with working on *N. calcarata* and its role as a WAA biocontrol agent. FCT gave generously of his time and expertise to assist us with various aspects of the project, for which we are eternally grateful. We learned that *N. calcarata* appeared to be a specialized predator of WAA in the apple ecosystem (Short & Bergh 2004) and, along with the specialized WAA parasitoid, *Aphelinus mali* Haldeman, 1851 (Hymenoptera: Aphelinidae), is a key member of a guild of WAA natural enemies (Bergh & Stallings 2016). Marked differences in the exochorionic sculpturing of eggs of the three most common syrphid predators of WAA, *N. calcarata, Eupeodes americanus* (Wiedemann, 1830), and *Syrphus rectus* Osten-Sacken, 1875, enabled reliable differentiation among them in the field and laboratory (Short & Bergh 2005). Various aspects of *N. calcarata* biology and ecology were investigated, including its host preference and voracity (Short & Bergh 2004), developmental rate (Bergh & Short 2008), and its seasonal phenology and abundance (Bergh & Short 2008, Gresham et al. 2013). Following a major outbreak of WAA in New Zealand in 2009, Plant and Food Research New Zealand became keenly interested in the possibility of releasing *N. calcarata* in their apple orchards, leading to work on aspects of the reproductive biology of the fly in relation to the potential to rear it in quarantine for host range testing in New Zealand (Gresham et al. 2013).

Meanwhile, FCT proceeded to develop a manuscript designating a lectotype for *Pipiza calcarata* (=*Neocnemodon calcarata*). However, despite our combined efforts over a number of years, it was never published, and he once sardonically described it as “one of the many piles of guilt littering the floor of my office”. Subsequent to FCT's work on the paper, taxonomic revisions of the Pipizinae by Vujić et al. (2013), Mengual et al. (2015), and Skevington et al. (2019) have established *Neocnemodon* as a separate genus, and not, as was used by FCT, a subgenus of *Heringia* Rondani, 1856. The following is a revised version of FCT's original manuscript, reflecting the current taxonomic paradigm. It includes his methods and descriptions, our updated drawings of the male genitalia of *N. calcarata*, photographs of the male and female flies, and sequencing of its genetic barcode (5′-end of the mitochondrial cytochrome *c* oxidase subunit I gene). Per FCT's explicit instructions during the development of the original manuscript, his name appears last in the list of authors.

Material and methods

Terminology follows Thompson (1999) and Skevington (2019), the abbreviations found in the synonymies follow Thompson & Thompson (2007), and the use of the asterisk in the distribution statement refers to verified records found in the material examined section. In the synonymies, all citations to the various names are included. Many of the earlier ones may be based on misidentifications or broader species concepts. However, regardless of their taxonomic status, these earlier citations are of value, as they document historical information that may be verified by vouchers. For example, we know today that Schiner (1861) broadly interpreted the species *vitripennis*, as there are vouchers in the museum in Vienna with his determination label. For Schiner, *vitripennis* was equivalent to the present concept of the genus *Neocnemodon* [see Thompson & Torp (1986: 237) on Schiner's broad interpretation of other species, such as *Sphegina clunipes* (Fallén, 1816)]. Also, *calcarata* was more broadly interpreted by earlier workers. Three vouchers in the USNM collection, labeled as *calcarata* by Shannon and Curran, are specimens of *Neocnemodon coxalis* (Curran, 1921). The modern classification of *Neocnemodon* (as *Heringia*) only began when the importance of the species for the biological control of aphids was recognized (Delucchi & Pschorn-Walcher 1955; Pschorn-Walcher & Zwölfer 1956; Delucchi et al. 1957).

Adult male and female *N. calcarata* were reared from larvae collected in Winchester, Virginia, and photographed with a Canon EOS 6D digital SLR with a MP-E 65 mm lens. Specimens preserved in 100 % ethanol were dried and their DNA extracted with a Qiagen DNeasy kit. The primers, LCO1490 (forward) and HCO2198 (reverse), were used to amplify a 600 bp region of the mitochondrial cytochrome *c* oxidase subunit I gene, a region which is commonly used as a species barcode for rapid identification and taxonomy (Hebert et al. 2003). DNA was sequenced according to methods described in Means & Marek (2017).

Taxonomy section

The following characters will separate the presumed sister species, *N. calcarata* and *N. vitripennis*, from all other flower flies. They are broken up into characters that separate the group (tribe Pipizinae) from other Syrphidae, the genus *Neocnemodon* from other pipizines, and these sister species from other *Neocnemodon* species. *Neocnemodon calcarata* is described in full and a diagnosis is provided to separate *calcarata* from its putative sister, *vitripennis*. Note that *N. vitripennis* is restricted to the Old World, while *N. calcarata* is a New World species.

Tribe Pipizinae is characterized by: 1) eyes pilose; 2) face pilose; 3) oral margin simple, not medially notched; 4) face simple, concave, without tubercle; 5) crossvein r-m basal, at basal 1/4 of cell dm; 6) postpronotum pilose; and 7) metasternum reduced and bare. Genus *Neocnemodon* is characterized by: 1) anepisternum bare on flattened anterior portion; 2) katepimeron pilose; 3) vein Sc ending beyond crossvein r-m; 4) cell r_{4+5} acute apically; 5) vein M_1 progressive apically, joining vein R_{4+5} at acute angle; and 6) postpedicel short, at most 1.5 times as long as broad.

The genera *Heringia* and *Neocnemodon* are readily separated by the length of the postpedicel and the presence of a spur in the metatrochanter in the males of the latter. The genus *Heringia* was established by Rondani (1856: 53) with *Pipiza heringi* Zetterstedt, 1843 as its type species by original designation. The name *Neocnemodon* (Goffe 1944: 128) is a replacement name for *Cnemodon* Egger (1865: 573), a junior homonym of *Cnemodon* Schoenherr, 1823 (Coleoptera: Curculionidae). *Cnemodon* was established for two new species, of which Goffe (1944: 128) subsequently selected *Cnemodon latitarsis* Egger, 1865 as the type species.

Species *N. calcarata* and *N. vitripennis* are characterized in the male by: 1) mesocoxa with long ventral process (Fig. 3); 2) metatrochanter with a long, slender, apically expanded process (Fig. 2); 3) sterna 3 and 4 simple, without carinae; and 4) wing partially bare basomedially. Also, the probasitarsomeres of both species are identical but differ from other *Neocnemodon* species [see figures in Verlinden (1994: 109) and van Veen (2004: 122)]. Females of *Neocnemodon* species are inseparable by morphological features. In their review of the Palaearctic species of *Heringia* (including *Neocnemodon*), Claussen et al. (1964) divided *Neocnemodon* into two species groups. Both *calcarata* and *vitripennis* belong to the *latitarsis* group.

Neocnemodon calcarata (Loew)

(Figs 1–4, 6)

Common name: Opaque Spikeleg (Skevington et al. 2019).

***Pipiza calcarata* Loew, 1866**: 154 [also 1872: 28, species #6]. Type-locality: New York. Lectotype ♂, MCZ here designated. Osten-Sacken 1875: 43, 1878: 120 (catalog citations); Williston 1887: 24 (translation original description); Smith 1890: 383 (New Jersey); Johnson 1900: 658 (New Jersey), 1910a: 764 (New Jersey); Aldrich 1905: 350 (catalog citation); Jones 1907: 239 (descr.); Kertész 1910: 15 (syn.); Metcalf 1913: 81 (cit.), 1921: 210 (MG*); Winn & Beaulieu 1915: 133 (Quebec); Banks et al. 1916: 178 (Va., D.C., Md.); Britton 1920: 185 (Connecticut); Curran 1921a: 363 (A* descr., distr.), Fluke 1922: 224 (descr. note, Wisconsin).

***Cnemodon calcarata* (Loew, 1866)** of: Curran 1921: 363, figs. 4–6, 8, 49 (key ref., description), 1926: 157 (New York), 1934b: 3 (New Hampshire, Slosson Coll.); Wehr 1924: 140 (Nebraska); Johnson 1925a: 162 (Maine); Johannsen 1928: 793 (New York); Petch & Maltais 1932: 45 (Quebec); Brown 1934: 247 (Ontario); Brimley 1938: 349 (North Carolina); Strickland 1938: 201 (?Alta.); Telford 1939: 40 (Minnesota); Procter 1946: 388 (Maine); Foxlee 1956: 36 (British Columbia).

***Neocnemodon calcaratus* (Loew, 1866)** of: Wirth et al. 1965: 581 (cat. cit.); Cole 1969: 309 (distr. western N.A.); Boyes & van Brink 1972: 324 (chromosomes*, British Columbia, Quebec); Telford 1975: 10 (Washington, Idaho).

***Pipiza radicum* Walsh & Riley, 1869**: 83. Type-locality: Illinois, near Cobden and at Du Quoin. Syntypes destroyed (see below). Osten-Sacken 1878: 120 (catalog citation, ?= *femoralis* Loew, 1866); Johnson 1900: 658 (New Jersey), 1910a: 764 (New Jersey); Coquillett 1904: 200 (taxonomic notes, synonymy, types); Kertész 1910: 21 (cat. cit.); Metcalf 1913: 82 (Ohio), 1916a: 99 (N.C.); Winn & Beaulieu 1915: 133 (Quebec); Davidson 1916: 456 (econ. import., prey *Eriosoma lanigerum* and *Phylloxera vitifoliae* (Fitch, 1855)); Britton 1920: 185 (Connecticut); Curran 1921: 356 (considered a synonym of *salax* Loew, 1866); Fluke 1922: 225 (Wisconsin); Knowlton 1931: 156 (Utah); Jaques 1937: 386 (Iowa); Brimley 1938: 349 (North Carolina); Heiss 1938: 69 (immature stages).

***Pipiza pistica* Williston, 1887** (unverified) of: Johnson 1900: 658 (New Jersey); Snow 1895: 227 (New Mexico); Chagnon 1901a: 44 (20) (description, key reference), 1901b: 8 (Quebec); Aldrich 1905: 350 (cat. cit.); Jones 1907: 239 (descr. note, Colo.); Tucker 1907: 98 (Colorado); Graenicher 1909: 24 (flower *Solidago canadensis*), 1910: 36, 1911: 68, 1913: 180 (Wisconsin); Kertész 1910: 311 (syn.); Banks et al. 1916: 179 (flower *Sedum ternatum*) Virginia, Maryland); Nicolay 1919: 278 (New Jersey); Jones 1922: 19 (Colorado); Hallock & Parker 1926: 10 (New Jersey); Robertson 1928: 173 (Illinois, flower *Rosa setigera*).

***Pipiza pisticoides* Williston, 1887** of: Metcalf 1913: 81 (H* Ohio), 1916b: 224 (AH* L* P* HSP* biol., descr. (L P A) prey (*Schizoneura lanigera* Gillette, 1908) Maine), 1916a: 99

(North Carolina), 1921: 209 (MG*); HOLDSWORTH 1970: 532 (in *Eriosoma lanigerum* colonies, Ohio).

***Neocnemodon calcarata* (LOEW, 1866)** of: SKEVINGTON et al. 2019: 306 (description, notes).

Description

Length (7): 5.6–7.2 (6.4) mm, body; 4.8–5.7 (5.2) mm, wing.

MALE. Head: Black; face shiny except very narrowly white pollinose laterally along eye margin, black pilose; gena sparsely gray pollinose, black pilose; lunule shiny, slightly orange laterally; frontal triangle shiny except dorsal 1/3 black pollinose, black pilose; eye contiguity long, as long as vertical triangle; eye white pilose; vertical triangle equilateral, black pollinose, brownish-yellow pilose; occiput white pollinose and pilose on ventral 2/3, black pollinose and pilose dorsally. Antenna: scape and pedicel brownish orange, black pilose; postpedical elongate oval, brownish black except yellow basoventral 1/3; arista yellowish basally becoming brown apically.

Thorax: Black except postpronotum brownish orange; postpronotum black pilose; scutum dull brownish-black pollinose, white pilose except black pilose adjacent to postpronotum, dorsal to wing, medially on post alar callus and marginally on scutellum; pleuron sparsely gray pollinose except shiny area anteromedially on katepisternum, pale pilose; calypter brown; plumula brownish basally, white apically; halter orange, except capitilum brownish-orange. **Wing**: hyaline, microtrichose except bare as follows: cell h, basal 1/3 cell c, basal 1/2

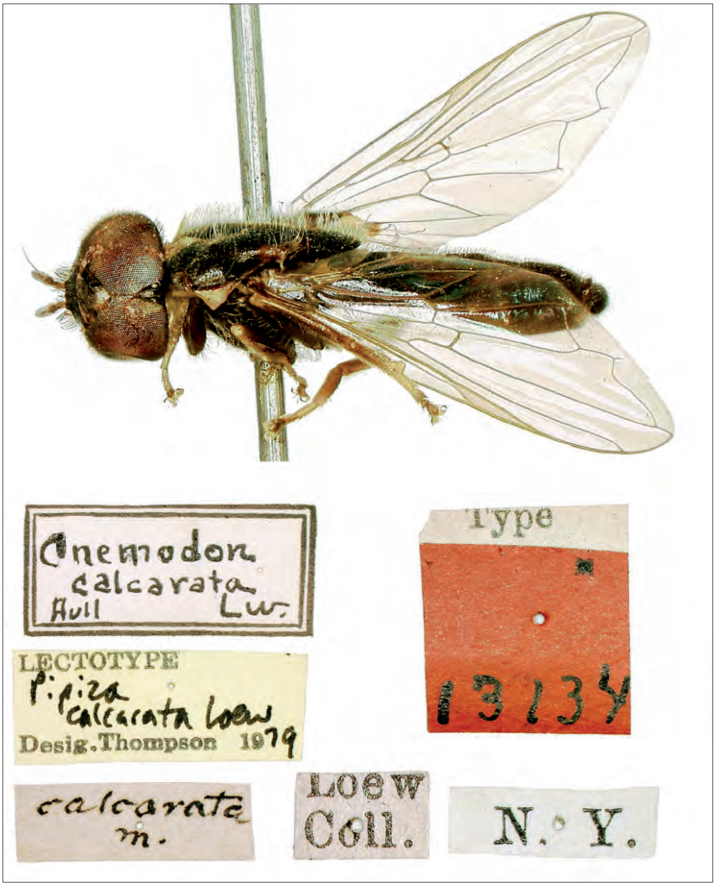

Fig. 1: *Neocnemodon calcarata* (LOEW), lectotype male with labels.

cell r_1, basal 2/3 cell r_{2+3}, anterobasal 1/4 cell cua and narrowly basomedially on alula. **Legs**: Coxa black, gray pollinose, black and white pilose; mesocoxa with long narrow ventral prong on anteromesial corner; trochanter black, gray pollinose, black and white pilose; metatrochanter with long basoventral prong only slightly expanded apically; femora black except yellow on apices, mainly black pilose, with white pile basally and dorsally; tibiae orange basally and apically, black medially, black pilose on dark areas, pale pilose on pale areas; mesotibia expanded slightly posteromedially; pro- and mesotarsi orange; metatarsus brownish-black except orange middle two tarsomeres and on apex of basitarsomere, black pilose.
Abdomen: Black; tergum 1 black pollinose, black pilose except white pilose laterally; tergum 2 dull black pollinose, black pilose except for triangular patch of white pile on medial 1/2 and white pilose laterally; tergum 3 black pollinose except shiny laterally and in form of large mediolateral macula, short black pilose on dull areas, white pilose on shiny areas; tergum 4 black pollinose on basomedial 3/4, lateral and apical margins broadly shiny, short black pilose on dull areas, long white pilose on shiny areas except basolateral 1/5 and apicolateral corner black pilose; sterna shiny except sparsely gray pollinose on sternum 1, black pilose; male genitalia black pilose.

Variation. The eye pile ranges from white to brown to almost black; the thoracic pile ranges from white to yellow to brown; and the metatarsus from having yellow middle tarsomeres (2-3) to being entirely dark. The above description is based on the lectotype of *calcarata*. The type and the reared specimens from Virginia agree well. The holotype of *Cnemodon elongata* Curran, 1921 and many other specimens are darker. Variation in leg color within species is interpreted as seasonal variation.

Distribution. British Columbia to Quebec, south to Kansas and Virginia (Skevington et al, 2019).

Material examined (27). **U.S.A.**: **Connecticut**: Stamford, Bartlett Tree Research Laboratory, 10 May 1930, S. W. Bromley (1 ♂, USNM). **District of Columbia, Washington**: 13.vi.1913, R. C. Shannon (1 ♂, USNM). **Idaho**: Lake Waha, 14.vi.1930 (1 ♂, USNM). **Indiana**: Lafayette, 24.vi, J. M. Aldrich (1 ♂, USNM); 6.viii.1917, J. M. Aldrich (1 ♂, USNM). **Maryland**: Hancock, viii.1915, F. R. Cole (1 ♂, USNM). **New Jersey**: Wenonah, 10.vii.1910 (1 ♂, USNM). **New York**: Lectotype ♂, here designated (1 ♂ lectotype, MCZ); Auburn, 16.viii.1969, D. J. Peckham (3 ♂, USNM); 6.viii.1970, D. J. Peckham (1 ♂, USNM); Long Island, Cold Springs, 5.vii.1931, C. H. Curran (1 ♂, USNM). **Pennsylvania**: Broomall, 24.viii.1910 (1 ♂, USNM); Lehigh Gap, 1.vii.1903 (1 ♂, USNM); Castle Rock, 30.vi.1910 (1 ♂, USNM). **Virginia**: Clarke Co., Shenandoah River, 3.ix.1923, J. M. Aldrich (2 ♂, USNM); Fairfax Co., Great Falls, 20.viii.1916 (1 ♂, USNM); Winchester (2 ♂, USNM), 27.vi.2000, J,C. Bergh (1 ♀, USNM), 29.vi.2000, J.C. Bergh (1 ♂, USNM). Texas, Paris, 1904, C. T. Brues (1 ♂, USNM). **West Virginia**: Kanawha Station, 27.vi.1918, S. A. Rohwer (1 ♂, USNM).

Names and types

Pipiza calcarata. Loew (1866) described *calcarata* from an unspecified number of males collected by Osten-Sacken in New York. In the collection of the Museum of Comparative Zoology today there is a single male with the appropriate labels (Fig. 1), which is here designated lectotype to fix the concept of the name and to ensure universal and consistent interpretation of the same.

Pipiza radicum. Walsh & Riley (1869) were the first to rear the "Root-louse *Syrphus*-fly", the common name they gave to the syrphid predator of WAA. Scientifically, they named the species *radicum* and provided descriptions of the adult female and the immature stages. The female was reared by Walsh from larvae found in Du Quoin, Illinois. This female, and all associated immature specimens, have been subsequently lost (Coquillett 1904). For no-

Fig. 2: *Neocnemodon calcarata* (LOEW), male, ventral view of metaleg and base of abdomen. Sterna 1 and 2 eliminated to highlight trochanter process.

Fig. 3: *Neocnemodon calcarata* (LOEW), male, ventral view of thorax and meso- and metalegs, showing processes on mesocoxa.

menclatural purposes, we restrict the name to the specimen from which the illustration of the female was made. OSTEN-SACKEN in his catalog (1878: 120) noted that this species was "apparently the same as *femoralis* LOEW". In this, he was followed by WILLISTON (1887: 26), who merely listed it as a dubious synonym of *femoralis*. COQUILLETT (1904) re-examined the issue and concluded, however, that this species was the same as the one described in 1887 by WILLISTON as *Pipiza pistica*. COQUILLETT based his decision on examination of the WILLISTON types of *pistica* and a voucher from the rearing work done by earlier USDA workers (see COMSTOCK 1880: 259). Therefore, he resurrected the name *radicum* as the valid name. CURRAN (1921: 355) later considered these two names (*Pipiza radicum* and *Pipiza pistica*) to be synonyms of *Heringia* (sensu stricto) *salax* (LOEW, 1866). CURRAN's synonymy has led some authors (ROJO et al. 2003: 115) to incorrectly cite *H. salax* as a predator of WAA. *Pipiza radicum*, synonymized with *pistica* by COQUILLETT, is now considered a synonym of *Heringia salax*.

Pipiza pistica. WILLISTON (1887) described this species from two females collected in New Haven, Connecticut. Both syntypes are in good condition, and in the USNM. These specimens appear to be *Heringia* (sensu stricto) *salax* as noted by CURRAN. CURRAN (1921: 347) noted that *Heringia* sensu stricto can be separated from *Neocnemodon* in the female by the mesotibia being slender (*Heringia*), not slightly rounded anteriorly (*Neocnemodon*) and postpedicel being elongate (*Heringia*), not "shorter and more roundish" (*Neocnemodon*). Our reared and associated females of *calcarata* do have the mesotibia slightly rounded anteriorly, moderately carinate dorsally, and with shorter pile than the slender, non-carinate and long pilose mesotibia of the syntypes of *Pipiza pistica*. Hence, I (FCT) accept CURRAN's placement of *pistica* as a synonym of *Heringia salax*.

Due to the nomenclatural and taxonomic confusion over these two species, *salax* and *calcarata*, earlier references to either need to be re-evaluated.

Pipiza pisticoides. WILLISTON (1887) described this species from a single female taken near the base of Mount Washington on August 1st. He compared it to his *pistica*, but believed it to

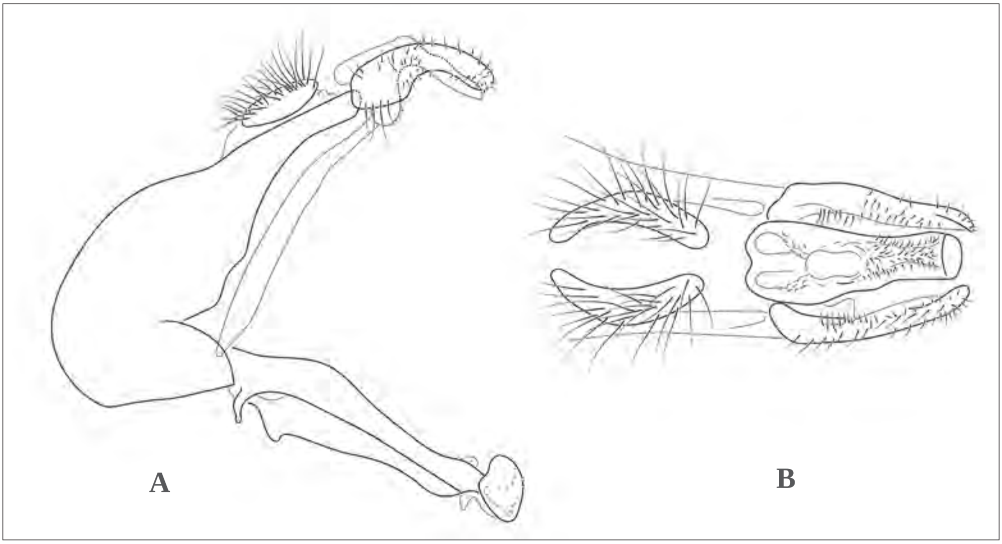

Fig. 4 A, B: *Neocnemodon calcarata* (Loew), male genitalia. – **A**: Epandrium and hypandrium, lateral view; – **B**: Apical part of epandrium, subepandrial sclerite, surstyli and cerci, dorsal view.

be distinct as 1) the postpedicel was orbicular, as broad as long [*pistica* has a more elongate postpedicel]; 2) "the pile throughout is shorter [and] on the abdomen scarcely discernible"; and 3) "the size is also distinctly smaller". This holotype is now in poor condition in the USNM, but there is an additional female from the Williston Collection with the same labels. While the taxonomy of females is not well known, these specimens clearly represent a species distinct from *pistica* as noted by Williston. Currently *pisticoides* is interpreted as a different species whose male has the abdominal sternum 3 carinate apically (Curran 1921: 368; Skevington et al. 2019).

Metcalf (1916) used the name *pisticoides* for a natural enemy of WAA in the Orono, Maine, area. He contrasted material collected in Ohio and one specimen reared from a pupar-

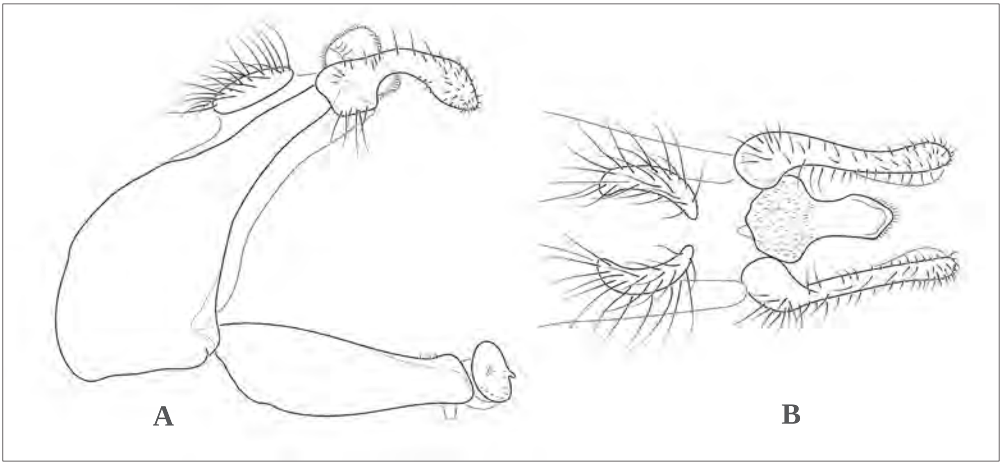

Fig. 5 A, B: *Neocnemodon vitripennis* (Meigen), male genitalia. – **A**: Epandrium and hypandrium, lateral view; – **B**: Apical part of epandrium, subepandrial sclerite, surstyli and cerci, dorsal view.

ium found among "*Schizoneura americana* on Elm" with his Maine material. He noted slight differences in antennal size and ratio, pilosity, and length of dm-cu crossvein. He therefore considered the Ohio specimens to refer to *radicum* and the Maine specimens to refer to *pisticoides*. Unfortunately, none of Metcalf's specimens have been found. However, Metcalf's measurements fall within the variation we have found for *calcarata* and his figure matches our females of *calcarata*, not the type of *pisticoides*.

Cnemodon elongata. Curran (1921) described this valid species from two males collected in Ontario. The holotype is in the California Academy of Sciences, is in good condition and has the following labels: "Type" [Curran's handwriting], "Orilla, Ont.," "22.6.14" 398 [Curran's handwriting], "H. Curran," "Cnemodon / elongata / Curran" [Curran's handwriting], "Type" [red] and "California Academy / of Sciences / Type no. 854." Skevington et al. (2019) illustrate some of the differences between *elongata* and *calcarata*.

Notes. Morphological molecular evidence from Vujić et al. (2013) and the phylogeny of pipizine syrphids by Mengual et al. (2015) have shown that species of *Neocnemodon*, including *vitripennis*, are sister to *Pipizella* and not *Heringia*, so *Neocnemodon* is a valid separate genus and not a subgenus of *Heringia*. Although *calcarata* was not included as an exemplar in the Mengual et al. (2015) phylogeny, presence of the apomorphic process on the mesocoxa (spike) clearly indicates that *calcarata* belongs to *Neocnemodon*.

Neocnemodon calcarata is most similar to *vitripennis* Meigen, but differs from that species as follows: 1) postpedicel longer (Figs 6, 7); 2) pro- and mesotibiae paler (Figs 6 A, B, 7 A–D); 3) mesotibia in male less dilated medially (Figs 6, 7); 4) metacoxa without apicolateral spur (Figs 2, 7); 5) metatrochanter in male with spur of different shape (Figs 2, 7); 6) male genitalia distinct with apical portion of surstyle of different shape as well as post anal hood (Figs 4 A, B, 5 A, B).

The COI barcode sequence of *N. calcarata* from Winchester, Virginia, has been deposited at the National Center for Biotechnology Information under the accession number ON155992.

Neocnemodon vitripennis (Meigen)

(Figs 5, 7)

Common name: Pale-haired Spikeleg.

***Pipiza vitripennis* Meigen, 1822**: 254. Type-locality: Austria [as Österreich]. Holotype ♂, NMW (see Thompson 1988: 204). Macquart 1829: 180 (description, northern France), 1834: 571 (description); Rossi 1848: 38 (Austria, flight period); Walker 1851: 272 (England); Schiner 1858: 309 (Austria), 1861: 264 (key reference, Austria), 1864: 111 (catalog citation); Rondani 1857: 182 (Italy); Heeger 1858: 295, pl. 1, figs. 1–6 (egg, larva, puparium) (biology, description of all stages, Austria); Neuhaus 1886: 123 (Germany, Berlin region); Kowarz 1885: 243 (similar to *latitarsis*).

***Cnemodon vitripennis* (Meigen, 1822)** of: Verrall 1901a: 177 (description, Great Britain, synonymy), 1901b: 28 (cat. cit.); Bezzi & Stein 1907: 14 (cat. cit.); Kertész 1910: 23 (cat. cit.); Drensky 1934: 112 (Bulgaria); Evenhuis 1958: 1, 1959: 238 (Netherlands, biol., prey (*Eriosoma lanigerum*); Stubbs & Falk 1983: 104, 207 (key reference, diagnosis, United Kingdom).

***Neocnemodon vitripennis* (Meigen, 1822)** of: Torp 1984: 145 (key ref., Denmark); Peck 1988: 85 (cat. cit.); Brădescu 1991: 12, 35 (Romania, key reference); Verlinden 1994: 109 (key ref, figures, Belgium); Vujić & Glumac 1994: 46 (Serbia).

***Heringia* (*Neocnemodon*) *vitripennis* (Meigen, 1822)** of: Vujić 1999: 139 (Serbia, key ref.); Stubbs & Falk 2002: 311 (United Kingdom, color habitus); van Veen 2004: 122 (key ref., figures, northwestern Europe).

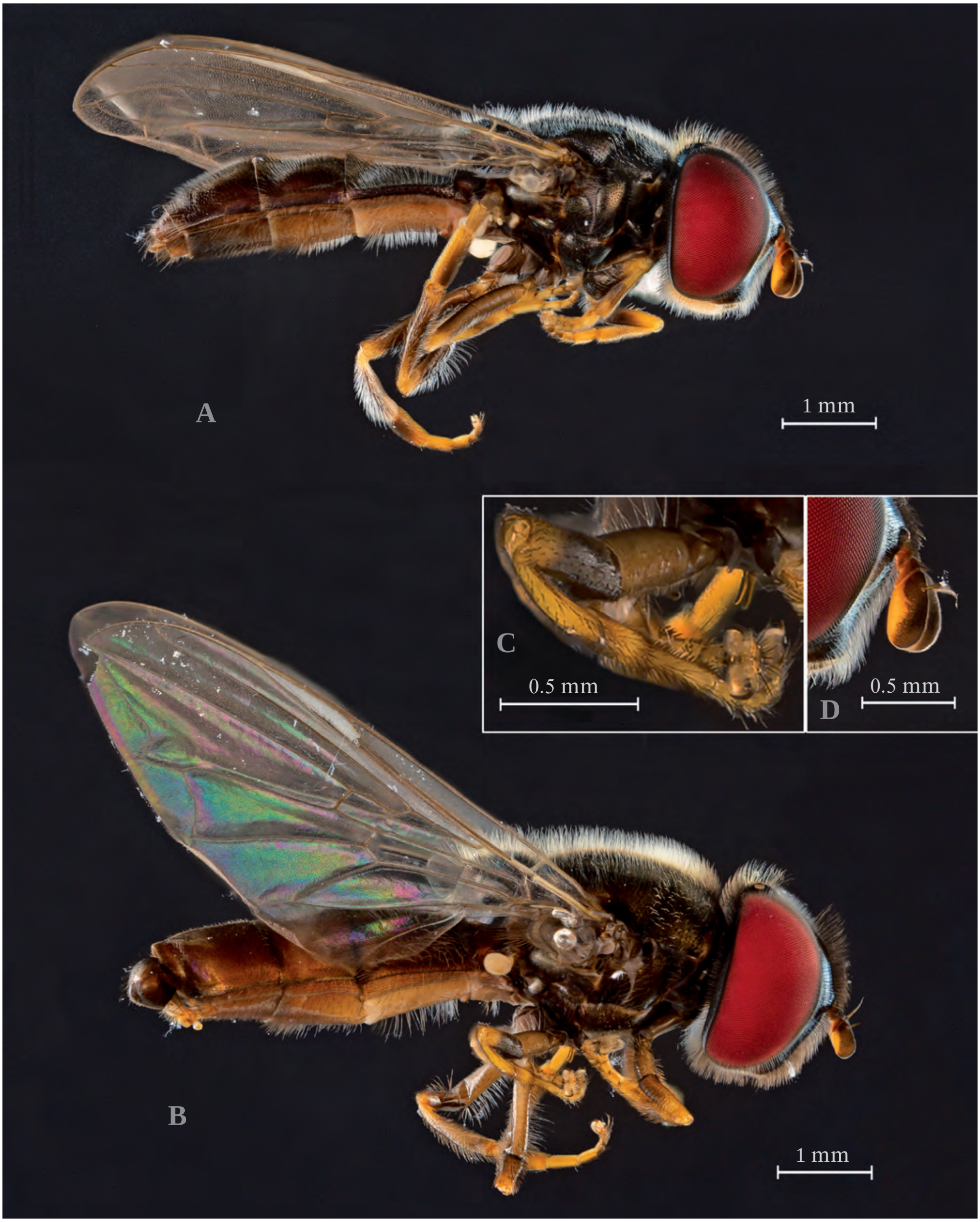

Fig. 6 A–D: *Neocnemodon calcarata* (LOEW). – **A**: Female; – **B**: Male; – **C**: Mesotibia, male; – **D**: Antenna, male.

***Pipiza albohirta* WIEDEMANN, 1830**: 110. Type-locality: Unknown [as Vaterland?]. Lectotype ♂, NMW designated THOMPSON (1988: 204). Syn. by THOMPSON (1988: 204).

***Pipiza acuminata* LOEW, 1840a**: 30 [also 1840b: 564]. Type-locality: Poland, Poznan area [as Posener Gegend]. Holotype ♀ lost. SCHINER 1857: 309 (citation), 1861: 265 (citation); VERRALL 1870: 176 (Great Britain, with *vitripennis* of WALKER as synonym). Syn. by VERRALL (1901a: 181).

Fig. 7 A–D: *Neocnemodon vitripennis* (Meigen), CNC_Diptera149534. – **A**: Dorsal habitus; – **B**: Mesotibia; – **C**: Antenna; – **D**: Metatrochanter spurs (right one copied and highlighted to better recognision of its shape).

Pipiza aphidiphaga **Costa, 1853**: 85. Type-locality: Italy, Naples. Palma 1864: 65 (Italy, Naples); Rondani 1868: 54 (note, syn. of *vitripennis*?). Syn. by Rondani (1868: 34).

Cnemodon dreyfusiae **Delucchi & Pschorn-Walcher, 1955**: 502. Type-locality: Austria. Holotype ♂, NMW. Syn. by Collin (1960: 144).

As this species is virtually identical to *calcarata*, we forgo a formal description. A differential diagnosis is provided above to separate *vitripennis* from *calcarata*.

Names and types

Pipiza vitripennis. Meigen (1822) described *vitripennis* from a male (= holotype) collected in Austria and sent to him from Megerle under the manuscript name *Scava* [=*Scaeva*] *dubia*. Thompson (1988: 205) identified the holotype in the Vienna Museum (NMW), which is labeled "*vitripennis*, Coll. Winthem" "*C. dreyfusiae*, Pschorn, V. Delucchi det." "Lectotype, *Pipiza*, *vitripennis*, Meigen, Design. Thompson 1985" [yellow]. The type is very pale and has apparently been bleached by the sun.

Neocnemodon vitripennis was frequently misidentified and/or was treated as a broader species concept in the earlier literature. Delucchi & Pschorn-Walcher (1955) were the first to properly redefine the species. Unfortunately, as noted by Collin (1960: 145), and verified by Thompson (1988), they re-described the species as *dreyfusiae*.

Pipiza albohirta. Wiedemann (1830) described *albohirta* from a male from an unknown locality [as Vaterland?]. Thompson (1988: 204) found a male in the Vienna Museum (NMW) with the appropriate labels and designated it as lectotype. He identified the specimen as *vitripennis* Meigen.

Pipiza acuminata. Loew (1840) described *acuminata* from only a female collected in the area in and around Poznan, Poland [as Posener Gegend]. Verrall (1901a: 181) reviewed this name and placed it as a synonym of *vitripennis*. As the type is lost (see Verrall) and also based on a female, Verrall's synonymy is to be accepted.

Pipiza aphidiphaga. Costa (1853) described *aphidiphaga* from adults reared from larvae preying on aphids causing leaf galls on elm in the Naples region. Rondani (1868: 34) suggested that *aphidiphaga* should be considered a synonym of *vitripennis*. The types of Costa were deposited in the museum in Naples, but while the material did survive World War II, the insect collection was discarded recently (Thompson & Thompson 2007, in respect to the Rondani material, the same is true of Costa material). While the biological data suggest that *aphidiphaga* may be a synonym of another *Neocnemodon* species, we leave the name as a synonym of *vitripennis*, as that is where Rondani placed it. However, even if the types are found and their identities were determined, the name would remain a *nomen oblitum* as it has never been used as valid since its introduction.

Cnemodon dreyfusiae. Delucchi & Pschorn-Walcher (1955) based their species on a holotype male from Austria from the collection of Egger and determined by Egger as *vitripennis* Meigen. This type is in the Vienna Museum (NMW) and labeled as "Schiner, 1866" "Austria, Coll. Egger" "*vitripennis*, det. Egger" "Type" [red], and "*Cnemodon dreyfusiae* n. sp., det. Delucchi & Pschorn". For its taxonomy, see above under *vitripennis*.

Distribution. Southern Sweden to central France, Ireland eastward through northern and central Europe into Russia and through Siberia to the Pacific coast (Speight 2020).

Material examined. **AUSTRIA**: LT of *albohirta* & *vitripennis*, HT *dreyfusiae*. Austria [as Österreich]. Holotype ♂ (1 ♂, NMW). **NETHERLANDS**: Rhynauwen, 12.viii.1965, H. J. P. Lambeck (2 ♂, 2 ♀, USNM). **GERMANY**: Berlin, Finkenkrug, 16.vii.1905 (1 ♂, USNM).

Notes. *Neocnemodon vitripennis* is the common predator of the WAA in northern Europe (Evenhuis 1959).

According to Peck (1988: 84), this species is apparently absent from Central Asia, as she does not list Kazakhstan or any of the other countries of the former Soviet Middle Asia. Given the origin of apple there (Dzhangaliev 2003), a careful examination of the pests and their predators and parasites on the wild ancestor of apple would be an interesting contribution to resolving the puzzle of the apple microecosystem.

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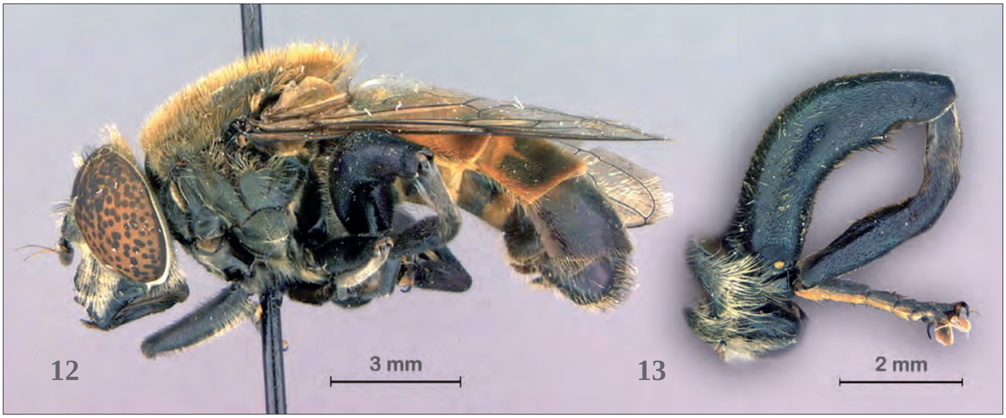
Selected species described by F. Christian THOMPSON. IV. Ximo MENGUAL

Among the many new species described by Chris, these two are remarkable by their hind leg. *Mallota merodontoides* is known so far from four specimens (three males and a female) from China, and as Chris stated in his publication "[it] is unique among flower flies in the structure of its metaleg, especially the metatibia". The second selected species depicted here is *Eristalinus megametapodus*, another outstanding taxon with a very unique hind leg. This species is known from Central Africa and it has been recently collected again (from Uganda) after more than 60 years (see JORDAENS and DE MEYER 2023, on page 56 of this issue).



Figs 10–13: Selected species described by F. Christian THOMPSON. – **10, 11**: *Mallota merodontoides* THOMPSON, 2019. – **10**: Male holotype, lateral view; – **11**: Left hind leg, probably illustrated by T. Britt GRISWOLD; – **12, 13**: *Eristalinus* (*Merodonoides*) *megametapodus* THOMPSON, 2019. – **12**: Male, lateral view; – **13**: Hind leg, lateral view. Specimen photographs from the original publications, modified.

Records of hover flies (Diptera: Syrphidae) as prey of robber flies (Diptera: Asilidae) in eastern New Mexico and western Texas, U.S.A.

[Schwebfliegen (Diptera: Syrphidae) als Beute von Raubfliegen (Diptera: Asilidae) – Fundmeldungen aus dem Osten von New Mexiko und dem Westen von Texas, Vereinigte Staaten von Amerika]

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Abstract

As part of a larger study on prey selection in robber flies in eastern New Mexico and western Texas, 148 specimens of Syrphidae (comprising 17 species in 14 genera and four subfamilies) were collected as prey of 15 species in six genera and three subfamilies of Asilidae. The top three syrphid predator asilids were *Diogmites bilobatus* Barnes, 2010, *Efferia helenae* (Bromley, 1951) and *Efferia bicaudata* (Hine, 1919) and accounted for 80 % of all records. The top three syrphid prey comprised 61 % of total records: *Allograpta exotica* (Wiedemann, 1830), *Eupeodes volucris* Osten Sacken, 1877, and *Eristalinus aeneus* (Scopoli, 1763). Most of the prey syrphids represented relatively common, widespread species in the semidesert habitats sampled.

Key words: Microdontinae, Syrphinae, specificity, invasive

Zusammenfassung

Im Rahmen einer größeren Untersuchung zur Beutewahl von Raubfliegen im östlichen New Mexico und westlichen Texas wurden 148 Exemplare von Syrphiden (17 Arten in 14 Gattung und vier Unterfamilien) gesammelt. Die drei häufigsten Prädatoren von Syrphiden waren *Diogmetes bilobatus* Barnes, 2010, *Efferia helenae* (Bromley, 1951) und *Efferia bicaudata* (Hine, 1919) welche 80 % aller Räuber-Beute Beziehungen ausmachten. Die drei häufigsten Schwebfliegenarten unter den Beutetieren waren *Allograpta exotica* (Wiedemann, 1830), *Eupeodes volucris* Osten Sacken, 1877 und *Eristalinus aeneus* (Scopoli, 1763). Sie machten 61 % aller Nachweise aus. Diese Arten erwiesen sich in den Halbwüsenbiotopen des Untersuchungsgebietes als vergleichsweise häufig und weit verbreitet.

Stichwörter: Microdontinae, Syrphinae, Spezifitäten, invasive

Introduction

Robber or assassin flies (Diptera: Asilidae) are a diverse and conspicuous component of many habitats in the arid southwestern United States (Wood 1981; Dikow 2009; Cannings 2014). These predatory flies usually intercept prey items in flight and then either land on the ground or vegetation to administer venom through a modified hypopharynx and to then feed. Recent research has shown however that some asilids attack their prey while the latter is on the ground (Pollock 2020). Asilid venom comprises a unique combination of proteins and other components (Drukewitz et al. 2018; Cohen et al. 2020), and when injected through a highly modified hypopharynx (Dikow 2009) it very quickly dispatches the prey insect or spider and then begins to liquefy the body contents. These are then removed by the asilid while it perches

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on the ground or vegetation or hangs from vegetation. Once the ingestible parts of the prey have been extracted, the asilid discards the prey item (WOOD 1981).

Many papers have included records of prey choice for Asilidae, usually consisting of a list of a few prey taxa. Robber flies with prey are often easier to collect than those without, which is one of the reasons that even strictly taxonomic papers dealing with these flies will often include a list of prey for the taxa under study. There are a few papers dealing exclusively with prey from a single taxon, for example Araneae (DENNIS et al. 2012); Hemiptera (DENNIS et al. 2010), Coleoptera (LAVIGNE & DENNIS 1994; POLLOCK & LAVIGNE 2019), Lepidoptera (LONDT 1999, DENNIS et al. 2009) and Hymenoptera (LONDT 1993, DENNIS & LAVIGNE 2007). For Diptera prey of Asilidae, no large-scale treatment exists for the entire order, though there have been publications based on asilid predation on other asilids (e.g., O'NEILL 1992; LONDT 1995).

Beginning in June 2014, a concerted effort was made by the first author to document local (i. e., around Portales, Roosevelt Co., eastern New Mexico) robber fly diversity, seasonality, and prey choice. Although papers derived from this effort have been published on specific prey taxa (e.g., POLLOCK & LAVIGNE 2019; POLLOCK & DAVIDSON 2020; POLLOCK 2020), collections continue to include any robber fly seen with a prey item. Approximately 20 % of the over 10,300 prey records for Asilidae comprise the order Diptera; it is the purpose of this paper to document records of robber fly predation upon hover flies (Syrphidae) obtained from this study of the eastern New Mexico Asilidae.

There has been no previously published account specifically on syrphid prey of Asilidae. Likewise, treatments of the entire order Diptera are non-existent. Past published records of asilids preying upon syrphids were gleaned from ROBERT LAVIGNE's "predator-prey database" (http://www.geller-grimm.de/catalog/lavigne.htm), which has been built up from an examination of (mainly) published papers worldwide which document prey of Asilidae. We searched only for records derived from studies in North America. Once the taxonomy and classification were updated (http://www.canacoll.org/Diptera/Staff/Skevington/Syrphidae/Syrphidae_Nearctic_Checklist.htm), the records indicated that 22 genera and at least 27 species of Syrphidae had been recorded as prey of Nearctic robber flies (Table 1). Of these genera, 13 are in Eristalinae and nine in Syrphinae. None were recorded from New Mexico.

Materials and methods

About a dozen localities were regularly (and several others irregularly) sampled for Asilidae in eastern New Mexico (Chaves, De Baca, Lea, Quay, and Roosevelt counties) and adjacent Texas (Bailey County). Not every fly was collected, but every robber fly seen with a prey item was collected, along with its prey item using a standard insect net with 30 cm hoop diameter. At no time was there an attempt to make collecting effort consistent among localities and dates of collection, nor was there an effort to visit each locality for the same duration or the same number of times per year. In other words, the collections were qualitative rather than quantitative. The asilid and its prey were mounted on the same pin (Fig. 1) and specimens were given unique catalogue numbers and entered into a spreadsheet along with pertinent label data. Robber flies were identified by D. A. POLLOCK, using published keys and occasionally with the advice of asilid experts (see acknowledgements). Subfamilial classification of Asilidae follows DIKOW (2009). The syrphid prey were seen and identified by M. HAUSER. For the higher classification of Syrphidae, we follow the four-subfamily classification of MENGUAL et al. (2015). All specimens documented in this paper are deposited in the Eastern New Mexico University Natural History Collection (ENMU).

Results

From June 2014 to September 2021, a total of 10,190 asilid-prey specimen pairs were collected, with the top five prey orders comprising Hymenoptera (37 %), Hemiptera (22 %), Diptera (20 %), Coleoptera (7 %), and Lepidoptera (6 %). Among dipteran prey, the 148 records of Syrphidae represent 7.2 % of all fly prey and 1.5 % of all prey. In New Mexico, records were obtained from Chaves, De Baca, Lea, Quay, and Roosevelt counties; in Texas, only Bailey County was sampled.

Six genera comprising 15 species of Asilidae (three subfamilies represented) were collected while preying upon individuals representing 14 genera and 17 species in four subfamilies of Syrphidae (Table 2). The top three asilid predators accounted for 80 % of all syrphid prey records: *Diogmites bilobatus* BARNES, 2010 (9 spp., 47 specimens, 32 %); *Efferia helenae* (BROMLEY, 1951) (9 spp., 37 specimens, 25 %); and *Efferia bicaudata* (HINE, 1919) (8 spp., 34 specimens, 23 %). Among the syrphid prey, the three most preyed upon species were: *Allograpta exotica* (WIEDEMANN, 1830) (35 specimens, preyed upon by 4 spp. of Asilidae); *Eupeodes volucris* OSTEN SACKEN, 1877 (29 specimens, preyed upon by 10 spp. of Asilidae); and *Eristalinus aeneus* (SCOPOLI, 1763) (27 specimens, preyed upon by 3 spp. of Asilidae).


USA, NM, Roosevelt Co. Portales, N. Ave. Q, nr. E N M U soccer field 34.180862, -103.356217 23.viii.2015; D.A. Pollock

1023

Omegasyr. spp.

det.: M. HAUSER

Fig. 1: A male *Diogmites bilobatus* BARNES with specimen of *Omegasyrphus baliopterus* (LOEW) as prey.

Seven genera and species recorded by LAVIGNE (Table 1) were also collected as prey of Asilidae in the present study; only one predator-prey pair was repeated from the records in LAVIGNE: *Efferia helenae* preying upon *Syritta pipiens* (LINNAEUS, 1758). All genera listed here were previously recorded as containing predators of syrphids except for *Lestomyia* WILLISTON, 1883 and *Stichopogon* LOEW, 1847. At the species level, of the 15 Asilidae species recorded in the present study, only two [*Efferia helenae* and *Promachus bastardii* (MACQUART, 1838)] had been previously recorded as syrphid predators.

Discussion

Most of the 25 localities sampled for asilid predation and at which syrphid prey were collected are within the High Plains or Llano Estacado (“stockaded plain”) in eastern New Mexico and western Texas. On this plateau, the climate is relatively dry and windy, with elevations ranging from 750 to 1500 m (ROSE & ARMENTROUT 1976). Three sides are sharply delimited from the surrounding plains by distinct escarpments. Most of the habitats sampled are semi-desert/prairie with much open ground (e.g., Figs 2, 3). In places, cacti (especially *Cylindropuntia* (ENGELM.) F. M. KNUTH and *Opuntia* MILL., Cactaceae) and mesquite (*Prosopis* LINNAEUS, Fabaceae) were common. Ground cover consisted of a combination of grasses and broadleafed plants. In most localities, the relative area covered by vegetation versus uncovered was approximately equal.

Table 1: Previously published records of syrphid prey of Asilidae (North America only) extracted from http://www.geller-grimm.de/catalog/lavigne.htm. Records are arranged alphabetically by genus of Syrphidae.

Syrphidae subfamily	Syrphidae genus and species	Asilidae subfamily	Asilidae genus and species
Eristalinae	*Chalcosyrphus pigra* (Fabricius, 1794)	Laphriinae	*Laphria virginica* (Banks, 1917)
Eristalinae	*Cheilosia* sp.	Stichopogoninae	*Lasiopogon polensis* Lavigne, 1969
Eristalinae	*Chrysogaster* sp.	Stenopogoninae	*Stenopogon engelhardti* Bromley, 1937
Syrphinae	*Chrysotoxum derivatum* Walker, 1849	Asilinae	*Proctacanthus philadelphicus* Macquart, 1838
Syrphinae	*Chrysotoxum* sp.	Stenopogoninae	*Stenopogon engelhardti* Bromley, 1937
Eristalinae	*Copestylum caudatum* Curran, 1927	Asilinae	*Efferia benedicti* (Bromley, 1940)
Eristalinae	*Copestylum caudatum* Curran, 1927	Dasypogoninae	*Diogmites angustipennis* Loew, 1866
Eristalinae	*Copestylum satur* (Osten Sacken, 1877)	Asilinae	*Megaphorus guildiana* (Williston, 1885)
Eristalinae	*Copestylum vesicularium* (Curran, 1947)	Laphriinae	*Atomosia puella* (Wiedemann, 1828)
Eristalinae	*Copestylum vesicularium* (Curran, 1947)	Asilinae	*Machimus novaescotiae* (Macquart, 1847)
Syrphinae	*Dasysyrphus amalopis* (Osten Sacken, 1875)	Stenopogoninae	*Cyrtopogon willistoni* (Curran, 1923)
Eristalinae	*Eristalinus aeneus* (Scopoli, 1763)	Dasypogoninae	*Diogmites grossus* Bromley, 1936
Eristalinae	*Eristalinus aeneus* (Scopoli, 1763)	Dasypogoninae	*Diogmites symmachus* Loew, 1872
Eristalinae	*Eristalinus aeneus* (Scopoli, 1763)	Dasypogoninae	*Saropogon dispar* Coquillett, 1902
Eristalinae	*Eristalis arbustorum* (Linnaeus, 1758)	Laphriinae	*Laphria flavicollis* Say, 1824
Eristalinae	*Eristalis flavipes* Walker, 1849	Asilinae	*Promachus fitchii* Osten Sacken, 1878
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Asilinae	*Efferia pogonias* (Wiedemann, 1821)
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Asilinae	*Efferia aestuans* (Linnaeus, 1763)
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Asilinae	*Efferia aestuans* (Linnaeus, 1763)
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Asilinae	*Machimus novaescotiae* (Macquart, 1847)
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Asilinae	*Proctacanthus philadelphicus* Macquart, 1838
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Asilinae	*Promachus bastardii* (Macquart, 1838)
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Dasypogoninae	*Diogmites basalis* (Walker, 1851)

Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Dasypogoninae	*Diogmites angustipennis* Loew, 1866
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Dasypogoninae	*Diogmites misellus* Loew, 1866
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Laphriinae	*Laphria canis* Williston, 1883
Eristalinae	*Eristalis tenax* (Linnaeus, 1758)	Laphriinae	*Laphria cinerea* (Back, 1804)
Eristalinae	*Eristalis* sp.	Dasypogoninae	*Diogmites basalis* (Walker, 1851)
Eristalinae	*Eristalis* sp.	Dasypogoninae	*Diogmites basalis* (Walker, 1851)
Syrphinae	*Eupeodes volucris* Osten Sacken, 1877	Asilinae	*Efferia frewingi* (Wilcox, 1966)
Syrphinae	*Eupeodes volucris* Osten Sacken, 1877	Stenopogoninae	*Stenopogon engelhardti* Bromley, 1937
Syrphinae	*Eupeodes volucris* Osten Sacken, 1877	Stenopogoninae	*Heteropogon wilcoxi* James, 1934
Eristalinae	*Helophilus latifrons* Loew, 1863	Asilinae	*Efferia helenae* (Bromley, 1951)
Syrphinae	*Lapposyrphus lapponicus* (Zetterstedt, 1838)	Stenopogoninae	*Cyrtopogon glarealis* Melander, 1923
Syrphinae	*Lapposyrphus* sp.	Laphriinae	*Laphria fernaldi* (Back, 1904)
Syrphinae	*Melanostoma* sp.	Stenopogoninae	*Stenopogon obscuriventris* Loew, 1872
Eristalinae	*Meromacrus acutus* (Fabricius, 1805)	Asilinae	*Efferia pogonias* (Wiedemann, 1821)
Eristalinae	*Milesia virginiensis* (Drury, 1773)	Laphriinae	*Laphria virginica* (Banks, 1917)
Eristalinae	*Orthonevra pictipennis* (Loew, 1863)	Stenopogoninae	*Cyrtopogon falto* (Walker, 1849)
Eristalinae	*Palpada vinetorum* (Fabricius, 1799)	Asilinae	*Megaphorus clausicellus* (Macquart, 1850)
Eristalinae	*Palpada vinetorum* (Fabricius, 1799)	Laphystiinae	*Laphystia litoralis* Curran, 1931
Eristalinae	*Palpada vinetorum* (Fabricius, 1799)	Asilinae	*Proctacanthus milbertii* Macquart, 1838
Eristalinae	*Palpada vinetorum* (Fabricius, 1799)	Dasypogoninae	*Diogmites symmachus* Loew, 1872
Eristalinae	*Palpada vinetorum* (Fabricius, 1799)	Dasypogoninae	*Diogmites missouriensis* Bromley, 1951
Syrphinae	*Scaeva* cf. *affinis* (Say, 1823)	Stenopogoninae	*Stenopogon martini* Bromley, 1937
Syrphinae	*Sphaerophoria* sp.	Asilinae	*Megaphorus guildiana* (Williston, 1885)
Eristalinae	*Spilomyia alcimus* (Walker, 1849)	Laphriinae	*Laphria saffrana* Fabricius, 1805
Eristalinae	*Spilomyia liturata* Williston, 1887	Dasypogoninae	*Diogmites angustipennis* Loew, 1866
Eristalinae	*Syritta pipiens* (Linnaeus, 1758)	Asilinae	*Megaphorus willistoni* (Cole, 1964)

Table 1 (continuation): Previously published records of syrphid prey of Asilidae (North America only) extracted from http://www.geller-grimm.de/catalog/lavigne.htm. Records are arranged alphabetically by genus of Syrphidae.

Syrphidae subfamily	**Syrphidae genus and species**	**Asilidae subfamily**	**Asilidae genus and species**
Eristalinae	*Syritta pipiens* (Linnaeus, 1758)	Asilinae	*Efferia helenae* (Bromley, 1951)
Eristalinae	*Syritta pipiens* (Linnaeus, 1758)	Asilinae	*Proctacanthus milbertii* Macquart, 1838
Syrphinae	*Syrphus opinator* Osten Sacken, 1877	Asilinae	*Efferia helenae* (Bromley, 1951)
Syrphinae	*Syrphus* sp.	Asilinae	*Promachus fitchii* Osten Sacken, 1878
Syrphinae	*Toxomerus marginatus* (Say, 1823)	Asilinae	*Promachus fitchii* Osten Sacken, 1878
Syrphinae	*Toxomerus marginatus* (Say, 1823)	Stenopogoninae	*Heteropogon johnsoni* (Back, 1904)
Syrphinae	*Toxomerus marginatus* (Say, 1823)	Asilinae	*Megaphorus willistoni* (Cole, 1964)
Syrphinae	*Toxomerus marginatus* (Say, 1823)	Dasypogoninae	*Diogmites missouriensis* Bromley, 1951

Robber flies have different "perching" habits (Londt 1994). Among those documented as syrphid predators in this paper, the two general perching habits consist of "vegetation perchers" (e. g., *Diogmites* Loew, 1866, *Megaphorus* Bigot, 1857) and "ground sitters" (e.g., *Efferia* Coquillett, 1893, *Lestomyia*, *Promachus* Loew, 1848 and *Stichopogon*). Depending on the ground temperature, asilids that usually perch on the ground will often restrict themselves to vegetation when the temperature is too high on the ground (e.g., *Efferia* and *Promachus*). The combination of moderate plant diversity and open ground at the study sites (Figs 2, 3) creates opportunities for feeding by the syrphids and foraging areas for the asilids, respectively. *Efferia* is the most diverse asilid genus in North America (Wilcox 1966) and dominates the eastern New Mexico asilid fauna; over half of the species collected with syrphid prey (including 90 out of the 148 specimens) are in this genus. They appear to be generalist predators though we have yet to analyze either the taxonomic or size relationships between the *Efferia* predators and the over 3,100 prey items collected with them. Individuals of *Diogmites bilobatus* and their syrphid prey documented in this paper were sampled mainly over a several week period in 2015 in a "greenfield land" habitat within the city limits of Portales, NM (Roosevelt Co.). Higher than average spring precipitation that year created an ideal habitat for both the *Diogmites* and their syrphid prey: an abundance of flowering forbs for the prey and vegetation from which the predators hang – usually by one or both front legs – while consuming their prey. Most asilids are thought to be generalized predators (Wood 1981; Dennis et al. 2012) and will at least pursue prey which fits a certain size requirement and is in close proximity to the asilid. However, ongoing research has indicated that there are some asilids that are seeming specialists on particular prey taxa. For example, Pollock (2020) showed that two species of *Saropogon* Loew, 1847 and a species of *Cerotainiops* Curran, 1930 are significant predators of harvester ant (*Pogonomyrmex* Mayr, 1868) workers. Data (Pollock, unpubl.) show, for example, that species of *Mallophora* Macquart, 1834 preferentially take aculeate Hymenoptera prey.

Fig. 2: Bosque Redondo Park, nr. Fort Sumner, De Baca Co., New Mexico, U.S.A. (34.4257, –104.2233). Photo taken on 28 July 2021. Here, *Efferia albibarbis* (MACQUART) and *E. luna* WILCOX and their syrphid prey were collected.

Fig. 3: Field near softball complex, Portales, Roosevelt Co., New Mexico, U.S.A. (34.1772, –103.3753). Photo taken on 28 August 2021. At this site, almost all records of syrphid predation by *Efferia bicaudata* (HINE) and *E. helenae* (BROMLEY) were collected. The asilids were found perching on the ground in the open areas.

Table 2: Asilidae (columns) and their prey Syrphidae (rows) collected during this study. Each is presented in alphabetical order by genus and species. A double numeral separated by a slash indicates the number of males, females collected for each predator-prey interaction.

The asilid predators are : *Diogmites bilobatus* (Dasypogoninae), *Efferia albibarbis* (Asilinae), *E. apache*, *E. argentifrons*, *E. bicolor*, *E. cressoni*, *E. helenae*, *E. luna*, *E. subarida*, *E. subpilosa*, *Lestomyia strigipes* (Dasypogoninae), *Megaphorus prudens* (Asilinae), *Promachus bastardii* (Asilinae), *P. oklahomensis*, and *Stichopogon trifasciatus* (Stichopogoninae).

Asilidae species. (abbreviated) → **Syrphid species ↓**	*Diog. bilob.*	*Eff. albi.*	*Eff. apa.*	*Eff. argen.*	*Eff. bic.*	*Eff. cress.*	*Eff. hel.*	*Eff. luna*	*Eff. suba.*	*Eff. subp.*	*Lest. strig.*	*Mega. prud.*	*Prom. bast.*	*Prom. okla.*	*Stich. trifas.*	**Total predations on each syrphid species**
Allograpta exotica (Wiedemann, 1830)	14/7				2/1	0/1	6/4									35
Allograpta obliqua (Say, 1823)	7/5				0/1		1/1			0/1					1/0	17
Anasimyia sp.								0/1								1
Copestylum caudatum Curran, 1927					2/2		2/0					1/0				7
Dioprosopa clavata (Fabricius, 1794)	1/1															2
Eristalinus aeneus (Scopoli, 1763)	0/2				9/6		2/8									27
Eristalis stipator Osten Sacken, 1877	0/4			0/1	0/1		0/1							0/1		8
Eristalis tenax (Linnaeus, 1758)							0/1									1
Eupeodes volucris Osten Sacken, 1877	3/0	0/1	1/2	2/0	2/4		2/6		0/1	3/0	1/0		0/1			29
Helophilus latifrons Loew, 1863	1/1													1/0		3
Omegasyrphus baliopterus (Loew, 1872)	1/1							0/1								3
Palpada vinetorum (Fabricius, 1799)							1/0									1
Paragus haemorrhous Meigen, 1822				0/1												1
Syritta pipiens (Linnaeus, 1758)							0/2						0/1			3
Toxomerus marginatus (Say, 1823)				2/1	3/0										1/0	**7**
Toxomerus politus (Say, 1823)					1/0											1
Trichopsomyia sp.	0/1													1/0		2
Total prey for each asilid species	49	1	3	7	34	1	37	2	1	4	1	1	2	3	2	

The dry desert-like habitats sampled for this study are preferred by many asilid species, but not necessarily by syrphids, which are more species-rich in humid forest habitats with streams and ponds (ROTHERAY & GILBERT 2011; SKEVINGTON et al. 2019). Of all the Syrphidae prey collected, the genus *Copestylum* MACQUART, 1846 is the most characteristic one for this arid habitat, because the larvae of this genus develop in rotting cacti and succulent plants (MARCOS-GARCÍA & PÉREZ-BAÑÓN 2001, 2002; ROTHERAY et al. 2009). Most of the other syrphids are widespread, common species, and some of the genera are known to migrate. Syrphid migration has been studied in the Old World for a long time (AUBERT & GOELDLIN 1981; GATTER & SCHMID 1990; GATTER et al. 2020), but only recently in North America (MENZ et al. 2019) and Australia (FINCH & COOK 2020). Several species are introduced from Europe [*Eristalinus aeneus, Eristalis tenax* (LINNAEUS, 1758)*, Syritta pipiens*] and are often very widespread and found in large numbers (SKEVINGTON et al. 2019). The most surprising prey is *Omegasyrphus baliopterus* (LOEW, 1872), a member of Microdontinae (compare Fig 1: page 167), larvae of which develop as ant parasites (REEMER 2013; REEMER & STÅHLS 2013). Adults of this genus are uncommonly collected but can be locally abundant in Arizona (M. HAUSER & M. IRWIN pers. observation), which might explain the three specimens being prey of Asilidae. Figure 2 shows a habitat in De Baca Co., NM at which this species was collected. The results of this study, although preliminary, confirm the notion that most Asilidae are not specialized predators, but opportunistic, and that therefore mainly common and widespread species of Syrphidae were caught and preyed upon.

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Two new species of *Lygistorrhina* (*Probolaeus*) WILLISTON (Diptera: Keroplatidae: Lygistorrhininae) from the Dominican Republic

[Zwei neue Arten der Gattung *Lygistorrhina* (*Probolaeus*) WILLISTON
(Diptera: Keroplatidae: Lygistorrhininae)
aus der Dominikanischen Republik]

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Abstract

Two new species of *Lygistorrhina* (*Probolaeus*) WILLISTON from the Dominican Republic are described, *L. christhompsoni* **spec. nov.** and *L. victori* **spec. nov.** Although *Lygistorrhina* were previously known from the Miocene of Hispaniola (Dominican amber), this is the first record of extant species of the group on the island.

Keywords: Caribbean, fungus gnats, new taxa, taxonomy

Zusammenfassung

Zwei neue Arten der Gattung *Lygistorrhina* (*Probolaeus*) WILLISTON werden aus der Dominikanischen Republik beschrieben, *L. christhompsoni* **spec. nov.** und *L. victori* **spec. nov.** Obwohl *Lygistorrhina* bereits aus dem Miozän von Hispaniola (Dominikanischer Bernstein) bekannt war, ist dies der erste Nachweis einer rezenten Art der Gruppe auf der Insel.

Stichwörter: Karibik, Pilzmücken, neue Taxa, Taxonomie

Introduction

One of the first papers published by F. Christian THOMPSON was a deviation from his lifelong studies of flower flies (Syrphidae). While a postdoctoral fellow in the American Museum of Natural History, he discovered a large population of a sciaroid gnat, *Lygistorrhina* SKUSE, 1890 (Diptera: Keroplatidae) previously thought to be extremely rare. The large amount of material collected (type series included 247 specimens) allowed him to describe the new species in detail and discuss classification and phylogenetic position of Lygistorrhinidae (THOMPSON 1975). The paper has provided a basis for all future progress in taxonomy of lygistorrhines.

Lygistorrhininae (Diptera: Keroplatidae) is a small group of Sciaroidea usually easily recognisable by long and slender body and legs, enlarged hind femorae and tarsi, long proboscis (with exception of *Seguyola* MATILE, 1990, *Gracilorrhina* HIPPA & VILKAMAA, 2005, and several fossil groups), and reduced wing venation. In 1975, when THOMPSON (1975) described *Lygistorrhina sanctaecatharinae* THOMPSON, 1975, only nine species in a single genus (*Probolaeus* WILLISTON, 1896 and *Palaeognoriste* MEUNIER, 1904 were considered by THOMPSON as subgenera of *Lygistorrhina*) were known. Today 58 species (15 fossil) in 16 genera are known (FUNGUS GNATS ONLINE TEAM 2021). It was suggested that lygistorrhines are not as rare as previously thought (BERTONE 2018) and may be much more diverse (BLAGODEROV & POLLET 2020). Discovery of a new Cretaceous fossil, *Vladelectra* EVENHUIS, 2020

(Keroplatidae *incertae sedis*), demonstrating characters of both Keroplatidae and lygistorrhines, and molecular analysis (Mantič et al. 2020) allowed clarification of the phylogenetic position of Lygistorrhininae as a subfamily of Keroplatidae, corroborating a hypothesis proposed by Tuomikoski (1966).

During a short collecting trip in the Dominican Republic in 2019, I collected a few specimens of *Lygistorrhina*, which unsurprisingly turn out to be new species. These two new species are described here and compared with other species of subgenus *L.* (*Probolaeus*) Williston, 1896.

Material and methods

The specimens were collected on 12–13 April 2019 in Ébano Verde Scientific Reserve (Monsenior Nouel and La Vega Provinces) and on 14–20 April 2019 in Armando Bermúdez National Park (La Vega Province), Dominican Republic, using Malaise traps and by sweeping (Map 1). The Malaise material was stored in 100 % alcohol; swept specimens were point-mounted in the field. Some specimens were later dissected and mounted on microscopic slides in Euparal and Dimethyl Hydantoin Formaldehyde (DMHF). Specimens of *Lygistorrhina sanctaecatharinae* were collected by the author in 2004 (U.S.A.: Georgia, St.-Catherines Island, 31.6755° N, 81.1567° W, Malaise trap, 24 April 2004). An attempt to extract DNA from several specimens was not yet successful. Images were taken using Leica 205C stereomicroscope with Canon EOS 7D camera attached and Olympus BX51 compound microscope with Olympus UC30 camera; extended depth of field images was obtained with Helicon Focus v. 6 software. Morphological nomenclature is based on (Grimaldi & Blagoderov 2001; Hippa et al. 2005; Cumming & Wood 2017); wing venation nomenclature is also according to (Cumming & Wood 2017). Measurements (in millimetres) are provided in Table 1.

Table 1: Measurements (length, in millimetres) for new species of *Lygistorrhina* (*Probolaeus*) (Williston). For *L. victori* **spec. nov.**, with multiple available specimens, numbers in each row indicate range (min.-max. length), followed by mean, and the measurements for the holotype in square brackets.

	***Lygistorrhina christhompsoni* spec. nov.**	***Lygistorrhina victori* spec. nov.**
Number of specimens	1	9
Sex	M	M
Total body	4.55	6.23–8.21, 7.42, [7.47]
Head	0.47	0.73–0.79, 0.77, [0.75]
Antenna	0.40	0.81–1.09, 1, [1.05]
Proboscis	1.42	2.02–2.78, 2.38, [2.38]
Wing	2.34	3.43–4.12, 3.7, [3.78]
Fore coxa	0.54	0.71–0.9, 0.8, [0.79]
Mid coxa	0.47	0.54–0.73, 0.65, [0.63]
Hind coxa	0.44	0.41–0.62, 0.53, [0.579]
Fore femur	0.82	0.77–1.17, 1.03, [1.03]
Mid femur	0.71	0.94–1.44, 1.25, [1.32]
Hind femur	1.20	1.93–2.31, 2.09, [2.05]
Fore tibia	0.81	1.07–1.41, 1.26, [1.28]
Mid tibia	1.10	1.62–1.89, 1.75, [1.64]
Hind tibia	1.71	2.81–3.12, 2.93, [2.89]
Fore basitarsus	0.73	1.29–1.75, 1.56, [1.51]
Mid basitarsus	0.78	1.5–1.83, 1.63, [1.59]
Hind basitarsus	0.86	1.55–1.78, 1.69, [1.74]

Map 1: Collecting localities for new species of *Lygistorrhina* (*Probolaeus*) WILLISTON. Symbols: blue: *L. chirthompsoni* **spec. nov.**; red: *L. victori* **spec. nov.**; green: *L. christhompsoni* **spec. nov.** and *L. victori* **spec. nov.**

All specimens collected by the author in the Dominican Republic. Collecting and export permits were obtained from Ministerio de Medio Ambiente y Recursos Naturales (No.: VAPB-06546). Map 1 was created with the help of OpenTopoMap (https://opentopomap.org/about).

The abbreviations use in the text are as follows:

MNHNSD	– Museo Nacional de Historia Natural “Prof. Eugenio de Jesús Marcano”, Santo Domingo, Dominican Republic
NMS	– National Museums Scotland, Edinburgh, United Kingdom
masl	– meters above sea level
Mya	– million years ago

Taxonomy

Family KEROPLATIDAE RONDANI, 1856

Subfamily Lygistorrhininae EDWARDS, 1925

Genus *Lygistorrhina* SKUSE, 1890

Type species: *Lygistorrhina insignis* SKUSE, 1890: 600

Subgenus *Lygistorrhina* (*Probolaeus*) WILLISTON, 1896

Type species: *Probolaeus singularis* WILLISTON, 1896: 261

Lygistorrhina (*Probolaeus*) *christhompsoni* spec. nov.

(Figs 1, 3, 6–9)

Diagnosis. Dark brown gnats, legs yellow except apical part on hind femur and coxae; tibial spur formula 1:1:2; flagellomeres without distinct bristles; abdomen with sternites 1–4 with white apical flange; vein Sc ending free; laterotergite with 18–20 setae, mesonotum shiny, without light seta.

The new species belong to subgenus *L.* (*Probolaeus*) sharing its synapomorphy, a single mid tibial spur (Grimaldi & Blagoderov 2001). *Lygistorrhina christhompsoni* **spec. nov.** is similar to *L. sanctaecatharinae* Thompson, 1975 (eastern U.S.A.), but differs in having antenna entirely dark; flagellomeres without prominent setae, basal flagellomeres 1.5 × longer than wide; vein C longer; M_{3+4} sinusoid (Fig. 4); fore coxa almost entirely dark; hind femur darkened on apical half; laterotergite with ~20 setae; mesonotum shiny, not covered with small light setae; abdominal sternite 1 with pale fringe. In addition, *L. sanctaecatharinae* has sternite 8 wider; tergite 9 parallel-sided in the middle, with apodeme almost as wide as tergite, tooth of gonostylus narrower, and aedeagal complex pointed at apex (Figs 10–12).

Examined material. Type material. *Holotype* ♂, pointed, labelled verbatim: "DR-2019-008. Dominican / Republic: Ébano Verde SR. / 19.0375°, –70.5257° (± 50m). / 1275–1300masl. Sweeping / 13.4.2019. leg. V. Blagoderov" // "NMS-10001280" [barcode] // "HOLOTYPE / *Lygistorrhina* / *christhompsoni*" [red]. *Paratypes*: **DOMINICAN REPUBLIC**: Ébano Verde Scientific Reserve, along right-hand track from Casabito station, 19.0401° N, 70.5174° W, 1450 masl, sweeping, 13.iv.2019 [♂ NMS-10001234 (in alcohol)]; **DOMINICAN REPUBLIC**: Jose Armando Bermúdez National Park; dry stream south of Arroyo Prieto, 19.0035° N, 70.91754° W, 1630 masl, 17.iv.2019, sweeping [♂ NMS-10001200 (slide mounted), ♀ NMS-10003914 (pointed)]; **DOMINICAN REPUBLIC**: Jose Armando Bermúdez National Park, Track to Virgin de Guadeloupe, 1180 masl, 19.0638° N, 70.8759° W, Malaise trap, 14–20.iv.2019 [4 ♀♀ NMS-10001165, ♀ NMS-10003905 (in alcohol), ♀ NMS-10003876 (dissected in glycerin)] (all in NMS).

Description

MALE. General coloration. Dark brown to black, with lighter abdominal bands (Fig. 1); measurements, compare Table 1.

Head: Rounded, dichoptic. Rounded ommatidia with subequal diameter, interocular setae longer than ommatidial diameter. Three ocelli. Antenna dark brown, short; 14 flagellomeres, densely covered with setae half the diameter of flagellomeres, without strong dorsal setae, subcylindrical, gradually tapering; length of 1–11 flagellomeres 1.1–1.5 × their width, and 1.5–2 × in flagellomeres 12–14. Palpus length 0.5 × the proboscis, tapering towards apex, with a single row of long setae. Proboscis longer than hind femur but shorter than hind tibia.

Thorax: Uniformly dark brown. Scutum irregularly setose. Mesonotum shiny, with distinct dorsocentral rows of setae, but irregularly setose anteriorly with dark setae. Scutellum rounded, with 4 pairs of posterior setae. Antepronotum and proepisternum with 4–5 setae each. Laterotergite lobed, with a row of ~20 setae. Hind coxa longer than both metepimeron and laterotergite. **Legs**: Coxae dark brown except yellow at very apex of fore coxa. Remainder of fore and mid legs yellow; hind femur pale-yellow basally, dark brown in distal 1/3–1/2; hind tibia brown in distal half; hind tarsus brown. Tibiae irregularly setose; dorsal setae on hind tibia as long as diameter of tibia. Claws of fore and mid legs curved, apically blunt, with a small incision at apex; claw of hind leg setiform, straight and pointed. **Wing** (Fig. 3): Membrane hyaline, densely covered with microtrichia. Vein Sc short, ending free; R_1 ends slightly proximad of the level of CuA tip; C extending to more than half the distance between tips of R_5 and M_1. Veins C, R_1 and R_5 with dark setae, remaining veins bare; M_1, M_2 and M_{3+4} slightly sinusoid, almost straight; CuA curved posteriorly. Anal lobe well developed. Halter white, same length as first abdominal segment.

Abdomen: Dark brown to black. Segments 2–4 with pale-yellow narrow transversal band in posterior part, occupying ~10 % of segment length; sternite 1 pale brown apically; posterior segments and terminalia entirely dark brown. **Genitalia** (Figs 6–9): Sternite 8 parallel-sided in basal half, trapezoid in apical; slightly rounded at apex. Tergite 9 is 2.5 × long as wide, ovoid, with a bunch of strong setae at apex, sparsely covered with long strong setae, slightly shorter than gonocoxites; its apodeme relatively wide, ~0.7 × the tergite 9 width. Gonostyli of equal width, their length 0.6 × that of gonocoxites; with very long basal and preapical medial setae and very dense brush of setae medioapically; apical tooth wide, scoop-shaped, slightly wider at apex than at the base. Aedeagal complex moderately sclerotised, short, abruptly flat at the apex; gonocoxal apodeme with short sclerotised curved branches directed caudoapically.

FEMALE. Similar to male. Body length: 3.5–4.2 mm, wing length: 2.5–3.2 mm. **Genitalia** (Fig 16–18): Two strongly sclerotised spermathecae, ovoid. Length of segment 8 is almost equal to length of segment 7. Tergite 9 as long as wide, rounded at apex and slightly narrower at base. Tergite 9 aligned with tergite 8 and fringes it caudally and laterally, length up to 1/4 the latter. Cerci shorter than tergite 8, pale yellow, weakly sclerotised, two-segmented, baciliform, length 2 × the width. Gonocoxites 8 as long as tergite 8, rounded as apex, slightly tapering in lateral view. Sternite 10 well developed, exceeds gonocoxites 8, sclerotised, trapezoid, with very shallow invagination at apex.

Etymology. The species epithet is in honour of Dr F. Christian Thompson (1944–2021).

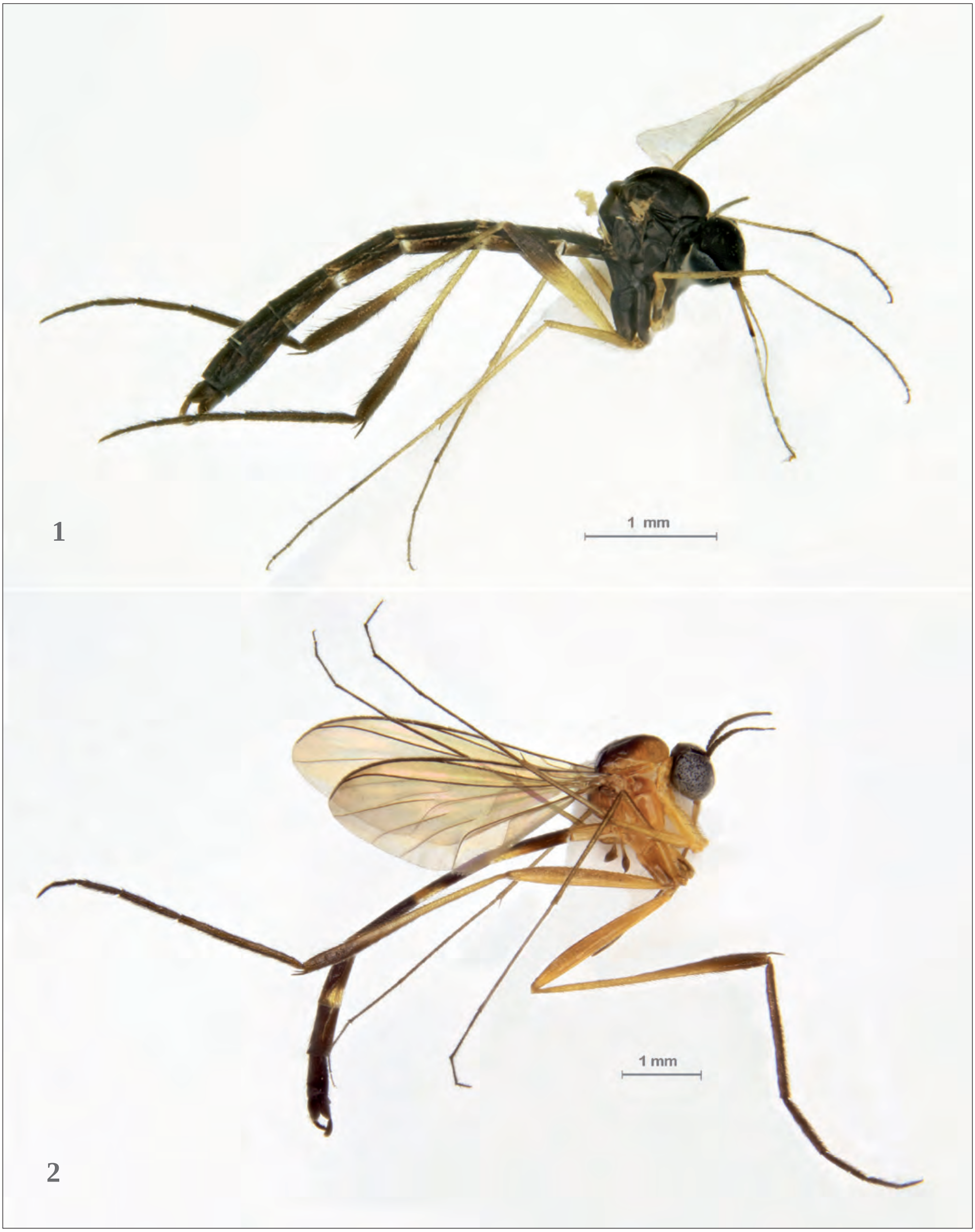
Lygistorrhina victori spec. nov.

(Figs 2, 5, 13–15)

Diagnosis. Relatively large lygistorrhines; brown with yellow spots on thorax and abdomen. Tibial spur formula 1:1:2. Antenna brown; flagellomeres with several strong setae each; mid coxa yellow; scutellum with 12–14 setae; laterotergite with ~30 setae. Vein Sc ending in C; base of cell r_1 of wing infuscate; R_1 ends slightly distad of the level of CuA tip. Fore basitarsus longer than fore tibia. Abdomen with segment 1 completely pale; segments 2–5 with yellow posterior band. Tergite 9 relatively narrow, with wide and sclerotised apodeme; apical tooth of gonostylus short.

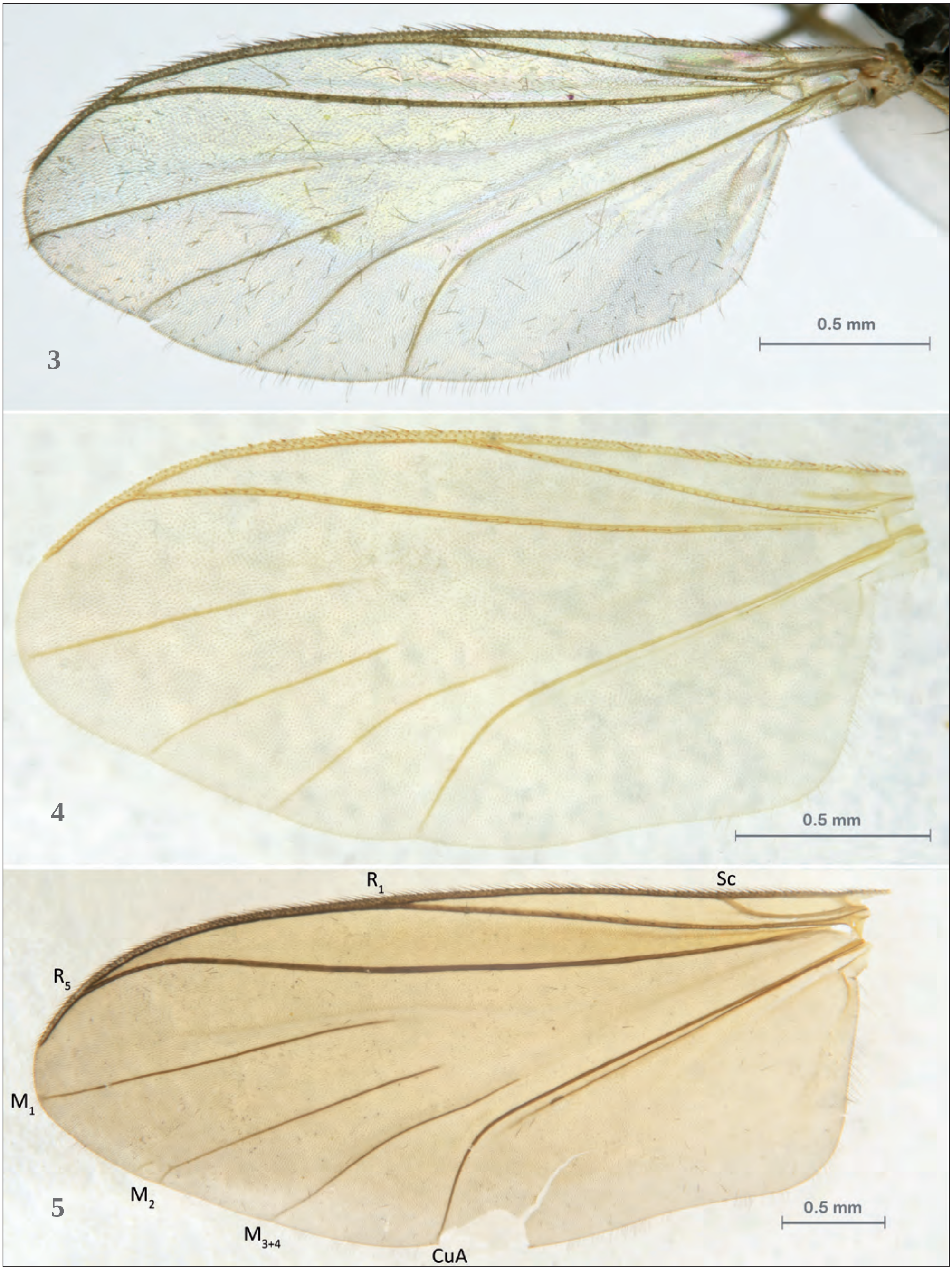
Lygistorrhina victori **spec. nov.** differs from *L. mitarakensis* Blagoderov & Pollett, 2020 (French Guiana) in having antenna brown (yellow in *L. mitarakensis*); flagellomeres with 3–4 short dorsal setae (one long seta); mid coxa yellow (brown); scutellum with 12–14 setae (6 setae); laterotergite with ~30 setae (14–20 setae); tergite 9 narrower, apical tooth of gonostylus shorter. *Lygistorrhina victori* **spec. nov.** differs from *L. singularis* Williston, 1896 (St. Vincent) in having wing membrane pigmented (hyaline in *L. singularis*); abdominal segment 5 with yellow fringe (completely dark in *L. singularis*); vein CuA sinusoid (curved back in *L. singularis*); proboscis slightly shorter than hind tibia (0.6 × the hind tibia); scutellum with 12–14 setae (6 setae in *L. singularis*); laterotergite with ~30 setae (13–14 setae in *L. singularis*).

Examined material. Type material. *Holotype* ♂, pointed, labelled verbatim: “DR-2019-006. Dominican / Republic: Ébano Verde SR. / 19.0406°, 70.5184° (± 100 m) / 1430 masl. Sweeping. / 13.4.2019. leg. V. Blagoderov” // “NMS-10001311” [barcode] // “HOLOTYPE / *Lygistorrhina* / *victori*” [red]. *Paratypes*: **DOMINICAN REPUBLIC**: Jose Armando Bermúdez National Park, Virgin de Guadeloupe, 19.07104° N, 70.8824° W, 1180 masl, 14.iv.2019, sweeping [♂ NMS-10001279 (pointed)]; **DOMINICAN REPUBLIC**: Ébano Verde Scientific Reserve, along right-hand track from Casabito station, 19.0406° N, 70.5184° W, 1470 masl, 13.iv.2019, sweeping [♂♂ NMS-10001228 (slide mounted), NMS-10001312, NMS-10001313, NMS-10001314, NMS-10001315 (pointed), NMS-10001316 (male genitalia dissected), NMS-10001317 (leg and wings on slide)]; **DOMINICAN REPUBLIC**: Ébano Verde Scientific Reserve, stream side to main river, 19.04° N, 70.5364° W, 1150 masl, sweeping, 12.iv.2019

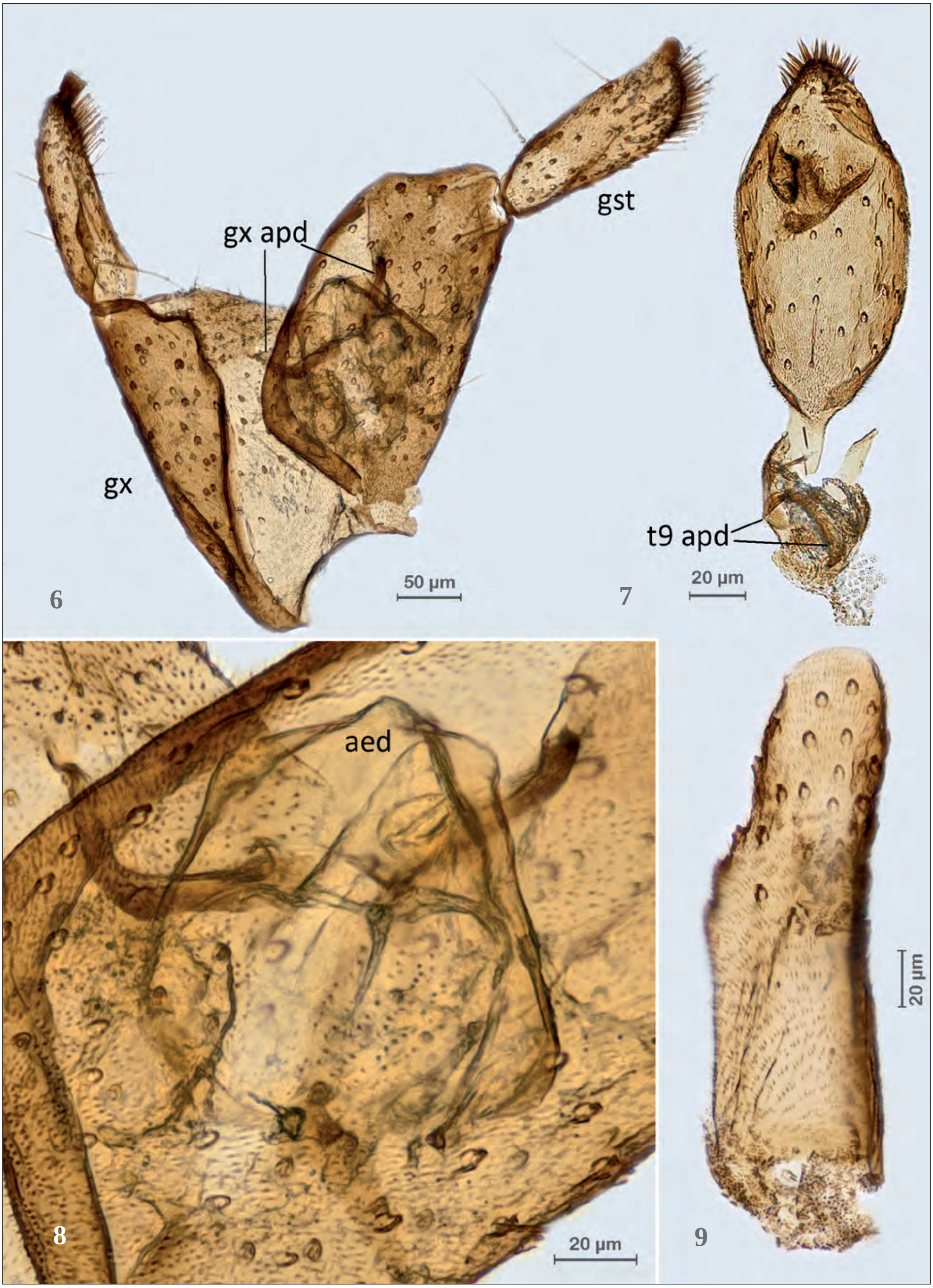


Figs 1–2: Habitus of *Lygistorrhina* species. – **1**: *Lygistorrhina christhompsoni* **spec. nov.** (holotype); – **2**: *Lygistorrhina victori* **spec. nov.** (holotype).

[♀ NMS-10001431 (pointed)]; **DOMINICAN REPUBLIC**: Ébano Verde Scientific Reserve, Along the stream, 19.0395° N, 70.5305° W, 1200 masl, sweeping, 12.iv.2019 [♀ NMS-10001248 (in alcohol)]. (NMS-10001312 and NMS-10001314 in MNHNSD, the rest in NMS).



Figs 3–5: Wings of *Lygistorrhina* species. – **3**: *Lygistorrhina christhompsoni* **spec. nov.** (holotype); – **4**: *Lygistorrhina sanctaecatharinae* THOMPSON (NMS-10003978); – **5**: *Lygistorrhina victori* **spec. nov.** (paratype NMS-10001317).



Figs 6–9: Male genitalia of *Lygistorrhina christhompsoni* **spec. nov.** (paratype NMS-10001020). – **6**: Dorsal view, tergite 9 removed; – **7**: Tergite 9; – **8**: Sternite 8; – **9**: Aedeagal complex. Abbreviations: aed: aedeagal comples; gx: gonocoxite; gx apd: gonocoxal apodeme; gst: gonostylus; t9 apd: tergite 9 apodeme.

Description

MALE. General coloration. Brown with yellow spots on thorax and abdomen (Fig 2); measurements, compare Table 1.

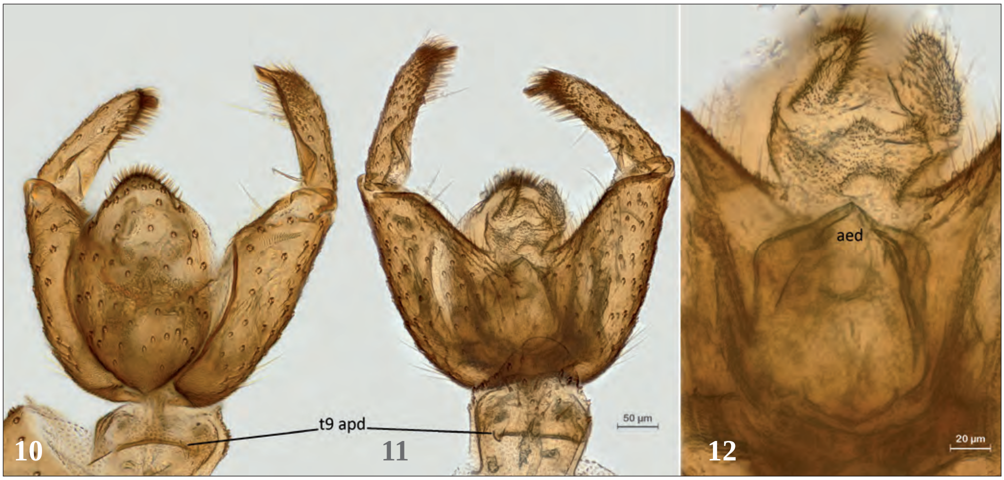
Head: Rounded, dichoptic. Rounded ommatidia with similar diameter, interocular setae slightly longer than ommatidial diameter. Three ocelli arranged almost on a straight line, semi-circular, with median ocellus 0.5 × the size of lateral ocelli. Antenna dark brown, shorter than fore femur, with length 0.8–1.1 mm; 14 flagellomeres, subcylindrical, gradually tapering, each with 3–4 dorsal setae shorter than width of flagellomeres; flagellomeres 1–9 as long as wide, flagellomeres 10–13 ~1.5 × as long as wide, apical flagellomere 2.5 × as long as wide. Clypeus pointed, setose. Palpus length ~0.7 × the proboscis, tapering towards apex, with a single row of long setae. Proboscis (labellum) 2–2.8 mm; longer than hind femur but shorter than hind tibia.

Thorax: Thorax yellow, mesonotum (except lateral margins and lateroapical corners, scutellum, and middle part of mediotergite brown). Scutum irregularly setose. Scutellum rounded, with 12–14 posterior setae. Antepronotum and proepisternum with 10–12 short setae each. Laterotergite lobed, with one row of ~30 setae. Hind coxa slightly longer than metepimeron but shorter than laterotergite. **Legs**: yellow including coxae, except dark-brown to black apical half of hind coxa and tarsi. Tibiae irregularly setose. Dorsal setae of hind tibia equal to tibial width. Fore basitarsus slightly longer than fore tibia. Claws of fore and mid leg curved, apically blunt, with a small incision at apex; claw of hind legs setiform, straight and pointed.

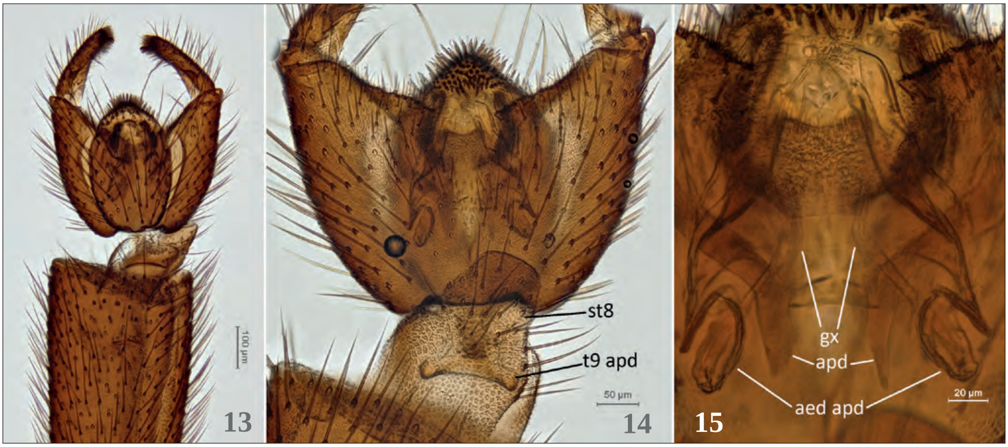
Wing (Fig 5): Membrane slightly infuscate, cell r_1 darker than the rest of the wing, densely covered with microtrichia. Vein Sc relatively long, ending in C; R_1 ends slightly distad of the level of CuA tip; C extending to more than half the distance between tips of R_5 and M_1; veins C, R_1 and R_5 with long dark setae, rest of the veins bare; M_1 longer than M_2 and M_{3+4}, latter subequal in length. Veins M_1 and M_2 almost straight; M_{3+4} curved anteriorly and slightly sinuous; CuA slightly sinuous. Anal lobe well developed. Halter yellow, with the same length as first abdominal segment.

Abdomen: Dark brown to black. Segment 1 completely pale; segments 2–5 with yellow posterior band, occupying 20–30 % of segment length; terminalia dark brown. **Genitalia** (Figs 13–15): Sternite 8 trapezoid, slightly narrower at the base, apex rounded, with setae on lateral sides and apical narrow part only. Tergite 9 ovoid, shorter than gonocoxites, flat at base, rounded at tip, evenly covered with very long setae, with a patch of sparse short setae at tip. Cerci large, sclerotised. Tergite 9 apodeme wide, ~ 0.7 × the tergite width, heavily sclerotised. Gonostyli wider at the base ventrally, with very dense apical and medioventral patches of setae at tip; apical tooth wide, scoop-shaped. Aedeagal complex membranous, with shallow incision at the apex; gonocoxal apodemes heavily sclerotised, with straight arms directed apically and caudally; aedeagal apodeme sinusoidally curved, with bell-shaped extensions apically.

FEMALE. Similar to male. Body length: 4.6 mm, wing length: 3.1 mm. Proboscis slightly longer than hind tibia. **Terminalia** (Figs 19–21): Two weakly sclerotised spermathecae, rounded. Tergite 9 shorter than wide, almost straight at apex, narrower at base. Length of segment 7 is almost 2 × that of segment 8. Tergite 9 aligned with tergite 8 and fringes it caudally and laterally, length at apex ~15 % that of tergite 8. Cerci as long as tergite 8; basal cercomere rectangular, flattened dorsoventrally, width 2 × the length; apical cercomere bacilliform, length 2.5 × the width. Gonocoxites 8 as longer than tergite 8, rounded as apex, slightly tapering in lateral view; slightly curved ventromesally. Sternite 10 weakly sclerotised, does not exceed gonocoxites 8; trapezoid, with triangular invagination at apex.



Figs 10–12: Male genitalia of *Lygistorrhina sanctaecatharinae* Thompson (NMS-10003978). – **10**: Dorsal view; – **11**: Ventral view; – **12**: Aedeagal complex. Abbreviations: aed: aedeagal comples; t9 apd: tergite 9 apodeme.

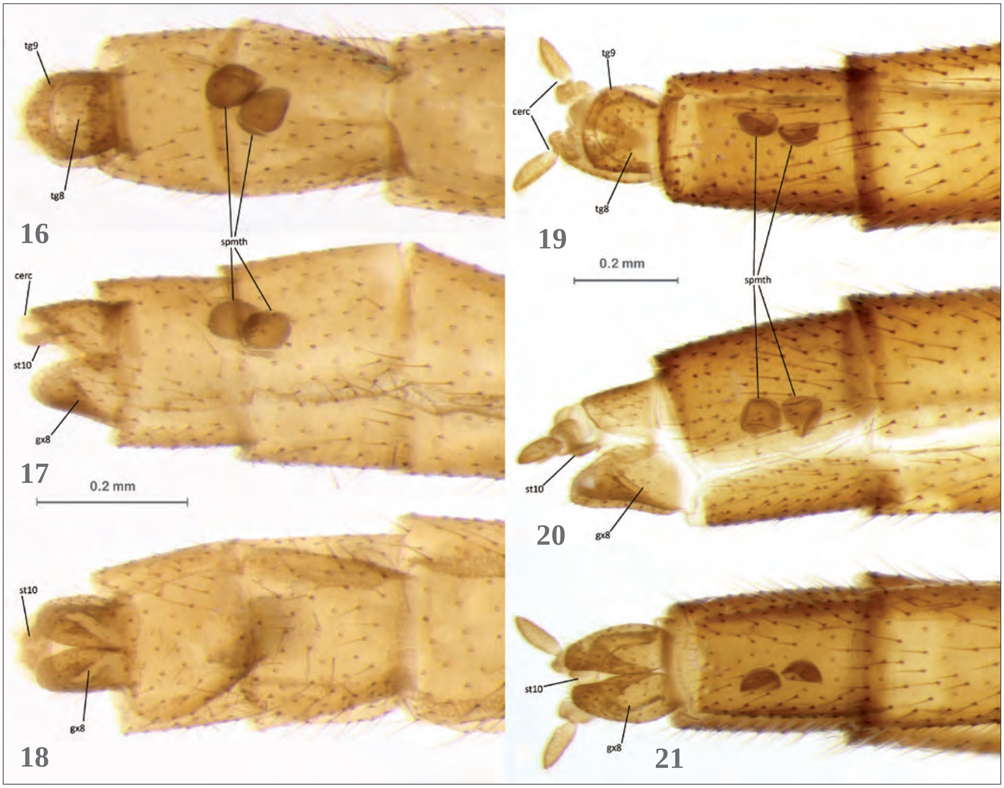


Figs 13–15: Male genitalia of *Lygistorrhina victori* **spec. nov.** (paratype NMS-10001316). – **13**: Dorsal view; – **14**: Ventral view; – **15**: Aedeagal complex. Abbreviations: aed pad: aedeagal apodeme; gx apd: gonocoxal apodeme; st8: sternite 8; t9 apd: tergite 9 apodeme.

Etymology. The species epithet is after Dr Victor Limay-Ríos, whose help was indispensable during this collecting trip.

Discussion

Although the island of Hispaniola is the second largest in the Caribbean and the first one colonised by Europeans (Herrera y Tordesillas 1601), our knowledge of insects of the island, particularly Diptera, is very limited. In fact, the most recent checklist (Perez-Gelabert 2020) recorded only 929 species of flies [for comparison, fauna of the British Isles contains 7224 species of Diptera at the last count (Chandler 2021)]. Perez-Gelabert (2020) reported representatives of 27 genera of fungus gnats (Keroplatidae and Mycetophilidae) known from



Figs 16–21: Female genitalia of *Lygistorrhina* species. – **16–18**: *Lygistorrhina christhompsoni* **spec. nov.** (paratype NMS-10003876); **19–21**: *Lygistorrhina victori* **spec. nov.** (paratype NMS-10001431). – **16, 19**: Dorsal view; – **17, 20**: Lateral view; – **18, 21**: Ventral view. Abbreviations: cerc: cerci; gx8: gonocoxite 8; spmth: spermathecae; st10: sternite 8; tg8: tergite 8; tg9: tergite 9.

the Miocene Dominican amber and only one species of recent Keroplatidae recorded from the island.

One species, *Lygistorrhina caribbeana* GRUND, 2012, was previously described from the Dominican amber (GRUND 2012), dated 15–20 Mya (ITURRALDE-VINENT & MACPHEE 1996). Although other genera of Lygistorrhininae are known since as early as the Early Cretaceous (BLAGODEROV & GRIMALDI 2004), *L. caribbeana* is the earliest known representative of the subgenus *L.* (*Probolaeus*). It is interesting that the two new species from Hispaniola are most similar morphologically to species from eastern North America and French Guiana/Lesser Antilles. Discovery of further Caribbean species and future phylogenetic analysis will undoubtedly help to clarify the complex historical biogeography of the region.

Most of the *Lygistorrhina* specimes in this study were collected by sweeping along walls covered in liverworts, mosses, and slime moulds (Fig. 16). It is possible that in their development, lygistorrhinines use non-vascular plants as larval substrate. Despite decades of investigation, the biology of Lygistorrhininae remains a mystery.

Acknowledgements

The author would like to express his deepest gratitude to Dr Carlos SURIEL, Museo Nacional de Historia Natural “Prof. Eugenio de Jesús MARCANO”, Santo Domingo, Dominican Republic for invalu-

Fig 22: Habitat of *Lygistorrhina* species. Insert: closeup of wall covered with liverworts and slime moulds.

able help with collecting permits and warm welcome in MNHNSD, as well as Arturo León BENÍTEZ, Cristian MARTE and Francisco PAZ, without whom the field work would not have been possible. Author also sincerely appreciates Dr Chris BORKENT's careful review of the manuscript and valuable comments and suggestions.

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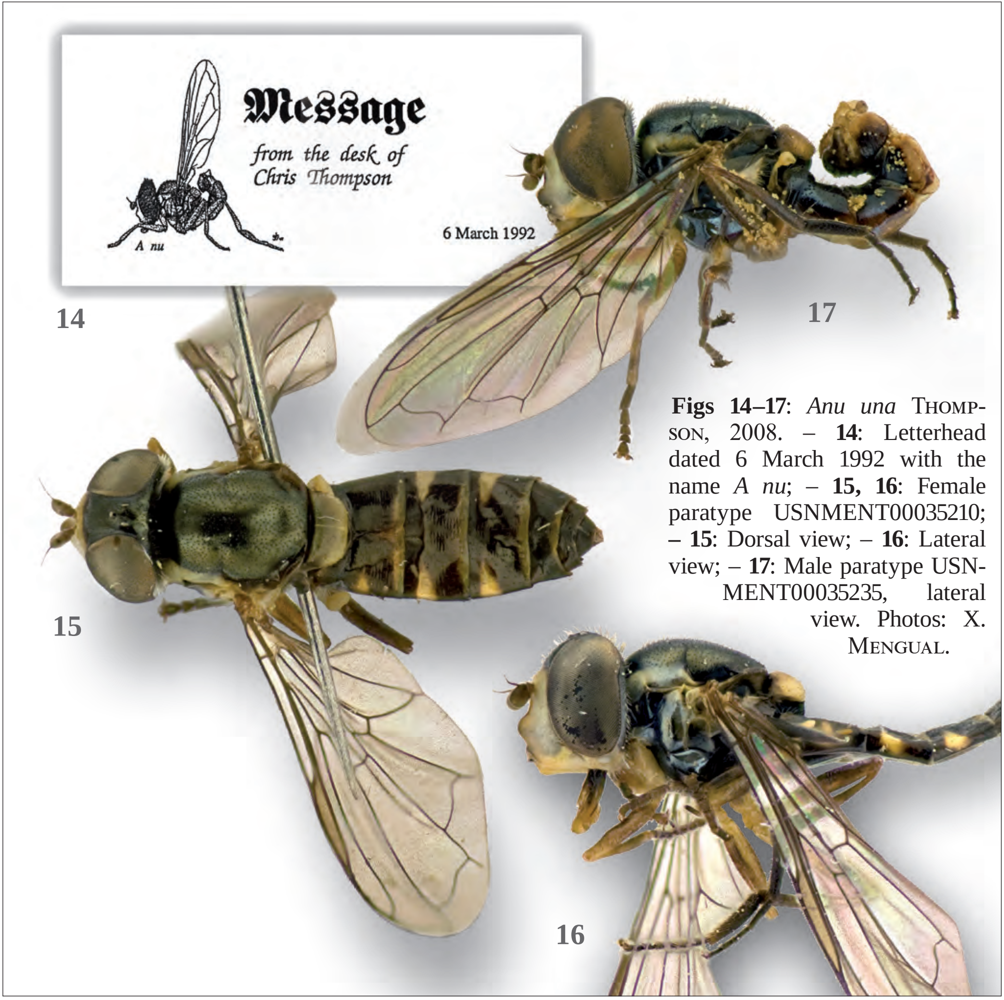
Selected species described by F. Christian Thompson. V.

Ximo Mengual

In 1977 Arnold Menke, hymenopterist at the Smithsonian Institution, described *Aha ha* Menke, 1977 (a palindrome, as well as sounding funny) and he even had it on his car license plate (he probably still does). Chris also wanted to use a palindrome for his new New Zealand fly but Arnold beat him to it.

Neal Evenhuis was known (and still is) for his funny names and told Chris in 1991 that he was going to propose the new replacement name "I" for a genus of fossil chaoborids whose original name, *Trichia* Hong, 1981, was preoccupied. This was going to be in the fossil fly catalogue, but ended up with a different name, *Iyaiyai* Evenhuis, 1994. Chris scoffed and said that a genus name had to be two letters and make a word. Then Neal explained to him that all Greek vowels are nouns and are words (a rarity to ever catch Chris not knowing something). You could see the light go off in Chris's head. And he came up with *A nu*.

Gustavo Hormiga had already drawn the fly back in 1987. Chris procrastinated in describing it, but made a letterhead for it with the name underneath (Fig. 14). His procrastination caught up with him as the new ICZN Code came out and all names after 1999 required genus-group names to be two letters or more. Chris changed his letterhead shortly thereafter (see the letter on page 306 from him dated 2001 and note that the name "*A nu*" is no longer under the drawing). Chris finally described the genus and species in his 2008 New Zealand paper as *Anu una*. He got his palindrome, but was still upset that he was unable to use *A nu*.



Message

from the desk of
Chris Thompson

6 March 1992

A nu

Figs 14–17: *Anu una* Thompson, 2008. – **14**: Letterhead dated 6 March 1992 with the name *A nu*; – **15, 16**: Female paratype USNMENT00035210; – **15**: Dorsal view; – **16**: Lateral view; – **17**: Male paratype USNMENT00035235, lateral view. Photos: X. Mengual.

A review of the genus *Pseudocyphomyia* KERTÉSZ (Diptera: Stratiomyidae) with description of two new species

[Ein Überblick der Gattung *Pseudocyphomyia* KERTÉSZ
(Diptera: Stratiomyidae) nebst der Beschreibung von zwei neuen Arten]

Norman E. WOODLEY

Hereford, Arizona, U.S.A.

Abstract

The genus *Pseudocyphomyia* KERTÉSZ (Diptera: Stratiomyidae: Pachygastrinae) is reviewed. Two new species are described, *P. hansoni* **spec. nov.** and *P. thompsoni* **spec. nov.**, both known only from Costa Rica. A neotype is designated for *P. mimetica* KERTÉSZ.

Key words: Stratiomyidae, *Pseudocyphomyia*, Neotropical Region, Costa Rica, mimicry, dedication

Zusammenfassung

Es wird eine Übersicht zu den Arten der Gattung *Pseudocyphomyia* KERTÉSZ (Diptera: Stratiomyidae: Pachygastrinae) gegeben. Zwei neue Arten, die bislang nur aus Costa Rica bekannt sind, werden beschrieben: *P. hansoni* **spec. nov.** und *P. thompsoni* **spec. nov.** Für *P. mimetica* KERTÉSZ wird ein Neotypus festgelegt.

Stichwörter: Stratiomyidae, *Pseudocyphomyia*, Neotropische Region, Costa Rica, Mimikry, Widmung

Introduction

The genus *Pseudocyphomyia* KERTÉSZ, 1916 was described for a single species originating from Amazonian Brazil (KERTÉSZ 1916). The genus is remarkable because of its close resemblance to females of a number of species of *Cyphomyia* WIEDEMANN, 1819 (Stratiomyidae: Clitellariinae), exhibiting a dark bluish black body, dark wings, and a bright yellow head. Two other genera of pachygastrine stratiomyids, *Hypselophrum* KERTÉSZ, 1909 and *Platylobium* LINDNER, 1933, belong to this mimicry complex, but nothing is known about the dynamics of the system, such as what the model is.

Pseudocyphomyia has been known from a single described species, but WOODLEY (2009) noted the existence of two undescribed species from Costa Rica. The purpose of this paper is to describe those species.

Materials and methods

Morphological terminology follows CUMMING & WOOD (2017). Specimens examined in this study are from the Museo Nacional de Costa Rica, San José, Costa Rica, incorporating the former collections of the Instituto Nacional de Biodiversidad (MNCR); the Canadian National Collection, Agriculture Canada, Ottawa, Canada (CNC); the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A. (MCZ); the Muséum national d'Histoire naturelle, Paris, France (MNHN); the Natural History Museum of Los Angeles

County, Los Angeles, California, U.S.A. (LACM); and the National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. (USNM).

In the description of type labels, the contents of each label are enclosed in double quotation marks (“ ”) and the individual lines of data are separated by a double forward slash (//). In the “examined material” sections, label localities without GPS data were searched on the internet. If they could be found, GPS data is included in brackets “[ ]”.

Results

Pseudocyphomyia Kertész

Pseudocyphomyia Kertész, 1916: 149.
Type species: *Pseudocyphomyia mimetica* Kertész, 1916, by original designation.

Diagnosis. *Pseudocyphomyia* is a genus in a group of Neotropical Pachygastrinae that has multiple spines on the scutellum (see Fig. 1). Within this subfamily, three genera have species that strongly resemble members of the genus *Cyphomyia*. The genus *Platylobium* can be distinguished from *Pseudocyphomyia* by having only two scutellar spines [versus four spines] and eyes with dense, short setae [versus bare eyes]. The genus *Hypselophrum* also has a similar habitus and has four scutellar spines, however it has an antennal flagellum that has a compact, ovoid complex with an arista-like style [more elongate, cylindrical with short, blunt eighth flagellomere in *Pseudocyphomyia* (Fig. 3)], and eyes with distinct setae [bare eyes in *Pseudocyphomyia*].

Woodley (2008) provided a key to the Neotropical genera of Pachygastrinae that have two or more scutellar spines.

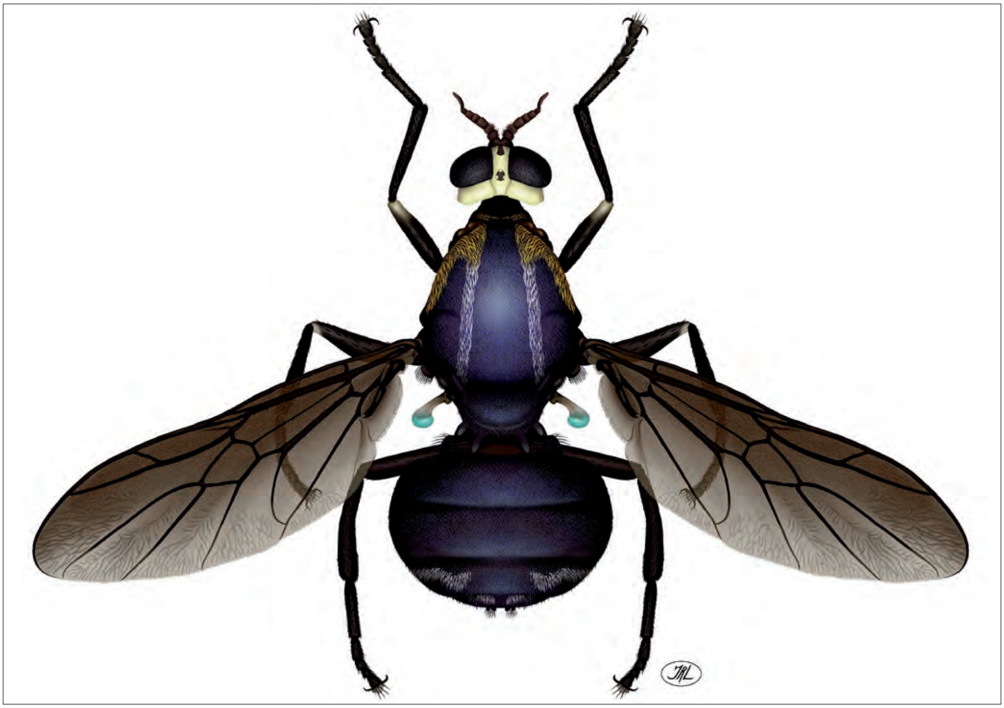


Fig. 1: *Pseudocyphomyia thompsoni* **spec. nov.**, habitus, dorsal view. Illustration by Taina Litwak.

Pseudocyphomyia mimetica Kertész, 1916

(Figs 2, 5–9)

Pseudocyphomyia mimetica Kertész, 1916: 150. HT ♂ [HNHM, destroyed]: Brazil: “Amazon”.

Diagnosis. *Pseudocyphomyia mimetica* (Fig. 2) can easily be distinguished from the two other species in the genus by having the appressed golden setae on the anterior part of the scutum uninterrupted, the appressed setae on the abdominal sternites dark in color and inconspicuous, and the alula completely covered with microtrichia.

Description. This species was well described by Kertész (1916). The male terminalia have not been described previously. **Male terminalia**: with gonocoxites (Fig. 5) almost completely divided ventrally at synsternum, narrowing anteriorly, with short, sharply rounded, ventromedial posterior processes, similar but more well-developed processes dorsally; gonostylus (Figs 5, 7) concave ventrally, with short apical process bent medially; gonocoxal apodemes (Fig. 5) arising almost at anterior margin of gonocoxites, moderately long; phallic complex (Figs 8, 9) rather simple, bilobed posteriorly; epandrium (Fig. 6) slightly longer than wide, dorsally convex, evenly rounded posteriorly.

Examined material. **FRENCH GUIANA**: 1 ♂, Nouveau Chantier, ii, (MNHN); 1 sex unknown, Nouveau Chantier, v, (MNHN); 1 ♂ Nouveau Chantier, no date (MNHN); 1 ♂, Saul [03.629454, –53.204877], i.1977, M. Duranton (MNHN). **ECUADOR**: **Orellana Province**: 1 ♂, Reserva Étnica Waorani, 1 km S of Onkone Gare Camp, 00°39'25.7"S, 76°27'10.8"W, 216 meters, 10.x.1994, Terry Erwin et al., insecticidal fogging, terre firme forest, Lot 931 (USNM); **Pastaza Province**: 1 ♂ (neotype designated below) 1 ♀, Santa Clara [–01.26399, –77.887391], 30.vi.1976, P. M. Turner (USNM); **Sucumbios Province**: 1 ♀, Sacha Lodge, 0.5° S, 76.5° W, 270 meters, 10.–20.ix.1994, P. Hibbs, Malaise trap (LACM); 1 ♀, Sacha Lodge, 0.5° S, 76.5° W, 290 meters, 30.ix–10.x.1994, P. Hibbs, Malaise trap (LACM).

Remarks. Kertész (1916) described *P. mimetica* from a unique male holotype that was subsequently destroyed at the Hungarian Natural History Museum in 1956 (Földvári & Papp 2007). Therefore, I am designating a neotype for the species here. The neotype is deposited at USNM and labelled:

“ECUADOR // Past. Prov. // Santa Clara // 30 June 1976 // P.M. Turner” “ECUADOR-PEACE CORPS-// SMITHSONIAN INSTITUTION // AQUATIC INSECT SURVEY” “NEOTYPE ♂ // *Pseudocyphomyia // mimetica* // Kertész // des. Woodley 2022”.

The neotype specimen is in excellent condition, missing only four tarsomeres on the left middle leg. The male terminalia are preserved in glycerin in a microvial on the specimen pin.

This species is the only one in the genus that is currently known to occur in South America. It has been collected at relatively low elevations in the Amazon Basin.

Pseudocyphomyia hansoni spec. nov.

(Figs 3, 10–14)

Diagnosis. *Pseudocyphomyia hansoni* **spec. nov.** (Fig. 3) can be distinguished from congeners by having the appressed golden setae on the anterior part of the scutum interrupted medially, the alula with microtrichia only along the anterior margin, the absence of silvery setal vittae on the scutum, and usually with the appressed setae on the abdominal sternites silvery in color and conspicuous.

Description

MALE. Body length: 9.0–12.5 mm.

Head: pale yellow except ocellar tubercle, lower frons and narrow median band extending dorsal to lower-upper frontal border and small genal projection brownish black, face below

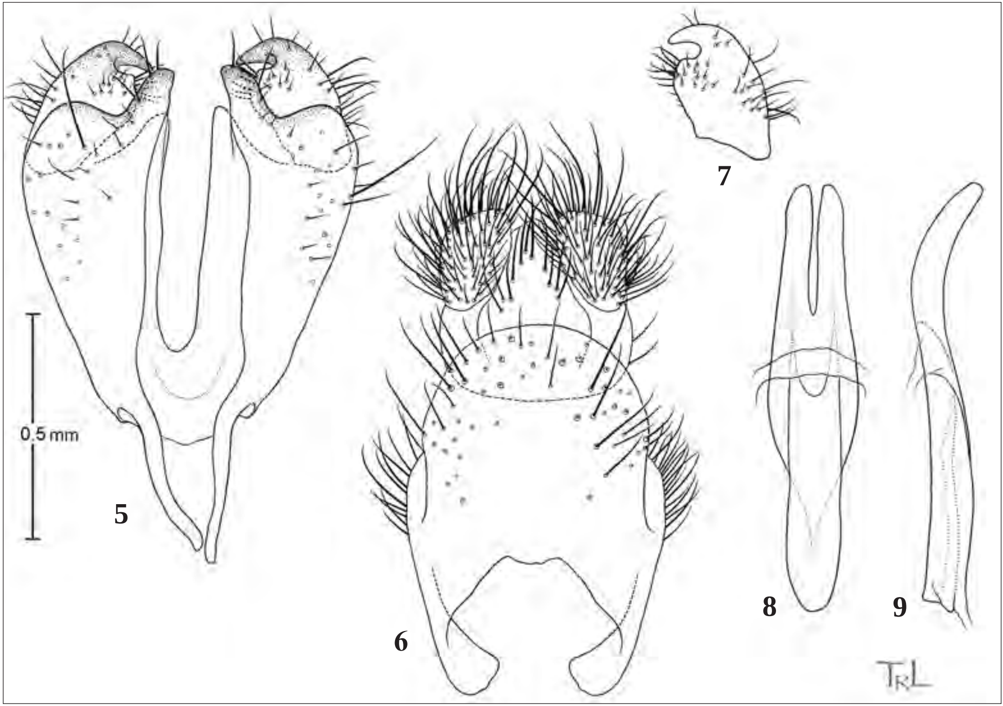
antennae suffused with brownish color; largely bare of setae, region of juncture of upper and lower frons with very short, inconspicuous silvery hair-like setae, with some similar but minute setae extending on upper frons, face below antennae with short, silvery setae; genal projection and narrow margins of face and lower frons with silvery tomentum. Postocular orbit evenly widening from gena to occipital region to about dorsal edge of eye, then narrowing toward ocellar tubercle. Eye bare, separate, upper frons 0.09–0.11 of head width. Antenna brownish-black, 0.89–1.00 length of head, seventh flagellomere very short, eighth forming an ovoid style; first antennal segment with short, semi-appressed dark setae, second segment with more conspicuous short, bristly setae, a few short setae on eighth flagellomere. Palpus brownish black, second segment elongate ovoid, longer than first, with dense, velvety tomentum.

Figs 2–4: *Pseudocyphomyia* species, dorsal habitus photographs. – **2**: *P. mimetica* KERTÉSZ; – **3**: *P. hansoni* **spec. nov.**; – **4**: *P. thompsoni* **spec. nov.**

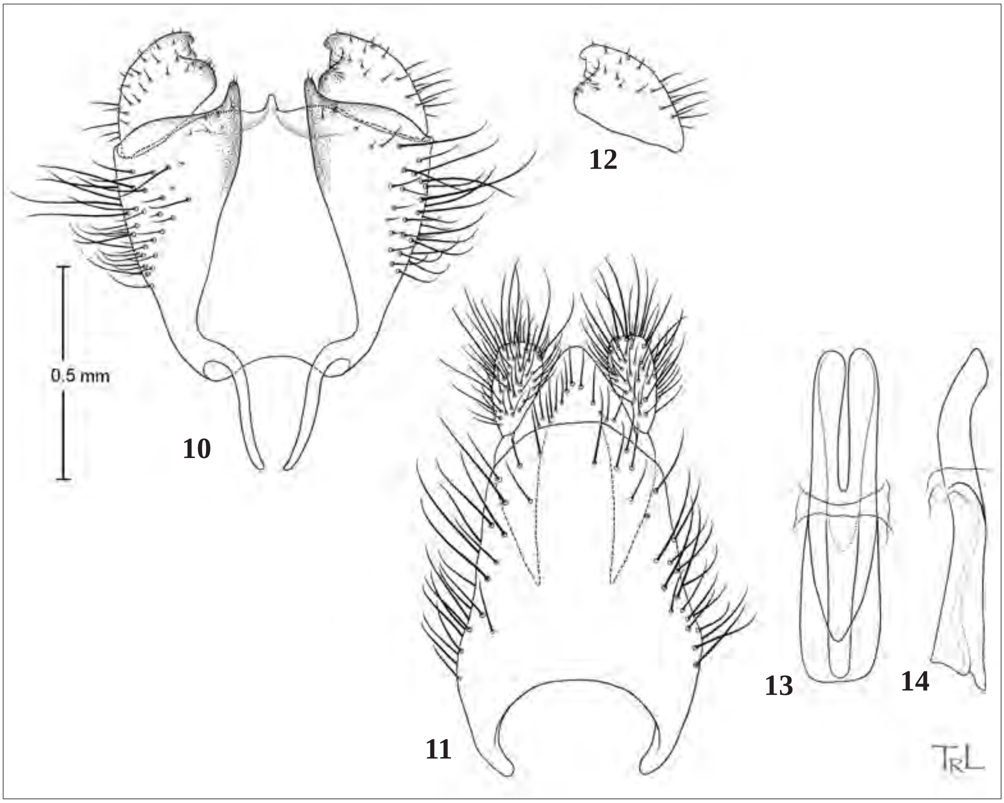
Thorax: black, scutum and scutellum with conspicuous dark blue metallic reflections, pleura with more faint reflections; scutum and scutellum with fairly dense short, dark, appressed hair-like setae, scutum with dense, golden appressed setae along broad margins extending to transverse suture, broadly interrupted at anterior margin; pleura with silvery appressed setae over most of surface except for shiny, bare areas on most of anepisternum except for medial portion, a small bare area on katepisternum, and posterior half of anepimeron; laterotergite with dense, erect blackish hair-like setae. Scutellum with four short, conical spines, much shorter than scutellum, space between medial pair about twice distance between medial and lateral spines; the spines can be dark or slightly yellowish. **Legs** blackish except for short apical part of front femur yellowish. **Wing** with uniform brownish infuscation, evenly set with dense microtrichia except bare at base of wing, basal and anterior portion of cell cua, and most of alula except narrow anterior margin. Halter pale yellowish, base of stem slightly brownish.

Abdomen: concolorous with scutum, tergites densely punctate giving them a somewhat matte appearance, densely set with dark, appressed setae, tergites three and four with some appressed silvery setae on lateral areas, narrowly extending medially along sutures, fifth tergite with some irregular silvery setae on anterior half; sternites two to five with dense, appressed silvery setae, first sternite and lateral corners of second with dark, hair-like setae in holotype, but can be extensively silvery.

Male terminalia: with gonocoxites (Fig. 10) not divided ventrally at synsternum, narrowing anteriorly, synsternum with a short, sharp, triangular ventromedial posterior process, and gonocoxites with a pair of short, sharply rounded processes dorsally; gonostylus (Figs 10,



Figs 5–9: *Pseudocyphomyia mimetica* KERTÉSZ, male terminalia of neotype. – **5**: Genital capsule, dorsal view; – **6**: Epandrium and postgenital segments, dorsal view; – **7**: Gonostylus, dorsal view; – **8**: Phallic complex, dorsal view; – **9**: Phallic complex, lateral view.



Figs 10–14: *Pseudocyphomyia hansoni* **spec. nov.**, male terminalia. – **10**: Genital capsule, dorsal view; – **11**: Epandrium and postgenital segments, dorsal view; – **12**: Gonostylus, dorsal view; – **13**: Phallic complex, dorsal view; – **14**: Phallic complex, lateral view.

12) concave ventrally, very slightly produced apically; gonocoxal apodemes (Fig. 10) arising almost at anterior margin of gonocoxites, moderately long but shorter than in *P. mimetica*; phallic complex (Figs 13, 14) rather simple, bilobed posteriorly; epandrium (Fig. 11) somewhat longer than wide, dorsally convex, evenly rounded posteriorly.

FEMALE. Body length: 7.0–11.5 mm. Very similar to male, differing as follows: **Head** with upper frons overlapping but averaging slightly wider than in male, 0.09–0.15 width of head. **Abdomen** with cerci two-segmented, second segment slightly shorter than first.

Examined material. The *holotype* male is deposited at CNC and labelled: "COSTA RICA: Alajuela // Penas Blancas 700 m // II 1987 // E. Cruz MT" "HOLOTYPE ♂ // *Pseudocyphomyia* // *hansoni* // N. E. Woodley 2022". The locality is at [10.3641, –84.6650]. The specimen is in excellent condition, missing only the left antennal flagellum. The terminalia are stored in glycerin in a microvial on the specimen pin. *Paratypes.* **COSTA RICA**: **Heredia Province**: 1 ♀, 11 km ESE of La Virgen, 10.350, –84.050, 250–350 m, 22.ii.2004, INB0003610950 (MNCR); 1 ♀, Estación Biológia La Selva, Bosque secundario, 10.433, –84.017, 50–150 m, 23.viii.1999, INBCRI002620746 (MNCR); 1 ♀, Estación Biológia La Selva, Bosque secundario, 10.433, –84.017, 50–150 m, 17.iv.2000, INBCRI002740649 (MNCR); **Limón Province**: 1 ♂ 1 ♀, Valle de la Estrella, Reserva Biológica Hitoy Cerere, Sendero Bobócara, L_N_184250_641800, 300 m, 17.vi–17.vii.1999, F. Umaña, Malaise trap, INB0003361177, INB0003361175 (MNCR); 1 ♀, Valle de la Estrella, Reserva Biológica Hitoy Cerere, Sendero Bobócara, L_N_184250_641800, 300 m, 17.ii–17.iii.2000, F. Umaña, Malaise trap, INB0003370269 (MNCR); 1 ♀, Valle de la Estrella, Reserva Biológica Hitoy Cerere, Sendero Toma de Agua, L_N_184600_643400, 100–140 m, 17.ii–17.iii.2000, F. UMAÑA, Malaise trap, INB0003370248, (MNCR); 2 ♀♀, Valle de la Estrella, Reserva Biológica Hitoy Cerere, Sendero Toma de Agua, L_N_184600_643400, 100–140 m, 17.iii–17.iv.2000, F. UMAÑA, Malaise trap, INB0003370360, INB0003370366 (MNCR); 1 ♀, Valle de la Estrella, Reserva Biológica Hitoy Cerere, L_S_398100_572800, 100 m, 3.v–15.vi.1994, G. CARBALLO, Malaise trap, INB0003359575 (MNCR); **Alajuela Province**: 1 ♀, La Fortuna, Sector Cerro Chato, L_N_269500_460900, 1,100 m, 4.ii–4iii.1998, G. CARBALLO, Malaise trap, INBIOCRI002417349 (MNCR); **Cartago Province**: 1 ♀, La Suiza [09.85238, –83.613307], 16.vii, P. SCHILD (USNM); 1 ♀, Monumento Nacional Guayabo, next to Rio Guayabo going down the trail, L_N_217400_570000, ix.1994, G. FONSECA (USNM); **Guanacaste Province**: 1 ♂, 9 km S of Santa Cecilia, Estacion Pitilla, 330200, 380200, 700 m, i.1989, GNP Biodiversity Survey, INBIOCRI000110345 (MNCR); 1 ♀, 9 km S of Santa Cecilia, Estacion Pitilla, 330200, 380200, 700 m, ix.1989, GNP Biodiversity Survey, INBIOCRI000035534 (MNCR).

Etymology. The species epithet is in honor of the late Wilford J. HANSON (1927–2013), a specialist in Stratiomyidae and the first to effectively use male terminalia as taxonomic characters in stratiomyids in his studies of *Nemotelus* GEOFFROY, 1762 (HANSON 1958, 1963).

Remarks. Some slight variation has been noted, most obviously in size. The larvae undoubtedly occur under bark as do virtually all pachygastrines, and size presumably varies depending on the abundance and quality of the food source. A couple of specimens have been noted in which the setae on the abdominal sternites are mostly dark, not silvery.

Pseudocyphomyia thompsoni spec. nov.

(Figs 1, 4)

Diagnosis. *Pseudocyphomyia thompsoni* **spec. nov.** can be distinguished from congeners by having the appressed golden setae on the anterior part of the scutum interrupted medially, the appressed setae on the abdominal sternites silvery in color and conspicuous, the alula with microtrichia only along the anterior margin, and the presence of silvery setal vittae on the scutum.

Description. **MALE**. Unknown.

FEMALE. Body length: 6.8–12.5 mm.
Head: pale yellow except ocellar tubercle, lower frons and narrow median band extending dorsal to lower-upper frontal border and small genal projection brownish black, face below antennae suffused with yellowish color; largely bare of setae, region of juncture of upper and lower frons with very short, inconspicuous silvery hair-like setae, with some similar but minute setae extending on upper frons, face below antennae with short, silvery setae; genal projection and narrow margins of face and lower frons with silvery tomentum. Postocular orbit gradually widening from gena to occipital region to about dorsal edge of eye, not as wide as in *P. hansoni* **spec. nov.**, then narrowing toward ocellar tubercle. Eye bare, separate, upper frons 0.08–0.14 of head width. Antenna brownish to brownish-black, 0.95–1.05 length of head, seventh flagellomere very short, eighth forming an ovoid style; first two antennal segments with short, semi-appressed dark setae, with a few pale setae intermixed, a few short setae on eighth flagellomere. Palpus brownish black, second segment elongate ovoid, longer than first, with dense, velvety tomentum.
Thorax: black, scutum and scutellum with conspicuous dark blue metallic reflections, pleura with more faint reflections; scutum and scutellum with fairly dense short, dark, appressed hair-like setae, scutum with dense, golden appressed setae along broad margins extending to transverse suture, widened in anterior part, broadly interrupted at anterior margin, with a narrow silvery setal vitta arising from inner medial margin of golden setae, extending to corners

of scutellum; pleura with silvery appressed setae over most of surface except for shiny, bare areas on most of anepisternum except for medial portion, a small bare area on katepisternum, and posterior half of anepimeron, a few golden setae often present at posterodorsal corner of anepisternum; laterotergite with dense, erect blackish hair-like setae. Scutellum with four short, conical spines, much shorter than scutellum, space between medial pair about twice distance between medial and lateral spines, but sometimes more evenly spaced; the spines can be dark or slightly yellowish. **Legs** blackish except for short apical part of front femur yellowish, extreme apices of mid and hind femora irregularly brownish to yellowish; first tarsomere of mid tarsus paler than rest of legs, dull yellowish, especially near base. **Wing** with more or less uniform brownish infuscation, slightly darker near costal margin, evenly set with dense microtrichia except bare at base of wing, basal and anterior portion of cell cua, with cells bm and cua more extensively bare in basal areas than in *P. hansoni* **spec. nov.**, and most of alula except narrow anterior margin. Halter pale yellowish, base of stem slightly brownish.
Abdomen: concolorous with scutum, tergites densely punctate giving them a somewhat matte appearance, densely set with dark, appressed setae, tergites three and four with some appressed silvery setae on lateral areas, narrowly extending medially along sutures, fifth tergite with some irregular silvery setae on anterior half; sternites with dense, appressed silvery setae, small lateral corners of second tergite occasionally with a few dark, hair-like setae.

Examined material. The *holotype* female is deposited at USNM and labelled: “COSTA RICA: Puntarenas // 24 km W Piedras Blancas // 8°45' N, 83°24' W. iv–v. // 1991. Malaise trap // P. Hanson 200 m” “HOLOTYPE ♀ // *Pseudocyphomyia* // *thompsoni* // N. E. Woodley 2022”. The specimen was mounted from alcohol and is in excellent condition. *Paratypes*. **COSTA RICA**: **Puntarenas Province**: 3 ♀♀, Peninsula de Osa, Rancho Quemado, L_S_292500_511000, 200 m, vii.1992, F. Quesada, INBIOCRI000736150, INBIOCRI000736155, INBIOCRI000736157 (MNCR); 1 ♀, Peninsula de Osa, Rancho Quemado, L_S_292500_511000, 200 m, vi.1992, F. Quesada & M. Segura, INBIOCRI000742036 (MNCR); 4 ♀♀, Estación Agujas, L_S_276750_526550, 300 m, 10.v.–15.vi.2001, J. Azofeifa, INB0003312550, INB0003312552, INB0003312556, INB0003312557 (MNCR); 1 ♀, Estación Cerro de Oro, 5.6 km NW of Cerro Rincon, Sendero La Tarde, L_S_280100_519200, 300 m, 5.v.1995, R. Villalobos, INBIOCRI002381708 (MNCR); 1 ♀, Albergue Cerro de Oro, L_S_279650_518450, 150 m, 22.viii.1995, L. Angulo, INBIOCRI002349947 (MNCR); 1 ♀, Golfito, [08.639011, –83.166029], 1948, P. & D. Allen (MCZ).

Etymology. The species epithet is to honor the memory of F. Christian Thompson, my colleague of over 32 years at the Systematic Entomology Laboratory, Agricultural Research Service.

Remarks. Again, as in *P. hansoni* **spec. nov.**, there is distinct variation in size in the series examined. Otherwise, specimens are quite consistent in coloration and structure.

Key to species of *Pseudocyphomyia*

1 Appressed golden setae on anterior part of scutum not interrupted medially (Fig. 2); alula completely covered with microtrichia; appressed setae on abdominal sternites brownish and inconspicuous; South America .... ***P. mimetica* Kertész**
– Appressed golden setae on anterior part of scutum broadly interrupted medially (Figs 1, 3, 4); alula with microtrichia only along anterior margin; appressed setae on abdominal sternites usually silvery and conspicuous; Central America **2**

2 Scutum with a pair of narrow vittae of appressed silvery setae extending from the appressed golden setae to the lateral corners of the scutellum (Figs 1, 4); wing cell cua mostly bare of microtrichia along vein CuA+CuP .... ***P. thompsoni* spec. nov.**
– Scutum without vittae of silvery appressed setae (Fig. 3); wing cell cua with microtrichia present along most of vein CuA+CuP .... ***P. hansoni* spec. nov.**

Dedication

I met Chris THOMPSON a year or so before I started work in my position as a dipterist at the Systematic Entomology Laboratory (SEL), USDA, housed at the National Museum of Natural History, Smithsonian Institution, Washington, DC, in 1983. After I had applied for the job, there was no interview process. In those days selections for positions were made by the scientists in the ordinal unit (Diptera unit, in my case) at the museum, and were based on information provided by the candidates on a long government employment form. When a candidate was selected, the selection was forwarded up the "chain of command" for approval, and then the USDA personnel office contacted the candidate with the formal job offer. There wasn't supposed to be any contact by the scientists who made the initial selection, but Chris telephoned me almost immediately after the unit selection and told me I had gotten the job. Most of Chris's colleagues can recount times he told them something that was "strictly confidential".

When I first started work at my position in 1983, SEL was not the most cutting-edge organization. When I was asked by the administrators what I needed for research equipment, I requested a microscope and a desk top computer. I was told that I couldn't have a computer, because nobody else in the lab had one. Chris, on the other hand, was already very much into computers, and had a desk top computer at home that he purchased personally. Quite early on, he recognized the huge potential that computers had for systematic research, and was certainly the first scientist in SEL to do so. His vision was certainly borne out, as none of us can even imagine working without a computer now.

Chris was also a very strong proponent of systematic catalogs. He was always proud of the fact that the Diptera community had put a priority on catalogs and eventually produced one for each major zoogeographic region. Early on in my career I did not have a great interest in cataloging, but over the years through Chris's influence I came to understand how important they were. In the late 1990s I embarked on a world catalog of Stratiomyidae (WOODLEY 2001). As I re-examined the original literature, I consulted with Chris on a daily basis about nomenclatural problems I encountered, and his command of the ICZN code was phenomenal, as well as his knowledge of the early entomological literature that involved Diptera. As a result, I feel my own knowledge of zoological nomenclature is excellent, and I attribute my learning entirely to Chris. In addition, in the process of working on a world catalog of stratiomyids, I gained much knowledge of the taxonomy of the family by reviewing all of the original literature. I came to realize that the process of producing a catalog was probably the most efficient way of learning the taxonomy of a group. Chris had a prodigious memory, and I'm sure that his vast knowledge of syrphids came about, in part, by cataloging them.

Of course, over our decades of working together, Chris and I had inevitable disagreements and arguments, some of which were frustrating. But Chris was a fine friend and colleague over those years, and I certainly owe him a great debt of gratitude for his help and influence.

Acknowledgements

I am grateful to Jeffrey CUMMING (CNC), Manuel ZUMBADO (Instituto Nacional de Biodiversidad, Costa Rica), and the late Loïc MATILE (MNHN) for the loan of specimens from their respective institutions. Martin HAUSER (California Department of Agriculture) provided some useful information and comments on related genera. I also thank Taina LITWAK (Systematic Entomology Laboratory, U.S. Department of Agriculture, Washington, D.C.) for the habitus illustration (Fig. 1) and the illustrations of male terminalia (Figs 5–14). Lucrecia RODRIGUEZ (also of the Systematic Entomology Laboratory) took the habitus photographs (Figs 2–4).

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New Australasian species of *Nepalomyia* Hollis (Diptera: Dolichopodidae), with the description of a new genus from the Solomon Islands

[Neue austral-asiatische Arten von *Nepalomyia* Hollis (Diptera: Dolichopodidae), nebst der Beschreibung einer neuen Gattung von den Salomonen]

Daniel J. Bickel

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Abstract

Four new species of *Nepalomyia* Hollis, 1964 are described and illustrated: *N. hastata* **spec. nov.** [Queensland (Australia), Papua New Guinea, and the Aru Islands, (Indonesia)], *N. thompsoni* **spec. nov.** [Papua New Guinea], *N. vitiensis* **spec. nov.** [Fiji], and *N. polhemusi* **spec. nov.** [Fiji]. The genus *Nepalomyia* is discussed, and its biogeographical distribution is enlarged; previously known from the Indian Ocean, the Nearctic, Palearctic, and Oriental regions, and now from tropical Australasia east to Fiji. The genus *Scotiomyia* Meuffels & Grootaert, 1997 is regarded as a **new junior synonym** of *Nepalomyia* Hollis, 1964, and the following five species described as *Scotiomyia* are newly referred to *Nepalomyia*: *N. flavicauda* (Wei & Yang, 2007) **comb. nov.** [China], *N. fusca* (Meuffels & Grootaert, 1997) **comb. nov.** [Papua New Guinea], *N. melanura* (Meuffels & Grootaert, 1997) **comb. nov.** [Papua New Guinea], *N. opercula* (Wei, 2006) **comb. nov.** [China], and *N. singaporensis* (Evenhuis & Grootaert, 2002) **comb. nov.** [Singapore]. The species *Nepalomyia singaporensis* Grootaert, 2013 from Singapore thus becomes a junior homonym and is replaced with *Nepalomyia grootaerti* **nom. nov.** The genus *Paluda* Wei, 2006 (preocc. Hemiptera; DeLong 1937), previously placed in synonymy with *Scotiomyia*, is regarded as a **new synonym** of *Nepalomyia* Hollis.

A related new monotypic genus, *Tatamba* **gen. nov.**, is described from the Solomon Islands based on a new species, *Tatamba parva* **spec. nov.** This species is small (wing length = 1.6 mm) and has unusual male genitalia, with cuticular lobes arising near the base of the surstylus and extending distally. A dedication to F. C. Thompson is included.

Key words: Australia, Fiji, New Guinea, Solomon Islands, new genus, new species, *Scotiomyia*, *Tatamba*

Zusammenfassung

Vier neue Arten der Gattung *Nepalomyia* Hollis, 1964 werden beschrieben und abgebildet: *N. hastata* **spec. nov.** [Queensland (Australien), Papua Neuguinea und Aru-Inseln (Indonesien)], *N. thompsoni* **spec. nov.** [Papua Neuguinea], *N. vitiensis* **spec. nov.** [Fidschi-Inseln], and *N. polhemusi* **spec. nov.** [Fidschi-Inseln]. Die Gattung *Nepalomyia* wird diskutiert und ihre zoogeographische Reichweite vergrößert sich: Sie war vom Indischen Ozean, der Nearktischen Region, der Paläarktis und der Orientalischen Region bekannt, nunmehr kennt man Vorkommen im tropischen austral-asiatischen Raum bis hin zu den Fidschi-Inseln. Die Gattung *Scotiomyia* Meuffels & Grootaert, 1997 wird als **neues jüngeres synonym** von *Nepalomyia* Hollis, 1964 aufgefasst und die folgenden fünf, ehemals in der Gattung *Scotiomyia* beschriebenen Spezies, werden nach *Nepalomyia* transferiert: *N. flavicauda* (Wei & Yang, 2007) **comb. nov.** [China], *N. fusca* (Meuffels & Grootaert, 1997) **comb. nov.** [Papua New Guinea], *N. melanura* (Meuffels & Grootaert, 1997) **comb. nov.** [Papua New Guinea], *N. opercula* (Wei, 2006) **comb. nov.** [China], and *N. singaporensis*

(EVENHUIS & GROOTAERT, 2002) **comb. nov.** [Singapore]. Die Art *Nepalomyia singaporensis* GROOTAERT, 2013 aus Singapur wird dadurch zum jüngeren Homonym. Ihr Name wird durch *Nepalomyia grootaerti* **nom. nov.** ersetzt. Die Gattung *Paluda* WEI, 2006 (preocc. Hemiptera; DELONG 1937), die vorhergehend in Synonymie mit *Scotiomyia* gesetzt war, ist nunmehr ein **neues Synonym** von *Nepalomyia* HOLLIS.

Eine verwandte neue monotypische Gattung, *Tatamba* **gen. nov.**, wird anhand einer neuen Art, *Tatamba parva* **spec. nov.**, von den Salomonen beschrieben. Diese Art ist klein (Flügellänge = 1,6 mm) und hat ungewöhnliche männliche Genitalien mit Hautlappen, die nahe der Basis des Surstylus inserieren und sich distal erstrecken. Eine Widmung für F. C. THOMPSON ist im Artikel enthalten.

Stichwörter: Australien, Fidschi, Neu Guinea, Solomonen, neue Gattung, neue Arten, *Scotiomyia, Tatamba*

Introduction

HOLLIS (1964) described the genus *Nepalomyia* HOLLIS, 1964 for two species of Dolichopodidae collected in Nepal. Later in the same year, ROBINSON (1964) erected the genus *Neurigonella* ROBINSON, 1964 for two North American species previously described in other genera. RUNYON & HURLEY (2003) placed the two genera in synonymy, described two additional species from the Nearctic fauna, and transferred twenty-one species of *Neurigonella* ROBINSON, 1964 described from China and the Russian Far East into *Nepalomyia*. The genus *Nepalomyia* currently includes 79 species, primarily from mainland China (both Palearctic and Oriental), Taiwan, the Russian Far East, the Caucasus, Malaysia, Singapore, Bali (Indonesia), and Reunion Island in the Indian Ocean, eastern North America, and California (see species list and references in EVENHUIS & PAPE 2022). This paper extends the range of *Nepalomyia* into Australasia with four new species from Australia, New Guinea and Fiji and newly refers five described species from New Guinea, Singapore, and China to the genus. *Nepalomyia* is close to *Tatamba* **gen. nov.**, a small-sized genus with unusual male genitalia from the Solomon Islands.

Nepalomyia thompsoni **spec. nov.** is here dedicated to the memory of F. Christian THOMPSON. I first met Chris in 1979, when as student at Cornell University, I travelled to Washington D.C., to see the United States National Museum collections for my Ph.D. revision of the Nearctic *Medetera* FISCHER VON WALDHEIM, 1819. I made a serious *faux pas* when I first met Chris. I had contacted Harold ROBINSON, the highly productive dolichopodid worker but member of the Smithsonian Botany Department regarding my visit. After our discussion, ROBINSON told me to go downstairs to the Entomology Department to see Chris THOMPSON, whose curatorial responsibilities included the family Dolichopodidae. Chris was annoyed that I had not contacted him first, as he was in charge of the collection. Of course, I apologized and said I was unaware of the protocol, that ROBINSON was the current active worker, etc. He calmed down but was still annoyed. Ultimately, he was glad somebody was working on the Dolichopodidae. He did not like the family and often had to identify taxa as part of his curatorial duties, especially *Medetera* specimens from forestry studies. Females of many species oviposit at the entrances to bark beetle (Curculionidae: Scolytinae) galleries, and after hatching the larvae move through the galleries preying on the beetle larvae. The genus *Medetera* is therefore an important biological control agent for these forest pests, and specimens are often reared in large numbers from scolytine infested logs. The Nearctic fauna was poorly resolved, and Chris was happy to have someone work on the genus. I saw him in subsequent visits to Washington and got to know other members of the Diptera Section: Wayne MATHIS, George STEYSKAL, Curt SABROSKY, Ray GAGNÉ, Willis WIRTH, Dee WILDER, Lloyd KNUT-

SON, Richard FOOTE, Allen NORRBOM, and Norm WOODLEY, a time when the USNM was well-staffed with researchers.

Later on, I would always see Chris at the International Congress of Dipterology and biodiversity planning meetings where he played a prominent role. In 2000 he recommended me to work with the South American Biological Control Laboratory, Buenos Aires [Argentina], to identify species of *Thrypticus* GERSTÄCKER,1864 (Diptera: Dolichopodidae) reared from water hyacinth, *Eichhornia crassipes* (MART.) SOLMS, with the view they might provide biological control agents for that invasive weed. *Thrypticus* is a cosmopolitan genus whose larvae are stem-miners in aquatic and semi-aquatic monocots. I twice visited the laboratory and participated in field work in northern Argentina, and with Cristina HERNANDEZ, my Argentinian co-worker, described a clade of six *Thrypticus* species, all reared from South American water hyacinths (BICKEL & HERNANDEZ 2004). Chris was generous and provided me with reprints of valuable dolichopodid papers. He was at times moody and a bit unpredictable, but I always found him helpful and wanting to promote the study of Diptera. Vale, Chris THOMPSON.

Materials and methods

The repositories of material cited in this revision use the following acronyms:

AMS	– Australian Museum, Sydney.
ANIC	– Australian National Insect Collection, CSIRO, Canberra.
BPBM	– Bishop Museum, Honolulu, Hawaii, U.S.A.
IRSN	– Institut royal des Sciences naturelles de Belgique, Brussels.
MNHN	– Museum National d'Historie Naturelle, Paris, France.
NMWC	– National Museum of Wales, Cardiff, U.K.
QDPI	– Queensland Department of Primary Industries, Indooroopilly, Australia.
USNM	– National Museum of Natural History, Washington, D.C., U.S.A.

Species are defined based on the male genitalia and male secondary sexual characters (MSSC). Keys are based on non-genitalic characters where possible, although accurate identification often requires male postabdominal characters. Species descriptions are condensed to avoid unnecessary repetition. Photographs were made with a Leica M205A photomontage system. The left lateral view of the hypopygium or male genital capsule is shown for all species. In describing the hypopygium, 'dorsal' and 'ventral' refer to morphological position prior to genitalic rotation and flexion. Thus, in figures showing a lateral view of the hypopygium, the top of the page is morphologically ventral, while the bottom is dorsal. Morphological terminology follows MCALPINE (1981), except for the male hypopygium where terms of CUMMING et al. (1995) are used. Measurements were made on representative dry specimens (usually the holotype). Body length of males is measured from the base of the antennae to the tip of the seventh abdominal segment. The position of features on elongate structures such as leg segments is given as a fraction of the total length, starting from the base. The relative lengths of the podomeres are representative ratios and not measurements, and they are given for each leg in the following formula and punctuation: trochanter + femur; tibia; tarsomere 1/ 2/ 3/ 4/ 5; CuAx ratio: length crossvein dm-m/ length distal vein M_4.

The following abbreviations and terms are used: MSSC: Male secondary sexual character(s), non-genitalic characters found only on male body; I, II, III: pro-, meso-, metathoracic legs; C: coxa; T: tibia; F: femur; ac: acrostichal setae; ad: anterodorsal; av: anteroventral; dc: dorsocentral setae; dv: dorsoventral; hm: postpronotal setae; npl: notopleural setae; pa: postalar setae: pd, posterodorsal; pm: presutural supra-alar setae; ppl: proepisternal setae; pv: posteroventral; sa: postsutural supra-alar setae; sr: presutural intra-alar setae; t: tarsus; t_{1-5}: tarsomeres 1 to 5.

For primary type material, information on the labels is given *ad verbatim*, i.e., reproduced from the labels, without omissions, abbreviations, or interpretations by the authors. The double quotation demarcate each label [“ ”] and double slash to demarcate lines on a label [//].

Results

Nepalomyia Hollis, 1964

Nepalomyia Hollis, 1964: 110. Type species: *Nepalomyia dytei* Hollis, 1964 by orig. des.
Neurigonella Robinson, 1964: 119. Type species: *Neurigona nigricornis* Van Duzee, 1914 by orig. des.
Scotiomyia Meuffels & Grootaert, 1997: 248. Type species: *Scotiomyia fusca* Meuffels & Grootaert, 1997 by orig. des. **Syn. nov.**
Paluda Wei, 2006: 489 (preocc. Hemiptera; DeLong 1937). Type species: *Paluda opercula* Wei, 2006 by orig. des. **Syn. nov.**

Generic and synonymic notes

Scotiomyia was described by Meuffels & Grootaert (1997) to accommodate two species from lowland Papua New Guinea and it was referred to the subfamily Sympycninae. The generic and species descriptions are detailed and well-illustrated. Later, three additional species from China and Singapore were described into to the genus (see list below). However, *Scotiomyia* should be regarded as a junior synonym of the large and complex genus *Nepalomyia*. Many of the structures noted by the authors as diagnostic, such as the shape of the antenna, the basal swelling of the costa and the structure of the male postabdomen (especially noting the form and variation of the cercus and surstylus) are found among the many species of *Nepalomyia*. Within the genus, the postpedicel is usually subrectangular with an apical indentation from which arista arises, although some species lack the apical indentation or have a subtriangular postpedicel, both with a dorsal subapical arista. Also, the basal swelling of the costa shows variable expression within the genus: it is absent in most species but occurs variously (e.g., in three of the four species newly described here, see Fig. 5 b), and even occurs in the North American *Nepalomyia dilaticosta* Runyon & Hurley, 2003. I regard the variation shown by *Scotomiya* species to be accommodated within the concept of *Nepalomyia*.

The Chinese species *Nepalomyia opercula* Wei, 2006 was originally described as the type species of a new genus, *Paluda* Wei, but the genus was preoccupied and the species was referred to *Scotiomyia* by Yang et al. (2006).

The following species are newly referred to *Nepalomyia*:

Nepalomyia flavicauda (Wei & Yang, 2007: 582) [*Scotiomyia*] **comb. nov.**: China.
Nepalomyia fusca (Meuffels & Grootaert, 1997: 249) [*Scotiomyia*] **comb. nov.**: Papua New Guinea.
Nepalomyia melanura (Meuffels & Grootaert, 1997: 252) [*Scotiomyia*] **comb. nov.**: Papua New Guinea.
Nepalomyia opercula (Wei, 2006: 489) [*Scotiomyia*] **comb. nov.**: China.
Nepalomyia singaporensis (Evenhuis & Grootaert, 2002: 313) [*Scotiomyia*] [nec. *Nepalomyia singaporensis* Grootaert, 2013] **comb. nov.**: Singapore.

As a result of *Scotiomyia singaporensis* Evenhuis & Grootaert (2002) here referred to *Nepalomyia*, the name *Nepalomyia singaporensis* Grootaert, 2013 becomes a junior homonym and must be replaced:

***Nepalomyia grootaerti* nom. nov.** for *Nepalomyia singaporensis* Grootaert, 2013: 112 [*Nepalomyia*]: Singapore.

Diagnosis

Body length: 2.5–3.5 mm.
Head (Fig. 1 c). Postcranium flat; vertex not excavated; with pairs of strong converging vertical and strong diverging ocellar setae; face slightly narrowing ventrally, but eyes distinctly sepa-

rated; scape and pedicel short, subequal, and scape dorsally bare; postpedicel usually subrectangular, with apical indentation from which arista arises, although some species without apical indentation or with subtriangular postpedicel with dorsal subapical arista.

Thorax (Fig. 5 e). Posterior mesonotum with slight flattening, but not depressed; ac short, regular biseriate; 5–6 strong dc present, decreasing in size anteriorly; scutellum dorsally flat; median scutellar seta strong, lateral scutellar seta very small; proepisternum dorsad of CI with strong lateral seta. **Legs**. CII with strong anterolateral seta near 1/2; CIII with strong black lateral seta at 1/2; pulvilli and claws short; leg I usually bare of major setae; FII and FIII with strong anterior preapical seta; TII with two very strong ad setae near 1/4 and 3/5, and with two pd setae near 1/5 and 3/5; male basitarsus III sometimes with basal spur abutting apex of tibia III (absent in Australasian species); tarsus $IIIt_2$ more than twice length $IIIt_1$.

Wing (Figs 1 e, 2, 5 b). Membrane hyaline; costa along cell c sometimes expanded in both sexes; R_{4+5} and M_1 subparallel distally, with R_{4+5} joining costa anteriad of apex, and M_1 joining posteriad; vein M_1 without flexion (*bosse alaire*); CuAx ratio: 0.4.

Abdomen. Tergites 1–5 mostly with short uniform vestiture; sternite 4 forming hood for hypopygium and with row of long marginal setae; postabdomen (Figs 1 a, 4 a): tergite 6 short, without vestiture; segment 7 with subrectangular tergite and narrower sternite; sternite 8 ovate and with V or Y-shaped thickening along basal margins; hypopygium (Figs 1 a, 3 a, 4 a);) with hypandrium forming curved hood over phallus; surstylus lobate with subrectangular arms; cercus sometimes with modified apical setae; female oviscapt (Figs 1 f, g) with tergites 9+10 medially divided into two acanthophorites, each bearing pointed spines.

Remarks. The morphology of *Nepalomyia* was reviewed in detail by RUNYON & HURLEY (2003) and will not be repeated here. However, some additional morphological notes are provided:

1. Absence of male secondary sexual characters. Dolichopodidae in general are noted for their wide range of male secondary sexual characters (MSSC), the non-genitalic modifications on the male body that are absent on females, and that are assumed to enable conspecific mate recognition during courtship. The only non-genitalic difference I could find between the sexes of the *Nepalomyia* species is the female face and clypeus being slightly wider than in the male, but such facial width dimorphism is found across the entire Diptera. Otherwise, males and females of this genus have a similar overall somatic appearance.
2. Male postabdomen. *Nepalomyia* has a large exserted and pedunculate hypopygium (Fig. 4 a), where both segments 6 and 7 act to support the extension of the genital capsule. Two points are worth noting: a) sternite 4 is arched and forms a sheath for the distal hypopygium at rest and has a characteristic row of long marginal setae; and b) the base of sternite 8 usually has a V-shaped marginal thickening, which can also be found in the genus *Acropsilus* MIK, 1878 (see BICKEL 1998).
3. Dilated costa in wing cell c. Both sexes in three of the new species have the costa dilated and expanded, ovate-shaped, into wing cell c (Fig. 5 b). Interestingly, the eastern North American *Nepalomyia dilaticosta* RUNYON & HURLEY, 2003 has a slight thickening of the costa, suggesting similar potential morphological development across the genus.
4. Two additional points that modify the generic definition in RUNYON & HURLEY (2003): a) no spur is present on basitarsus III of any Australasian species, and b) all Australasian species have only 5 dorsocentral setae (dc), not 6 dc.

With the addition of the four species described in this paper and the five species newly referred to the genus, *Nepalomyia* now comprises 88 species (also see EVENHUIS & PAPE 2022). It has been referred to the dolichopodid subfamily Peloropeodinae (e.g., YANG et al. 2006), but that subfamily is not defined by strong synapomorphies and shows a wide range of male genitalic structure.

As noted in the Introduction, the geographical distribution of *Nepalomyia* is primarily eastern Palearctic, Nearctic, Oriental (including Southeast Asia), and now Australasia. The genus appears to be ancestral Laurasian and it shows strong similarities to the Paleogene Baltic amber genus *Gheynia* MEUNIER, 1899. It probably secondarily dispersed into Melanesia and the northern tropics of Gondwanan Australia, as the Australian plate moved northwards. *Nepalomyia hastata* **spec. nov.** is found along the Cape York Peninsula south to the Cairns district, Queensland and in New Guinea. This distribution pattern characteristically suggests a relatively recent arrival to Australia from New Guinea, possibly facilitated during Pleistocene glacial maxima when lowered sea levels created a land bridge across the Sahul Shelf. Since *Nepalomyia* occurs in Fiji, one might expect to find the genus in the Solomon Islands and Vanuatu, as part of a "stepping-stone" dispersal route from a Sundaland/ Papuan source area.

In addition to the four New Guinean *Nepalomyia* species treated here [*N. hastata* **spec. nov.** and *N. thompsoni* **spec. nov.**, sympatric above 1200 m in the Wau district, and *N. fusca* (MEUFFELS & GROOTAERT, 1997) and *N. melanura* (MEUFFELS & GROOTAERT, 1997), found sympatrically at Baiteta, in lowland Madang Province], I have seen undescribed species from Papua New Guinea (BPBM, AMS) that were too poorly preserved to warrant description.

Nepalomyia hastata BICKEL, spec. nov.

(Figs 1 a–g, 5d, 5e)

Examined material. Type material. *Holotype* ♂, "15º 03' S, 145º 09' E // Mt Webb Nat. Park QLD // 30 Sept. 1980 // D. H. COLLESS" "Malaise trap"[from Mount Webb National Park, Queensland, Australia] (ANIC). *Paratypes*: 2 ♂♂, 2 ♀♀, same data as holotype; paratypes 1 ♂, 2 ♀♀, same but 28–29.IV.1981 (ANIC).
Additional material. AUSTRALIA: **Queensland**: 4 ♂♂, 3 ♀♀, 3 km ENE of Mt Tozer, Iron Range, 12.45º S 143.17º E, 28.VI–4.VII.1986; 2 ♂♂, 3 ♀♀, Mossman Gorge, 16º26' S 145º16' E, 24.IV.1967; 1 ♂, The Boulders, NW of Babinda, 17º22' S 145º 55' E, 10.V.1967; 1 ♂, Mt Haig, 21 km ENE of Atherton, 17º06' S 145º36' E, 18.XI.1981; 2 ♂♂, 2 ♀♀, Wongabel State Forest, nr Atherton,17º19' S 145º31' E, 7.V.1967; 2 ♂♂, 2 ♀♀, Mt Edith Forest Rd, 1.6 km from Danbulla Rd, 6.V.1967; 1 ♀, Palmerston Nat. Park, Wallacha Falls, 30.IV.1967; 1 ♀, Whitfield Range, nr Cairns, 16º56' S 145º42' E, 19.IV.1967; 1 ♀, Cedar Bay Nat. Park, Gap Ck, 5 km ESE of Mt Finnigan, 15º50' S 145º20' E, 15.V.1981; 2 ♀♀, Kuranda Range State Forest, 20.IV.1967; 1 ♀, 3 km NNE of Julatten,16º35' S 145º22' E, 27.IX.1980 (all D. H. COLLESS, ANIC); 6 ♂♂, 6 ♀♀, 11 km W by N of Bald Hill, McIlwraith Range, 13.44º S 143.19º E, 600 m, 26.VI.–13.VII.1989, Malaise trap, I. NAUMANN (ANIC); 1 ♂♂, 1 ♀♀, Mission Beach, 17.52º S 146.04º E, 40 m, 4.XII.1995–2.I.1996, Malaise trap, M. CERMAK (ANIC); 2 ♀♀, Ingham-Wallaman Falls Rd, 3.IV.1971, D. A. DUCKHOUSE (ANIC); 1 ♀, Lake Eacham Nat. Park, 17º17' S 145º37' E, 23.IV.1957, W. W. WIRTH (USNM); 1 ♂, 1 ♀, Barron Falls Lookout, Kuranda, 5.II.1975, B. CANTRELL (QDPI); 4 ♂♂, 5 ♀♀, Cape Tribulation, 18º07' S 145º26' E, 2.–19.III.2000, ground Malaise trap and yellow pans, R. L. KITCHING (AMS); 18 ♂♂, 3 ♀♀, Black Mtn Rd, 9 km N of Kuranda Rd. 450 m, 16.8140º S 145.6432º E, 22.–25.III.2007, rainforest edge, tree trunk sticky trap, D. BICKEL (AMS); 3 ♂♂, 1 ♀, Spear Ck, 5.8 km N of Mount Molloy, 16.63183º S 145.3255º E, 24.–26.III.2007, rainforest tree trunk sticky trap, D. BICKEL (AMS); 1 ♀, Tully, X.1928, F. H. TAYLOR (AMS); 1 ♀, Goldsborough to Mulgrave Rd, nr Gillies Highway turnoff, 29.VIII.1976, I. BOCK (AMS). **INDONESIA**: **Maluku**: 1 ♂, Aru Islands, Trangan, 1 km S of Popjetur, 06º48' S 134º04' E, 90 m, 23.VIII.1994, primary forest & bamboo thicket, Malaise trap, A. H. KIRK-SPRIGGS (NMWC). **PAPUA NEW GUINEA**: **Morobe Province**: 1 ♂, Wau, Hospital Ck, 1250 m, 22.V.1965, J. SEDLACEK (BPBM). **Western Province**: 1 ♂, Tabubil, 602 m, 5.273° S 141.224° E, 8.II.2009, S. F. MCEVEY (AMS).

Description

MALE. **Length**: Body: 2.6–2.7 mm; wing: 3.2 × 1.2 mm.

Head (Fig. 1 c). Vertex, frons and face dark brown with dusting of grey pruinosity; setae black; postoculars forming single row of short black setae around posterior orbit, with dorsalmost longer; ventral postcranium without field of setae; pair of strong converging vertical and pair strong diverging ocellar setae present; face slightly narrowing ventrally, but eyes distinctly separated; clypeus conformable with eye curvature; eye facets uniform; palp short, ovate with grey pruinosity and black subapical seta; proboscis brownish and rather short; scape and pedicel yellowish, postpedicel dark brown; scape and pedicel both short; pedicel with corona of short black setae; postpedicel rounded subrectangular, with apical indentation from which arista arises; arista with short pubescence and slightly longer than head height.

Thorax (Fig. 5 e). Posterior mesonotum with slight flattening; mostly brown but with yellowish transverse band between the second and third posteriormost dc setae, and with yellowish band anterior to mesonotal suture and extending laterally to "notopleuron", with ac band brown, but with varying degree of mesonotal infuscation among specimens; scutellum flat, mostly yellow but with brownish base adjacent to mesonotum; pleura mostly brown, but yellowish along sutures; setae black, and setation similar to Fig. 5 c; 8–9 regular pairs of short ac, 5 strong dc present, decreasing in size anteriorly; 1 pa, 2 sa with posteriormost seta stronger, 1 sr, 1 strong hm, 1 pm, 2 strong npl; humeral area, anteriad and laterad of anteriormost dc seta with weak field of short setulae; median scutellar seta strong, lateral scutellar seta tiny; proepisternum dorsad of CI with strong lateral seta. **Legs**. CI, distal third of CII, and most of CIII, trochanters, femora, tibiae, and tarsi yellow although CI and femora infuscated brownish on some specimens; CII dark brown on basal two-thirds; CI with anterior field of short black setulae and with 3–4 strong black distolateral setae; CII with dense field of short black anterior setae, with strong anterolateral seta near 1/2; CIII with strong black lateral seta at 1/2; all tarsomere 5 with very short paired claws and pulvilli; I: 4.3; 3.7; 1.7/ 0.9/ 0.7/ 0.5/ 0.6; FI bare except for weak posterior subapical seta; TI bare except for very short ad row of setulae along distal half; II: 5.1; 5.0; 2.2/ 1.5/ 1.0/ 0.7/ 0.3; FII with strong anterior preapical seta and weak subapical pv seta; TII with ad setae at 1/5 (short), 1/4 (very strong), and 3/5 (strong), with pd setae at 1/5 and 3/5, and with subapical corona of strong ad, av, pv, pd and dorsal (short) setae; III: 5.2; 6.0; 0.7/ 2.1/ 1.2/ 0.8/ 0.4; FIII broad with strong anterior preapical seta; TIII with strong ad setae at 3/10 and 7/8, dorsal setae at 1/6, 1/2, with row of short dorsal setae between 1/2 and 7/8, and with subapical corona of short ad, av and pv setae; tarsus $IIIt_2$ more than twice length $IIIt_1$. **Wing** (Fig. 1 e). Membrane hyaline; costa in cell c slightly expanded and white; R_{2+3} joining costa at 7/8; R_{4+5} and M_1 diverging from base and bowed with respect to each other beyond dm-m crossvein, but subparallel distally, with R_{4+5} joining costa anteriad of apex, and M_1 joining posteriad; vein M_1 without flexion; CuAx ratio: 0.4; CuA+CuP not reaching posterior wing margin; anal angle weak; lower calypter yellowish with fan of whitish setae; halter pale yellow.

Abdomen. Tergites 1–5 mostly dark brown with short black uniform vestiture, and each tergite with a posterior row of longer setae, sternite 4 forming hood for hypopygium with row of long marginal setae; postabdomen (Fig. 1 a): tergite 6 short, mostly retracted under segment 5, without vestiture; segment 7 with subrectangular tergite and short sternite; sternite 8 ovate setose and with V-shaped thickening along basal margins, and forming cap over left lateral hypopygial foramen; epandrium subrectangular, mostly brown with shining black surstylus (Fig. 5 d), hypandrium forming curved hood over phallus; epandrial lobe digitiform with short setae; surstylus lobate with subrectangular dorsal arm and narrower ventral arm; cercus pale yellow and ovate and with short black peduncle bearing two stalked spear-like setae (variant Fig. 1 b).

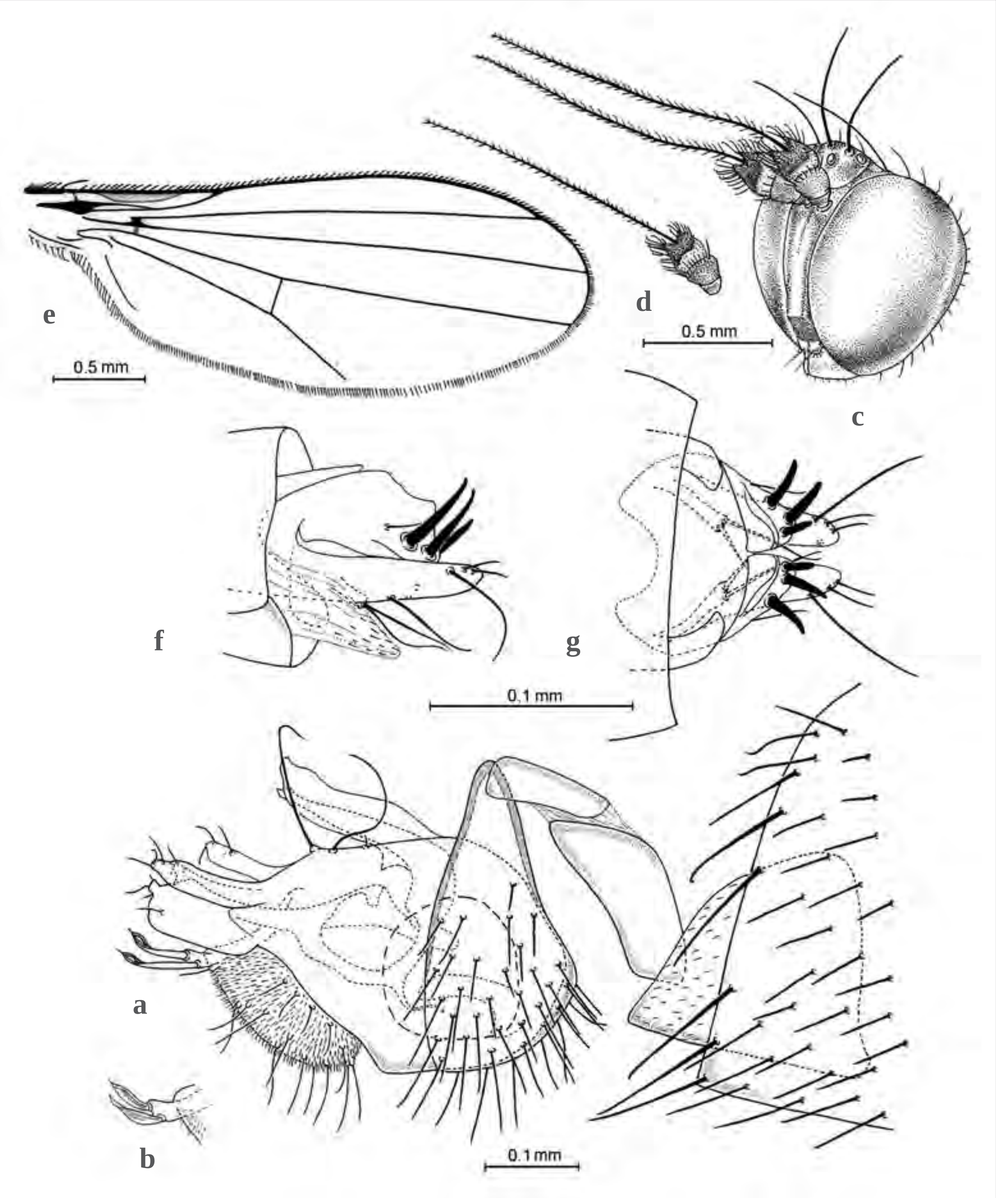

Fig. 1 a–g: *Nepalomyia hastata* **spec. nov.** – **a**: Male postabdomen, left lateral; – **b**: Apical setae of male cercus, variant; – **c**: Male head, left anterior; – **d**: Female antenna, left lateral; – **e**: Male wing dorsal; – **f**: Female oviscapt, left lateral; – **g**: Female oviscapt, dorsal.

FEMALE. Similar to male except as noted: lower face and clypeus wider; antenna similar (Fig. 1 d); thorax, leg podomere ratios, color and setation similar; costa also slightly expanded and white ovate in cell c; oviscapt (Figs 1 f–g) with tergites 9+10 divided into two acanthophorites, each bearing 3 pointed spines; cercus with setae as figured.

Etymology. The specific epithet *hastata* is from Latin meaning spear- shaped, in reference to the modified setae at the apex of the male cercus.

Remarks. *Nepalomyia hastata* **spec. nov.** is known primarily from Queensland rainforest, from the Iron Range in northern Cape York Peninsula to the lowland Cairns district, and the Atherton Tablelands. It is also known from 1250 m in Wau district Morobe Province, Papua New Guinea, and lowland Aru Islands, Indonesia, and is possibly widespread in New Guinea. The species appears to be abundant at times, and in addition to various Malaise trap captures, series collected with sticky traps suggest the species rests on tree trunks.

Nepalomyia hastata **spec. nov.** displays a range of intraspecific variation. The thoracic coloration varies from the distinctive yellow and brown banded pattern (Fig. 5 e) to a general brown thoracic coloration with only faint yellow banding. Also, the dorsal scutellum can vary from almost entirely yellow with a brown basal lunule to a large brown base and a yellow rim. Such variation can be found even within the same locale (e.g., the Mt.Tozer and the Kuranda series), but generally specimens from the Cairns district are darker than those from northern Cape York Peninsula. As well, I have seen variation in the two spear-like setae at the apex of the cercus (compare Figs 1 a and 1 b). The specimens from Papua New Guinea have the thorax mostly brown and the two spear-like setae of the cercus on a slightly longer stalk but are otherwise similar to Queensland specimens, and I regard them as conspecific.

An isolated male from Chimbu Province, Mt. Wilhelm at 2200 m (MNHN) is related but has a distinctly different cercus and represents an undescribed species.

Nepalomyia thompsoni BICKEL, spec. nov.

(Figs 2, 3 a, b)

Examined material. Type material. *Holotype* ♂ (BPBMENT 0000081236), “NEW GUINEA: NE // Wau, 1250m// 8.II.1965” “J. SEDLACEK // Malaise trap // BISHOP”. *Paratypes*: **PAPUA NEW GUINEA**: **Morobe Province**: 3 ♂♂, Wau, 1250 m, 15.II.1965, Malaise trap, J. SEDLACEK (BPBM); 1 ♂, same but Wau, Hospital Ck, 1230 m, 26.VI.1965; 1 ♂, Wau, 1200–1500 m, 30.VIII.1965, J. SEDLACEK; 2 ♂♂, 1 ♀, same but Wau, Kunai Ck, 1230 m, 28.V.1965, Malaise trap, J. SEDLACEK (BPBM).
Additional material. PAPUA NEW GUINEA: **Morobe Province**: 1 ♂, 10 km W Bulolo, 780 m, 5–25. VIII.1967, Malaise trap across stream, R. STRAATMAN (BPBM).

Description

MALE. **Length**: Body: 3.4 mm; wing: 3.5 × 1.3 mm (Fig. 2).
Similar to *N. hastata* except as noted: **Head**. Vertex, frons dark brown with dusting of grey pruinosity; face dull metallic blue; antenna brown; postpedicel rounded subrectangular, with apical indentation from which arista arises, and with ventral projection; arista apical with short pubescence and slightly longer than head height.
Thorax. Mesonotum and pleura entirely dark brown with dusting of grey pruinosity; setae black; 8–9 regular pairs of short ac, 5 strong dc, decreasing in size anteriorly. **Legs**. CI brown basally becoming yellow on distal half; all CII and CIII dark brown; all trochanters, femora, tibiae, and tarsi yellow; CI with anterior field of short black setulae and with 3–4 strong black distolateral setae; CII with dense field of short black anterior setae, with strong anterolateral seta near 1/2; CIII with strong black lateral seta at 1/2; I: 4.3; 4.8; 2.8/ 1.8/ 1.7/ 1.3/ 0.7; II: 4.8; 6.8; 4.0/ 2.4/ 2.0/ 0.8/ 0.6; FII with strong anterior preapical seta and weak subapical pv seta; TII with ad setae at 1/5 (short), 1/4 (longer), and 2/3 (strong), with pd setae at 1/5 and 1/2, and with subapical corona setae; III: 6.3; 8.2; 1.4/ 3.8/ 2.0/ 1.5/ 0.6; FIII with strong anterior preapical seta; TIII with strong ad setae at 1/3 and 9/10, dorsal setae at 1/6, 1/2, and with subapical corona of short ad, av and pv setae; tarsus $IIIt_2$ more than twice length $IIIt_1$. **Wing**. Costa brown and not expanded; CuAx ratio: 0.4; lower calypter yellowish with fan of whitish setae; halter pale yellow.
Abdomen. Tergites 1–5 mostly dark brown with short black uniform vestiture, and each tergite with a posterior row of longer setae, sternite 4 forming hood for hypopygium with row of long

Fig. 2: *Nepalomyia thompsoni* **spec. nov.** (holotype, male), male habitus, left lateral.

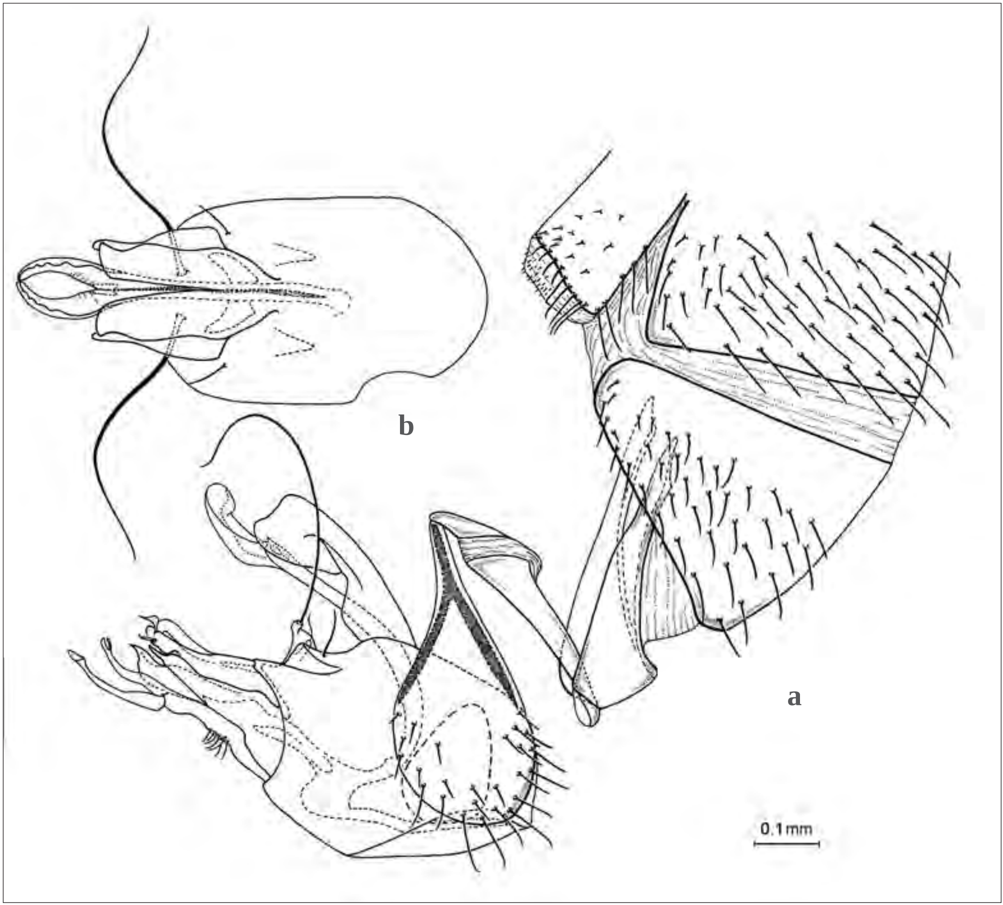

Fig. 3 a, b: *Nepalomyia thompsoni* **spec. nov.** (paratype, male). – **a**: Male postabdomen, left lateral; – **b**: Hypopygium, dorsal.

marginal setae; postabdomen (Fig. 3 a, b); tergite 6 elongate, mostly retracted under segment 5, without vestiture; segment 7 with elongate tergite and short sternite; sternite 8 ovate with Y-shaped sclerotized thickening along basal margins, with setae only along distal quarter, and forming cap over left lateral hypopygial foramen; epandrium mostly dark brown with yellowish surstylus, and cercus brown, hypandrium yellow, and forming subrectangular covering for clavate phallus; epandrium ovate with short epandrial seta and very long curved epandrial lobe seta; surstylus with three elongate arms; cercus pale yellow, and tapering into elongate distal projection, possibly a modified seta.

FEMALE. Similar to male except lower face and clypeus wider; oviscapt similar to that of *N. hastata* **spec. nov.**

Etymology. The specific epithet *thompsoni* is a patronym in honor of F. Christian THOMPSON, who contributed so much to the study of Diptera.

Remarks. *Nepalomyia thompsoni* **spec. nov.** is known only from Morobe Province, Papua New Guinea, at elevations ranging from 780–1500 m. It has relatively long tarsomeres compared to the other three species treated here (compare Fig. 2 with Fig. 5 a). This species does not have an expanded costa in the costal cell. The single epandrial lobe seta is very long and similar to is very long and similar to those found in some Oriental species [see figures variously in Yang, et al. (2004) and Yang & Saigusa (2001)].

Nepalomyia vitiensis Bickel, spec. nov.

(Figs 4 a, 59 P a–c)

Examined material. Type material. *Holotype* ♂ (BPBMENT 0000081237) "FIJI, Vanua Levu, Bua Prov.,// Batiquere Range: 6 km NW Kilaka //Village, lowland wet forest, [–16.811, 178.988], //61 m, 3.VI.–10.VI.2004, Malaise trap M03 // P. Manueli, FBA 115375" (BPBM). *Paratypes*: 5 ♀♀, same data as holotype (BPBM). *Paratypes*: **FIJI**: **Vanua Levu**: **Bua Province**: Batiquere Range: 5 ♂♂, 10 ♀♀, 6 km NW Kilaka Village, lowland wet forest, [16.807º S 178.991º E], 98 m, 3.–10.VI.2004, 15.–24.VI.2004, 28.VI–21.VII.2004, Malaise trap M05, P. Manueli; 3 ♂♂, 2 ♀♀, 6 km NW Kilaka Village, lowland wet forest, [16.815º S 178.986º E], 146 m, 3.–10.VI.2004, 28.VI.–21.VII.2004, Malaise trap M01, P. Manueli; 4 ♀♀, 6 km NW Kilaka Village, lowland wet forest, [16.732º S 179º E], 113 m, 3.–15.VI.2004, 15.–28.VI.2004, Malaise trap M02, P. Manueli; 1 ♂, 1 ♀, 6 km NW Kilaka Village, lowland wet forest, [16.807º S 178.988º E], 154 m, 28.VI.–2.VII.2004, 13.–26.IV.2004, Malaise trap M04, P. Manueli (all BPBM). **Additional material**. **FIJI**: **Taveuni**: **Cakaudrove Province**: 14 ♂♂, 8 ♀♀, 5.3 km SE Tavuki Village, Mt. Devo, montane wet forest, [16.841º S 179.968º W], 1064 m, 17.–24.X.2002, 24.–31.X.2002, 14.–21.XI.2002, 20.–27.XII.2002, 27.XII.2002–3.I.2003, 3.–10.I.2003, 7.–23.X.2004, Malaise trap M04, P. Vodo; 3 ♂♂, 3 ♀♀, 5.6 km SE Tavuki Village, Devo Peak, cloud forest, [16.843º S 179.966º W], 1,187 m, 7.–23.X.2004, 31.X.–14.XI.2002, 7.–23.X.2004, Malaise trap M01, P. Vodo; 13 ♂♂, 4 ♀♀, Tavuki Village, Mt. Devo, montane wet forest, [16.831º S 179.98º W], 734 m, 31.VII.–14.VIII.2004, 14.VII.–14.VIII.2004, 29.XI.2004–14.I.2005, Malaise trap M04, P. Vodo. **Viti Levu**: **Naitasiri Province**: 3 ♂♂, 2 ♀♀, 3.2 km E Navai Village, Veilaselase Track, gymnosperm dominated rainforest, [17.624º S 178.009º E], 1,020 m, 30.VIII.–23.IX.2004, Malaise trap M02, E. Namatalau; 1 ♂, 4 ♀♀, 3.8 km N Veisari Settlement, logging road to Waivudawa, lowland wet forest, [18.079º S 178.363º E], 300 m, 12.XII.2002–3-.I.2003, Malaise trap M02, M. Tokotaa; 5 ♀♀, 4.8 km N Veisari Settlement, logging road to Waivudawa, lowland wet forest, [18.075º S 178.362º E], 300 m, 12.XII.2002–3.I.2003, Malaise trap M01, M. Tokotaa; 1 ♂, 2 ♀♀, 1.8 km E Navai Village, old trail to Mt. Tomaniivi (Victoria), [17.621º S 177.998º E], 700 m, 6.VI.–15.VII.2003, Malaise trap M04, E. Namatalau. **Vuda Province**: 1 ♂, Koroyanitu EcoPark, Mt. Evans Range, 0.5 km N Abaca Village, disturbed mid-elevation moist forest, [17.667º S 177.55º E], 800 m, 7.–12.X.2002, Malaise trap M01, L. Tuimereke (all BPBM).

Description

MALE. **Length**: Body: 2.6–2.7 mm; wing: 3.2 × 1.2 mm (Fig. 5 a).

Similar to *N. hastata* **spec. nov.** except as noted: **Head**. Antenna yellowish; postpedicel with distinct apical indentation from which arista arises.

Thorax (Fig. 5 c). Meosonotum and scutellum almost entirely dull yellow to brownish, darker along ac band and base of scutellum, but more generally infuscated in some specimens; pleura mostly brownish, but yellow along sutures, and metepimeron yellowish. **Legs** (Fig. 5 a). CI, distal third of CII, and most of CIII, trochanters, femora, tibiae, and tarsi yellow although CI and femora infuscated brownish on some specimens; CII brown on basal two-thirds; I: 4.3; 3.9; 1.9/ 1.0/ 0.8/ 0.5/ 0.6; FI bare except for weak posterior subapical seta; TI also bare; II: 5.4; 5.6; 2.3/ 1.5/ 1.2/ 0.7/ 0.4; FII with strong anterior preapical seta and short subapical pv seta; TII with ad setae at 1/5 (short), 1/4 (very strong), and 3/5 (strong), with pd setae at 1/5 and 3/5; III: 5.4; 6.5; 0.7/ 2.4/ 1.7/ 1.0/ 0.8; FIII with strong anterior preapical seta; TIII with ad seta at 1/4, dorsal setae at 1/6, 1/2, and 7/8, with row of short dorsal setae between 1/2 and 7/8, ventral seta at 1/2, and with subapical corona of short ad, av and pv setae; tarsus $IIIt_2$ more than twice length $IIIt_1$. **Wing**. Membrane hyaline; costa distinctly expanded along cell c and elongate, ivory-coloured (Fig. 5 b); CuAx ratio: 0.4; lower calypter yellow with fan of black setae; halter yellow.

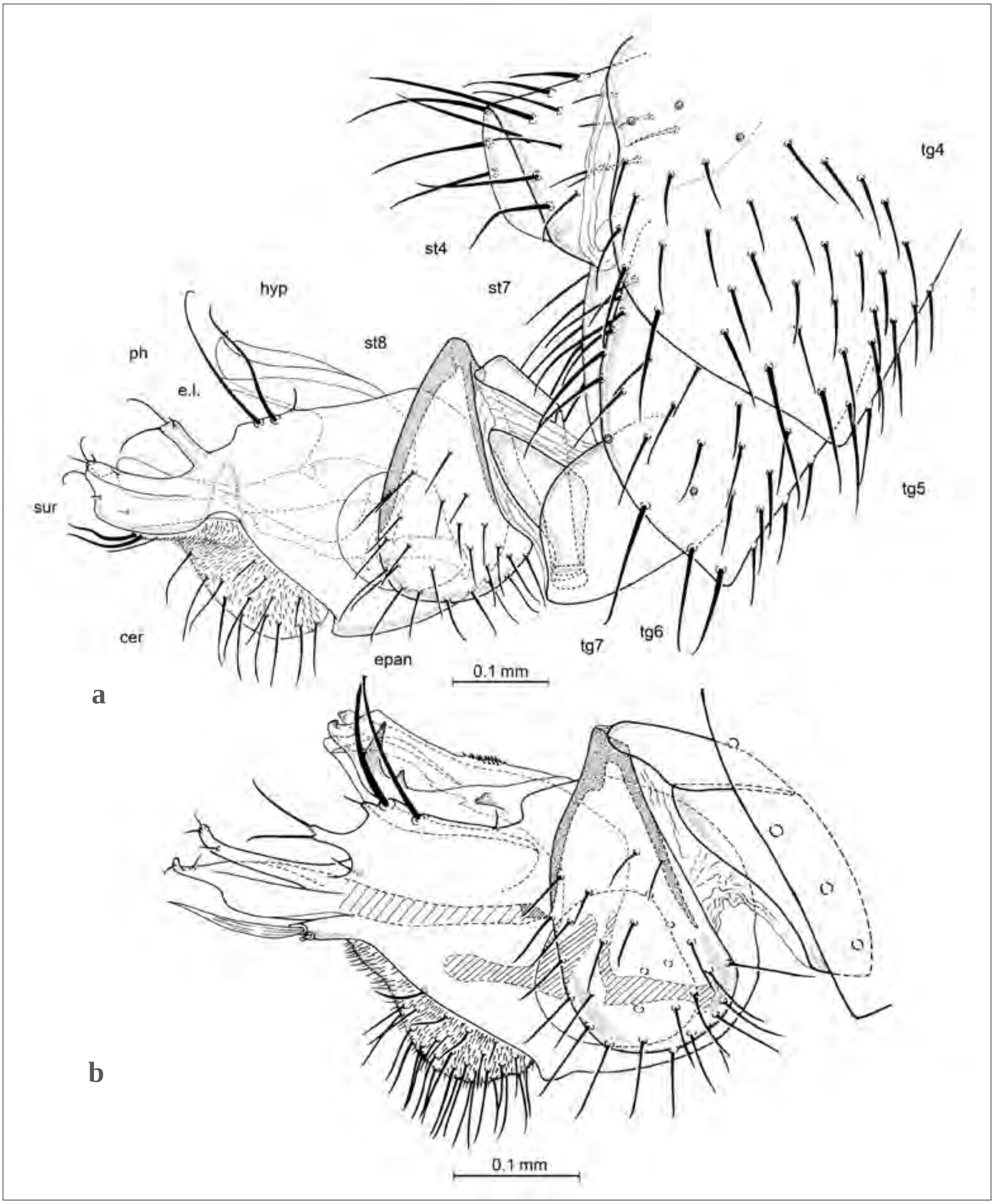

Fig. 4 a, b: Male postabdomen of *Nepalomyia* species. – **a**: *Nepalomyia vitiensis* **spec. nov.**, male postabdomen, left lateral; – **b**: *N. polhemusi* **spec. nov.** (holotype, male), male postabdomen, left lateral. Legend: cer: cercus; e.l.: epandrial lobe; epand: epandrium; hyp: hypandrium; ph: phallus; st4, st7, st8: sternite 4, 7, 8; sur: surstylus; tg4, tg5, tg6, tg7: tergite 4, 5, 6, 7.

Abdomen. Postabdomen (Figs 4 a, 5 b); sternite 4 forming hood for hypopygium with row of long marginal setae; tergite 6 short, mostly retracted under segment 5, without vestiture; segment 7 with subrectangular tergite and short sternite; sternite 8 ovate setose and with V-shaped thickening along basal margins, and forming cap over left lateral hypopygial foramen; epandrium subrectangular, mostly brown with shining black surstylus; hypandrium

Fig. 5 a–e: *Nepalomyia vitiensis* **spec. nov.** (holotype, male): – **a**: Habitus left lateral; – **b**: Wing, abdomen and thorax, left dorsal; – **c**: Head and thorax, dorsal. *Nepalomyia hastata* **spec. nov.**: – **d**: Male postabdomen, left lateral; – **e**: Male head and thorax, dorsal.

forming curved hood over phallus; epandrium with 2 strong setae on ventral margin; epandrial lobe digitiform with two apical setae; surstylus lobate with subrectangular dorsal arm and narrower ventral arm; cercus yellow and ovate and with strong black curved apical setae.

FEMALE. Similar to male except: lower face and clypeus wider; thorax, legs and abdominal colour and setation similar, wing also with costa expanded and white in cell c; oviscapt similar to that of *N. hastata* **spec. nov.**

Etymology. The specific epithet derives from *Viti*, the Fijian word for Fiji.

Remarks. *Nepalomyia vitiensis* **spec. nov.** is known from a range of elevations on the three main high islands of the Fijian Group, Viti Levu, Vanua Levu and Taveuni. The species was relatively abundant in Malaise traps. Intraspecific variation is evident in dorsal thoracic coloration, ranging from almost entirely dull yellow to a brownish color. However, all specimens have the distinctive hypopygium, and cercus bearing strong curved apical setae. Both sexes have a distinctive ivory-coloured costa expanded into the costal cell (Fig. 5 b).

Nepalomyia polhemusi BICKEL, spec. nov.

(Fig. 4 b)

Examined material. Type material. *Holotype* ♂ (BPBMENT 0000081238) “FIJI, Viti Levu, Naitasiri Pr //, Upper Waivudawa Ck & logging Rd., 290 m, 18° 04' 22" S// 176° 21' 48"” “E. D. POLHEMUS, 23.// I.2005, insecticide spray on moss// r’forest, FJVL-151-S01-01” (BPBM).

Description

MALE. **Length**: Body: 2.4 mm; wing: 2.6 × 0.8 mm.

Similar to *N. hastata* **spec. nov.** except as noted: **Head**. Antenna dark brown; postpedicel rounded subrectangular, with apical indentation from which arista arises and with apicoventral tooth-like projection.

Thorax. Almost entirely dark brown; setation similar to *N. hastata* **spec. nov. Legs**. Leg coloration similar to *N. hastata* **spec. nov.**; I: 4.0; 3.6; 1.9/ 1.0/ 0.8/ 0.7/ 0.6; leg I also bare of major setae; II: 4.9; 4.7; 1.9/ 1.4/ 1.1/ 0.8/ 0.4; setation similar to *N. hastata* **spec. nov.**; III: 5.1; 6.1; 0.6/ 2.1/ 1.2/ 0.9/ 0.6; setation similar to *N. hastata* **spec. nov.**; tarsus $IIIt_2$ more than twice length $IIIt_1$. **Wing**. Membrane hyaline; costa distinctly expanded into cell c and ivory coloured; CuAx ratio: 0.4; lower calypter yellowish with fan of black setae; halter pale yellow.

Abdomen. Postabdomen (Fig. 4 b); sternite 4 with row of long marginal setae; segment 7 with subrectangular tergite and short sternite; sternite 8 ovate setose and with V-shaped thickening along basal margins, and forming cap over left lateral hypopygial foramen; epandrium subrectangular, mostly brown with shining black surstylus; hypandrium forming curved hood over phallus; phallus curved with sharp projections distally; epandrium with 2 strong setae on ventral margin; epandrial lobe short, digitiform with two apical setae; surstylus with elongate dorsal and ventral arms, and with dorsal peduncle bearing bladelike seta; cercus yellow and ovate.

FEMALE. Unknown.

Etymology. This species is named in honor of the collector of the holotype, the hemipterist Dan POLHEMUS.

Remarks. *Nepalomyia polhemusi* **spec. nov.** is only known from the Viti Levu type locality and was collected with insecticide spray knockdown. Like *N. vitiensis* **spec. nov.**, it has an expanded ivory coloured costa in wing cell c, but differs in having a dark brown thorax and in details of the hypopygium (compare Figs 4 a and 4 b, page 211).

Tatamba BICKEL, gen. nov.

(Figs 6 a–e)

Type species. *Tatamba parva* BICKEL **spec. nov.**, here designated.

Diagnosis. This new genus is very close to *Nepalomyia* and the two genera share a similar overall habitus, head setation, apical arista arising in an indentation of the subrectangular postpedicel, similar thoracic setation (but see following), almost identical leg setation (leg I bare of major setae, femora II and II with strong anterior preapical setae, tibia II with two very strong ad setae and two only slightly weaker pd setae), leg III tarsomere 2 more than twice length of the tarsomere 1, and similar wing venation. The only difference in somatic characters is that *Tatamba* **gen. nov.** has lost the thoracic ac setal field and the lateral scutellar seta, but loss of characteristic setae and setal fields occurs frequently in small-sized dolichopodid taxa. As noted above *Nepalomyia* has been referred to the dolichopodid subfamily Peloropeodinae, but that subfamily is not defined by strong synapomorphies. *Tatamba* **gen. nov.** should be included with any future higher level placement of *Nepalomyia*.

The remarkable feature of *Tatamba parva* **spec. nov.** (apart from its small size) is its unusual male postabdomen. It may be a bizarre autapomorphy found only in this species, or it may represent a genitalic morphotype found within a wider but uncollected Melanesian radiation. The subrectangular epandrium is exserted and pedunculate, as in *Nepalomyia*, but in *Nepalomyia*, the hypopygium can rest against the ventral abdomen. In *Tatamba* **gen. nov.**, by contrast, an ovate cuticular lobe arises laterally near the base of each surstylus, and extends distally, covering the surstylus and distal epandrium in lateral view (Figs 6 d, 6 e). I have never previously encountered such a cuticular structure in the Dolichopodidae.

Description

This description is based on the male of a single species and notes characters considered to be of generic level importance.

Size. Body length: 1.4 mm; wing: 1.6 × 0.6 mm. (Fig. 6 a).

Head (Fig. 6 b). Pairs of strong vertical and diverging ocellar setae present; face parallel sided ventrad of antenna and eyes distinctly separated; eye facets enlarged anteriorly; pair of short yellowish setae projecting from clypeal margin; postpedicel rounded subrectangular, pubescent, with apical indentation from which apical arista arises.

Thorax. Posterior mesonotum with slight flattening; ac absent, 5 dc present, decreasing in size anteriorly; median scutellar seta strong, lateral scutellar seta absent. **Legs**. CIII with lateral seta at 1/2; leg I bare of major setae; FII and FIII with strong anterior preapical seta; TII with strong ad setae at 1/4, and 3/5 , with weak pd seta at 1/4 only; TIII with ad seta at 1/4 and 7/8; tarsus $IIIt_2$ more than twice length of $IIIt_1$. **Wing** (Fig. 6 c). R_{2+3} joining costa at 7/8; R_{4+5} and M_1 diverging from base, and subparallel beyond dm-m crossvein, with R_{4+5} joining costa anteriad of apex, and M_1 joining slightly posteriad of apex; vein M_1 without flexion; CuAx ratio: 0.4.

Abdomen. Tergites 1–6 with short vestiture; hypopygium (Figs 6 d, 6 e) brown, subrectangular but tapering distally, and exserted, pedunculate, and elongate, about equal in length to preabdomen; large ovate cuticular lobes arise laterally from surstylar base (near fused join of surstylus with epandrium), and extend distally covering surstylus and distal epandrium in lateral view (Figs 6 d, 6 e); cerci yellow, elongate but tapering distally, and slightly shorter than length hypopygium.

FEMALE. Unknown.

Etymology. *Tatamba* is an indigenous place name on Santa Isabel, Solomon Islands. The gender is treated as feminine.

Remarks. *Tatamba* **gen. nov.** is known from a single small-sized male collected at low elevation on Santa Isabel, Solomon Islands. The Solomon Islands themselves are quite rugged with elevations reaching over 2000 m., and they have a complex geological history of varied terranes and active tectonics. This new genus is part of the poorly known insect fauna of that archipelago (also see BICKEL 2020).

The unique holotype of the type species is in remarkable condition despite having been collected in a dry Malaise trap at a remote rainforest site. It appears to have been removed from the trap while fresh and mounted with a minuten pin, dorsoventrally though the base of the abdomen so that the thoracic setation, legs, wings, head and postabdomen (Figs 6 a–e) are all in excellent condition and worthy of description.

Tatamba parva BICKEL, spec. nov.

(Figs 6 a–e)

Examined material. Type material. *Holotype* ♂ (BPBMENT 0000081239), "SOLOMON IS.// SANTA YSABEL: SE// Tatamba, 0–50 m.// 4.IX.1964" "R. STRAATMAN // Malaise Trap // BISHOP" [= **SOLOMON ISLANDS**: **Santa Isabel**: Tatamba, ~ 8°23' S 159º49' E, 0–50 m, 4.IX.1964, Malaise trap, R. STRAATMAN (BPBM)].

Description

MALE. **Length**: Body: 1.4 mm; wing: 1.6 × 0.6 mm (Fig. 6 a).

Head (Fig. 6 b). Vertex, frons dull metallic green with bronze reflections; pairs of strong vertical and diverging ocellar setae present; face covered with yellowish pruinosity; setae dark brown with yellowish reflections; face parallel sided ventrad of antenna and eyes distinctly separated; clypeus conformable with eye curvature; eye facets enlarged anteriorly; pair of short yellowish setae projecting near clypeal margin; palp short, ovate; proboscis yellowish and rather short; antenna yellowish, scape and pedicel short, subequal; postpedicel rounded subrectangular, pubescent, with apical indentation from which arista arises, and with small pointed ventral projection; arista apical with short pubescence and slightly longer than head height.

Thorax (Fig. 6 b). Posterior mesonotum with slight flattening; mostly dull brown with dusting grey pruinosity; setae brown; ac absent, 5 dc present, decreasing in size anteriorly; 1 pa, 2 sa with posteriormost seta stronger, 1 sr, 1 strong hm, 1 pm, 2 strong npl; median scutellar seta strong, lateral scutellar seta absent. **Legs**. CI, trochanters, femora, tibiae, and tarsi yellow; CII and CIII brown; CIII with brown lateral seta at 1/2; leg setae brown; I: 2.4; 2.3; 1.0/ 0.6/ 0.4/ 0.3/ 0.2; leg I bare of major setae; II: 3.0; 2.9; 1.0/ 0.8/ 0.6/ 0.6/ 0.4; FII with strong anterior preapical seta; TII with strong ad setae at 1/4, and 3/5, with weak pd seta at 1/4 only, and with subapical corona of ad, av, pv, pd and dorsal (short) setae; III: 3.0; 3.2; 1.0/ 2.1/ 0.6/ 0.4/ 0.3; FIII with anterior preapical seta; TIII with ad setae at 1/4 and 7/8, and some short dorsal setae; tarsus IIIt$_2$ more than twice length IIIt$_1$. **Wing** (Fig 6 c). Membrane hyaline; R_{2+3} joining costa at 7/8; R_{4+5} and M_1 diverging from base, and subparallel beyond dm-m crossvein, with R_{4+5} joining costa anteriad of apex, and M_1 joining slightly posteriad of apex; vein M_1 without flexion; CuAx ratio: 0.4; anal angle weak; lower calypter yellowish with fan of whitish setae; halter brownish.

Abdomen. Tergites 1–4 mostly dark brown with short yellowish vestiture; segments 5–7 not visible; sternite 8 forming left lateral cap over hypopygial foramen; hypopygium (Figs 6 d, 6 e) brown, subrectangular but tapering distally, and exserted, pedunculate, and elongate, equal in length to preabdomen; large ovate cuticular lobes arise laterally from near surstylar base (fused join with epandrium), and extend distally covering surstylus and distal epandrium in lateral view (Figs 6 d, 6 e); cerci yellow, elongate digitiform but gradually tapering distally, and slightly shorter than length hypopygium, with abundant white hairlike setae along ventral surface and apically, and with row of 5 black medial setae.

FEMALE. Unknown.

Etymology. The specific epithet *parva* is Latin and refers to the small size of this species.

Remarks. *Tatamba parva* **spec. nov.** is known only from a single male collected in lowland habitat on Santa Isabel, Solomon Islands; also see "Remarks" under the generic discussion above.

Key to the species of Australasian *Nepalomyia* and *Tatamba*

The following key separates males of the genus *Nepalomyia* and *Tatamba* in the context of the Australasian fauna. For definitions and figures of the structures noted below, consult GRICHANOV & BROOKS (2017).

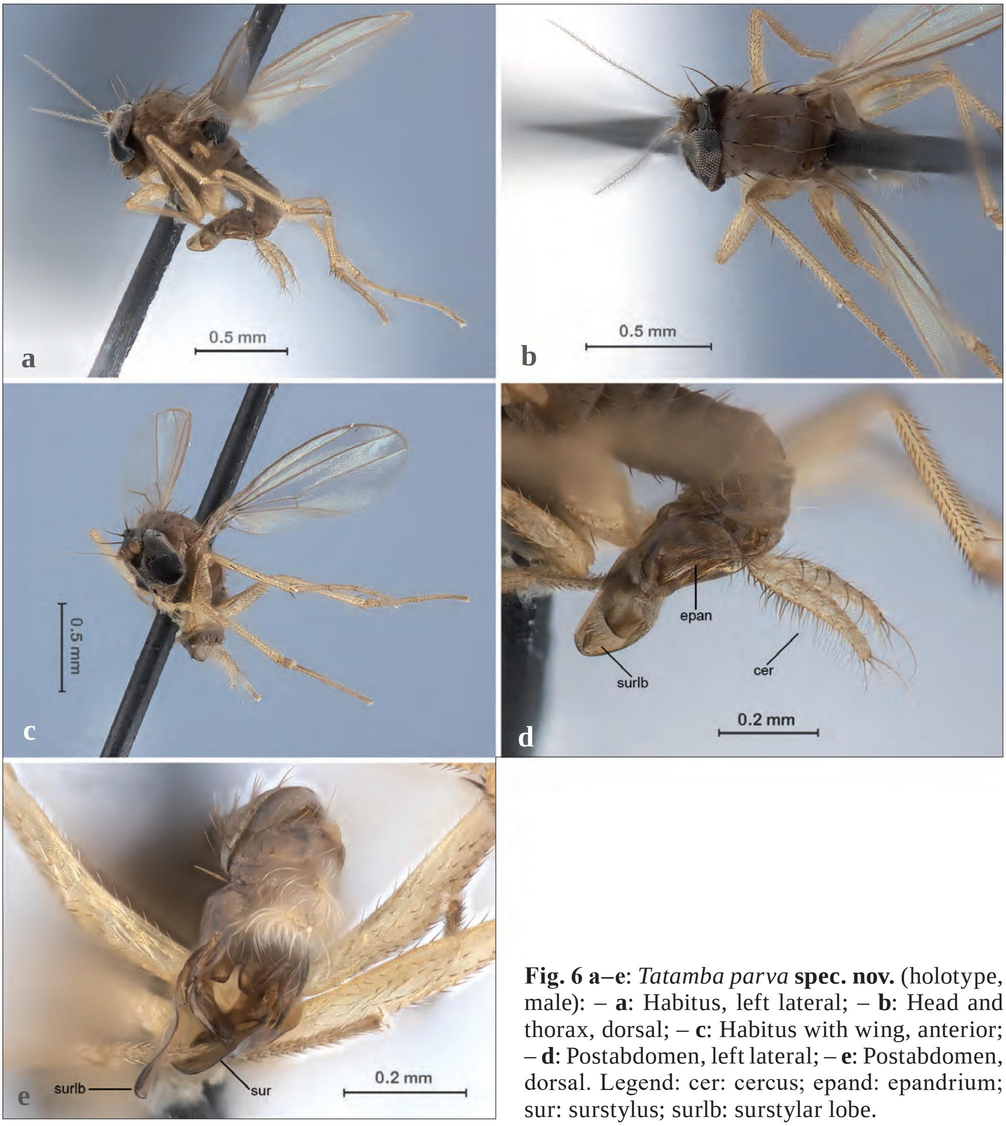

Fig. 6 a–e: *Tatamba parva* **spec. nov.** (holotype, male): – **a**: Habitus, left lateral; – **b**: Head and thorax, dorsal; – **c**: Habitus with wing, anterior; – **d**: Postabdomen, left lateral; – **e**: Postabdomen, dorsal. Legend: cer: cercus; epand: epandrium; sur: surstylus; surlb: surstylar lobe.

1 Vertex flat, not deeply excavated; vein M_1 unbranched, antennal scape bare of dorsal setae; femora II and III with distinct anterior preapical setae; posterior mesonotum flattened; veins R_{4+5} and M_1 subparallel distad of dm-m crossvein, and vein M_1 joining costa just posteriad of apex; body pruinosity not dense, and underlying cuticle visible **2**

– Without this combination of characters .... **other Dolichopodidae**

2 Acrostichal setae totally absent; small sized, wing length < 1.8 mm; scutellum with only one pair of setae **3**

– Acrostichal distinct, biseriate; larger, wing > 2.3 mm; scutellum usually with two pairs of scutellar setae, even if lateral pair reduced to tiny hairs **4**

3 Arista dorsal, subapical; male hypopygium often with bright white pilose subtriangular cercus (widespread western Pacific) .... ***Acropsilus* MIK, 1878**

– Arista apical on rectangular postpedicel; male hypopygium with large lateral projections covering distal epandrium; cercus tapering (Figs 6 a–e) (Solomon Islands) ....***Tatamba parva*** **gen. & spec. nov.**

4 Arista inserted in apical notch of subrectangular postpedicel (Figs 1 c, 1 d); thoracic setae brown or black; thorax usually dull yellow or brown; male genital capsule enlarged and somewhat spheroidal; wing length only slightly longer than body length; male leg III tarsomere 2 more than twice length leg III tarsomere 1; female abdomen usually brown .... **5 [*Nepalomyia* Hollis, 1964]**

– Arista dorsal on subtriangular postpedicel; thoracic setae often yellow; thorax usually metallic green; wing usually distinctly longer than body length; leg III tarsomere ratios various; female abdomen often with yellow tergites (widespread) ....***Chrysotimus*** **Loew, 1857**

5 Costa brown and not expanded into cell c; mesonotum and pleura entirely dark brown; male genital capsule with single very long ventral seta (Figs 2, 3 a, b) (New Guinea)...... .... ***N. thompsoni*** **spec. nov.**

– Basal costa white and expanded into cell c (e.g., Fig. 5 b); other features various **6**

6 Cercus with strong bladelike apical seta or setae (e.g., Figs 1 a, 4 b) **7**

– Cercus without such apical setae; mesonotum and scutellum dark brown; surstylus with elongate dorsal and ventral arms, and with dorsal peduncle bearing bladelike seta (Fig. 4 b) (Fiji) .... ***N. polhemusi*** **spec. nov.**

7 Cercus with two strong apical setae **8**

– Cercus with single strong apical seta 9

8 Cercus rounded with short peduncle bearing two spear-shaped apical setae (Fig. 1 a); thorax with distinctive yellow and brown banded pattern (Fig. 5 e), varying to brown coloration with only faint yellow banding (Australia, New Guinea) .... ***N. hastata*** **spec. nov.**

– Cercus rounded with elongate arm with two curved apical setae; thorax mostly brownish (Meuffels & Grootaert 1997: figs 2–13) (Papua New Guinea) ....***N. fusca*** **(Meuffels & Grootaert, 1997)**

9 Mesonotum almost entirely dull yellow to brownish; cercus with strongly curved apical seta (Figs 4 a, 5 a–c) (Fiji).. ***N. vitiensis*** **spec. nov.**

– Mesonotum dark brown; cercus with short broad blade-like setae; thorax mostly brownish (Meuffels & Grootaert 1997: fig. 14) (Papua New Guinea).................................... .... ***N. melanura*** **(Meuffels & Grootaert, 1997)**

Acknowledgements

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A new species of *Homoneura* (Diptera: Lauxaniidae) from Tianmu Mountain (China)

[Eine neue Art der Gattung *Homoneura* (Diptera: Lauxaniidae)
vom Berg Tianmu (China)]

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Abstract

The species *Homoneura* (*Homoneura*) *thompsoni* **spec. nov.** is described as new to science from Oriental China. An identification key to separate the eight known species in the *Homoneura* (*Homoneura*) *laticosta* group is presented.

Key words: Lauxanioidea, Zhejiang Province, Tianmu Mountain, identification key, *laticosta* group

Zusammenfassung

Homoneura (*Homoneura*) *thompsoni* **spec. nov.** aus dem Osten Chinas der zur orientalischen Region gehört, wird beschrieben. Ein Bestimmungsschlüssel der nunmehr acht Arten der *Homoneura* (*Homoneura*) *laticosta*-Gruppe wird vorgestellt.

Stichwörter: Lauxanioidea, Provinz Zhejiang, Berg Tianmu, Bestimmungsschlüssel, *laticosta*-Gruppe

Introduction

The subgenus *Homoneura* van der Wulp, 1891 (Lauxaniidae: Homoneurinae: *Homoneura*) has rich diversity in China. There are 543 species in the world and 181 species in China of this subgenus. *Homoneura* (*Homoneura*) can be separated from other subgenera by the following characters: mesonotum with 0–1+3 dorsocentral setae, acrostichal setae in 4–12 rows, 0 supra-alar seta, 0 intra-alar seta. Fore tibia not compressed in male; mid tibia with 2–3 apicoventral setae, 0 posterior seta. Hind leg with tarsomere 2 not black. Wing with small costal black spines extending to tip of R_{4+5}, occasionally before tip of R_{4+5}; M_1 not curved upward and close to R_{4+5} (Miller 1977; Stuckenberg 1971). Shi & Yang (2009, 2014) divided this subgenus into twenty species groups. Among these groups, the *Homoneura* (*Homoneura*) *laticosta* group can be diagnosed by the wing having a narrow brown or broad deep brown area extending from the costal margin to R_{4+5} or M_1 or CuA_1 (Fig. 12 in Shi & Yang 2014).

The Tianmu Mountain National Nature Reserve sits in the municipality of Lin'an, Zhejiang Province, in the Oriental part of China, with the geographical coordinates between 30°18'30" to 30°24'55" N and 119°23'47" to 119°28'27" E. The reserve is at the northern edge of central-subtropical zone with a temperate climate throughout the year. About 88.2 % of the reserve is covered in forest. In 1996, it became a member of the UNESCO's Man and Biosphere Reserve Network. There are 924 species in 409 genera and 51 families of Diptera reported from this reserve (Yang et al. 2016a, 2016b). Among them, seven species of subgenus *Homoneura* were known until 2001 (Yang et al. 2001). By 2016, there were nine species of subgenus *Homoneura* recorded from this reserve (Shi et al. 2016).

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In this work we describe a new *Homoneura* (*Homoneura*) species to science from the Tianmu Mountain National Nature Reserve belonging to the *laticosta* group. In addition, an identification key to separate the eight known species of the *laticosta* group in China is presented.

Material and methods

General terminology follows Cumming & Wood (2009), Gaimari & Silva (2010) and Shi & Yang (2014). Genitalia preparations were made by removing and macerating the apical portion of the abdomen in warm lactic acid for 10–20 minutes, then rinsing them with distilled water for dissection and study. After examination in glycerin, genitalia were transferred and stored in a microvial with glycerin pinned below the type.

Specimens were examined with a Nikon SMZ 1500 dissection microscope. Adult images were taken with a Nikon DS-Fi2 digital camera and a series of images montaged using Helicon Focus (©HeliconSoft). All images and drawings were further processed with Adobe Photoshop CS 6.0.

The type specimen of the new species is deposited in the California State Collection of Arthropods, Plant Pest Diagnostics, California Department of Food and Agriculture, Sacramento, California, U.S.A. (CSCA).

Results

Homoneura (*Homoneura*) *thompsoni* Shi, Liu & Wang, spec. nov.

(Figs 1 a–g, 2 a–e)

Description

MALE. Body length: 4.2 mm; wing length: 3.9 mm.

Head: yellowish brown. Ocellar triangle yellowish brown. Posterior fronto-orbital seta longer than anterior fronto-orbital seta, anterior fronto-orbital seta longer than outer vertical seta. Parafacial yellowish brown with inner margin brown and a row of short setulae in same length at apical half. Gena about 1/6 height of eye. Antenna yellowish brown, 1st flagellomere 1.4 times longer than high; arista brown except for yellowish brown base, pubescent, with longest ray shorter than 1/12 height of 1st flagellomere. Proboscis yellow and palpus yellowish brown.

Thorax: yellowish brown. Postpronotum yellow. Mesonotum with a pair of brown medial stripes extending to apical 2/3 of scutellum; 0+3 dorsocentral setae, acrostichal setae in 6 rows in the anterior half and 4 rows in the posterior half, and prescutellar seta as long as half of length of 3rd post-sutural dorsocentral seta. Anepisternum and katepisternum yellowish brown with 1 anepisternal seta and 2 katepisternal setae. **Legs** yellow, fore femur with 5 posterior dorsal setae, 5 posterior ventral setae and ctenidium with 7 short setae; fore tibia with 1 long preapical anterior dorsal seta and 1 short apicoventral seta. Mid femur with 6 anterior setae and 1 short apical posterior seta; mid tibia with 1 strong preapical anterior dorsal seta, 2 short apicoventral setae and 1 strong apicoventral seta. Hind femur with 1 preapical anterior dorsal seta; hind tibia with 1 long preapical anterior dorsal seta and 1 short apicoventral seta. **Wing** (Fig. 1 a) with broad deep brown area extending from costal margin to R_{4+5} or M_1, brown stripe-like spot present on r-m and dm-cu, costa with 2nd (between R_1 and R_{2+3}), 3rd (between R_{2+3} and R_{4+5}) and 4th (between R_{4+5} and M_{1+2}) sections in proportion of 4.2:1.7:1; r-m near the middle of discal cell; ultimate and penultimate sections of M_1 in proportion of 1:1.2; ultimate and penultimate sections of CuA_1 about 1:9. Halter yellow.

Abdomen: yellow. Male genitalia (Figs 2 a–e): syntergosternite 7+8 being a complete ring, saddle-shaped dorsally and becoming narrow ventrally, with several dorsal setae; epandrium

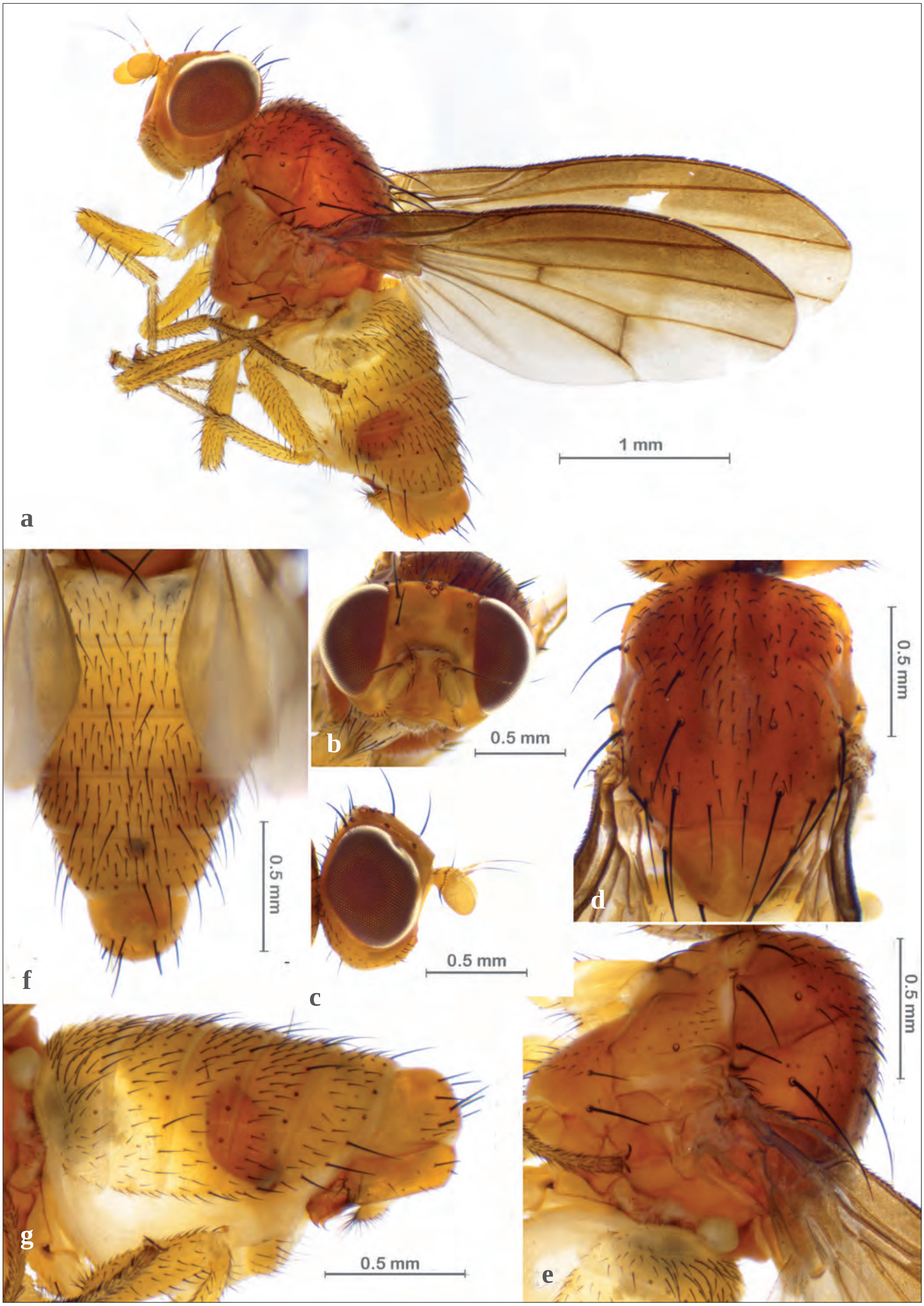

Fig. 1 a–g: *Homoneura* (*Homoneura*) *thompsoni* **spec. nov.**, holotype male from China. – **a**: Habitus in lateral view; – **b**, **c**: Head in anterior and lateral view; – **d**, **e**: Thorax in dorsal and lateral view; – **f**, **g**: Abdomen in dorsal and lateral view.

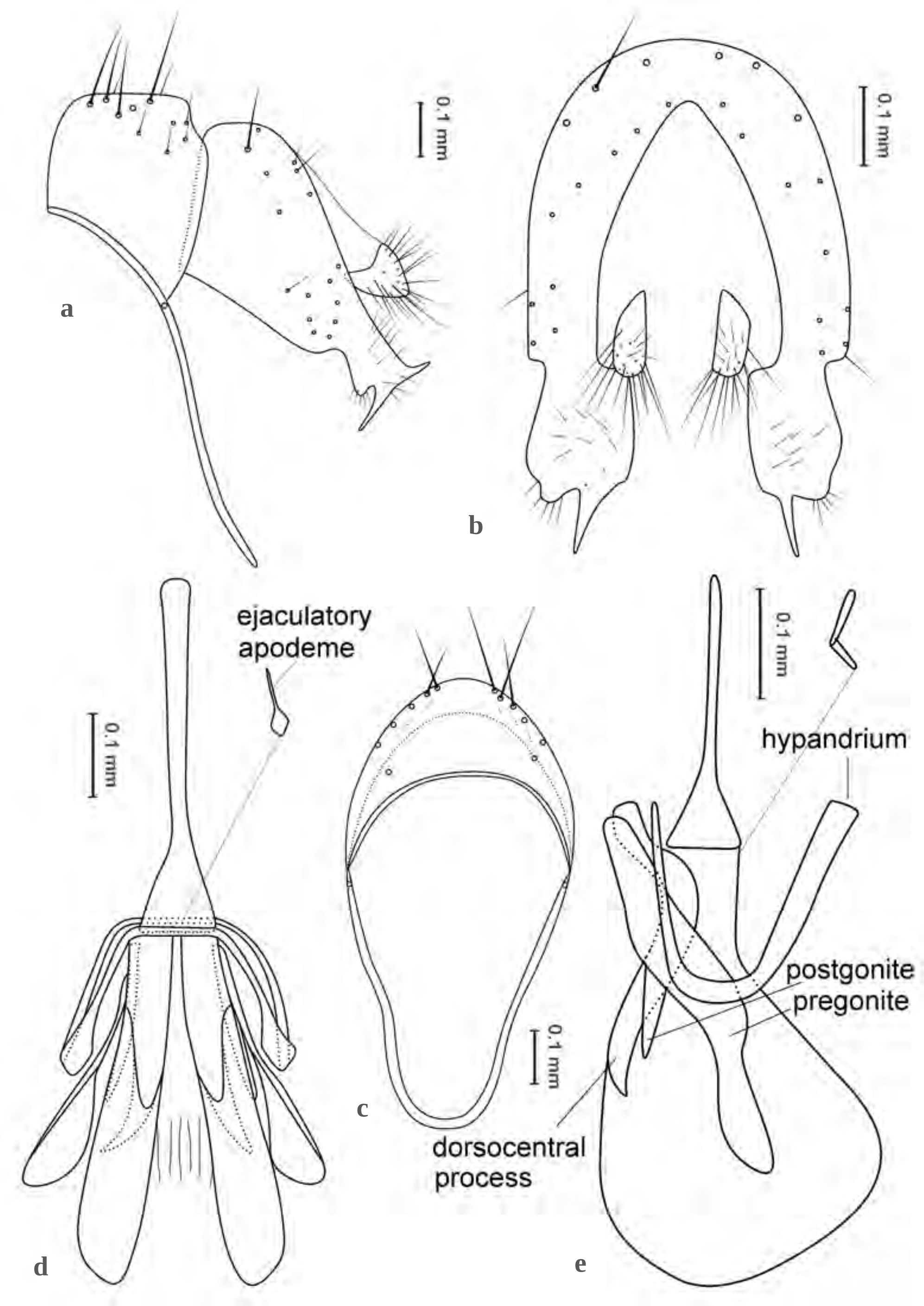

Fig. 2 a–e: *Homoneura* (*Homoneura*) *thompsoni* **spec. nov.**, holotype male terminalia. – **a**: Syntergosternite and epandrium in lateral view; – **b**: Epandrial complex in posterior view; – **c**: Syntergosternite in anterior view; – **d**, **e**: Phallic complex in ventral and lateral view.

truncate at apex with anterior ventral corner sharp; surstylus broad with a triangular distal process in posterior view, and thick basally and tapering distally in lateral view, with a subapical ventral bump and dorsal and ventral sharpened prongs; hypandrium narrow and reverse U-shaped; pregonite tapered and ladle shaped, no extending beyond apex of phallus; postgonite small, triangle and shorter than half length of phallus; phallus broaden subapically and blunt distally in lateral view, consisting of two broad sclerites and full of membrane between them, with a pair of dorsocentral processes; phallapodeme long Y-shaped.

Examined material. Type material. *Holotype*, male (CSCA), **CHINA**: **Zhejiang Province**: Tianmu Mountain (West), 850 m, 30º22'13" N, 119º25'22" E [12–13], 20.vi.2012. Leg.: S. D. GAIMARI & M. HAUSER.

Distribution. China (Zhejiang).

Etymology. The species is named after Frederic Christian THOMPSON, a famous dipterist and entomologist, giving sincere thanks to him for his outstanding contributions in insect classification research and online database construction.

Discussion. The species belongs to *Homoneura laticosta* species group (see Appendix 1). It is similar to *Homoneura* (*H.*) *yehliuensis* SASAKAWA, 2002 from China (Taiwan), but the latter has darker abdomen than thorax and the surstylus has three sharp processes in lateral view.

Key to the species of the *Homoneura* (*Homoneura*) *laticosta* group in China

[Modified from SHI & YANG, 2014]

1 Wing with broad deep brown area extending from costal margin to M_1 and a dark stripe on CuA_1 (see KERTÉSZ 1915: 518, fig. 10); mesonotum with a broad grayish brown medial stripe and a pair of post-sutural lateral spots and short lateral stripes............................... .... ***H.* (*H.*) *discoidalis* (KERTÉSZ, 1815)**

– Wing with brown area extending from costal margin to tip of R_{4+5} or M_1, but no dark stripe on CuA_1; mesonotum without pattern as above **2**

2 Mesonotum with a blackish gray area between postpronotum on anterior margin, a pair of blackish gray post-sutural lateral stripes extending to postsutural third dorsocental setae; acrostichal setae in 4 rows; katepisternum blackish gray on lower part ....***H.* (*H.*) *czernyi* SHATALKIN, 1993**

– Mesonotum yellow or yellowish brown, without pattern as above; acrostichal setae in 6–8 rows; katepisternum yellow **3**

3 Mesonotum with a pair of brown medial stripes between dorsocental setae rows; abdomen yellow or with blackish brown areas **4**

– Mesonotum without brown stripes; abdomen yellow 5

4 Abdominal tergites 1–4 blackish brown except for yellow lateral margin and tergites 5–6 blackish brown; surstylus with three sharp processes at apex in lateral view (see SASAKAWA 2002: fig. 14) .... ***H.* (*H.*) *yehliuensis* SASAKAWA, 2002**

– Abdomen yellow; surstylus with two sharp processes at apex and a blunt subapical process (Figs 2 a, b).. ***H.* (*H.*) *thompsoni* spec. nov.**

5 Arista pubescent, with longest ray about 1/4 height of 1st flagellomere; surstylus hooked apically in lateral and posterior views (see SHI & YANG 2014: figs 123, 125) .... ***H.* (*H.*) *grahami* MALLOCH, 1929**

– Arista plumose, with longest ray longer than 1/3 height of 1st flagellomere; surstylus not as above **6**

6 Antennal 1st flagellomere yellowish brown on apical half; wing with brown spots on r-m and dm-cu; abdominal tergites 3–4 or 3–6 with a small brown medial spot; surstylus consisting of an anterior ventral process and a short apical process in lateral view; aedeagus narrow subuliform apically with a small apical incision in ventral view (see Yang et al. 2002: figs 17, 18) .... ***H.* (*H.*) *obtusa* Yang, Hu & Zhu, 2002**

– Antennal 1st flagellomere yellow; wing without brown spots on r-m and dm-cu or only brown spot on dm-cu; abdominal tergites without spot; surstylus and aedeagus not as above **7**

7 Wing only with brown spot on dm-cu; surstylus short, slightly curved and acute apically in lateral view (see Shi & Yang 2014: fig. 147) .... ***H.* (*H.*) *laticosta* (Thomson, 1869)**

– Wing without brown spot on r-m and dm-cu; surstylus long and curled upward in lateral view (see Gao & Yang 2002: figs 7, 8) .... ***H.* (*H.*) *longa* Gao & Yang, 2002**

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This article is in honor of Frederic Christian (“Chris”) Thompson for his great contribution to dipterology. As a postdoc at CDFA during 2011–2012, I (Li Shi) had a chance to visit the Smithsonian Institute and examined the types of Agromyzidae, and talked with Dr. Thompson only once. He was a warm and nice man like my father, showed me his books and talked more about flower flies, even giving me some experiences on the taxonomy of these flies. I enjoyed that special afternoon. I still remember all despite it being ten years later. All my best regards and really sincere thanks to Chris.

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Appendix

A species list of the *Homoneura* (*Homoneura*) *laticosta* group in China with their known distribution.

Homoneura (*Homoneura*) *czernyi* SHATALKIN, 1993. Oriental: China (Sichuan).

Homoneura (*Homoneura*) *discoidalis* (KERTÉSZ, 1915). Oriental: China (Taiwan).

Homoneura (*Homoneura*) *grahami* MALLOCH, 1929. Oriental: China (Sichuan), Vietnam.

Homoneura (*Homoneura*) *laticosta* (THOMSON, 1869). Oriental: China (Fujian, Hainan, Taiwan), Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam; Australian/Oceanian: Australia, Micronesia, New Guinea, Solomon Islands.

Homoneura (*Homoneura*) *longa* GAO & YANG, 2002. Oriental: China (Guizhou).

Homoneura (*Homoneura*) *obtusa* YANG, HU & ZHU, 2002. Oriental: China (Hainan).

Homoneura (*Homoneura*) *thompsoni* **spec. nov.** Oriental: China (Zhejiang).

Homoneura (*Homoneura*) *yehliuensis* SASAKAWA, 2002. Oriental: China (Taiwan).

A new species of *Cheilosia* MEIGEN (Diptera: Syrphidae) from high mountains of India

[Eine neue Art der Gattung *Cheilosia* MEIGEN (Diptera: Syrphidae)
aus dem Hochgebirge Indiens]

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Abstract

A new species of the subgenus *Cheilosia* (*Montanocheila*) BARKALOV, 2002 is described from the Ladakh region, in the Jammu and Kashmir State, northwest India. The new species, *Cheilosia christiani* **spec. nov.**, is described in full and adult habitus and male genitalia images are provided, together with DNA barcodes and drawings of the female head.

Key words: hover flies, flower flies, *Montanocheila*, DNA barcode, Jammu and Kashmir, Ladakh

Zusammenfassung

Eine neue Art von der Untergattung *Cheilosia* (*Montanocheila*) BARKALOV, 2002 wird aus der Region Ladakh, im Bundesstaat Jammu und Kaschmir im Nordwesten Indiens, beschrieben. Die neue Art, *Cheilosia christiani* **spec. nov.**, wird in vollem Umfang beschrieben und Bilder des erwachsenen Habitus und der männlichen Genitalien werden zusammen mit DNA-Barcodes und Zeichnungen des weiblichen Kopfes bereitgestellt.

Stichwörter: Schwebfliegen, *Montanocheila*, DNA-Barcode, Jammu und Kaschmir, Ladakh

Introduction

The genus *Cheilosia* MEIGEN, 1822 (Diptera: Syrphidae) is the most species-rich hover fly genus in the world with approximately 420 described species (THOMPSON et al. 2010; STÅHLS & BARKALOV 2017), a number that is still growing (BARKALOV 2020). It belongs to the monophyletic tribe Rhingiini (subfamily Eristalinae) (VUJIĆ et al. 2019) and has been divided into 13 subgenera (BARKALOV 2002, 2007). The Palaearctic Region is the most diverse biogeographic region for *Cheilosia* species, with more than 310 species (BARKALOV 2020). In comparison, the Indomalayan Region is relatively poor in number of *Cheilosia* species with 30 species described (KNUTSON et al. 1975; BARKALOV & CHENG 2004; EVENHUIS & PAPE 2021).

India is a large country, sometimes considered a subcontinent. Zoogeographically, the western border of India and the high mountains and valleys in the north and northwest represent transition zones between the Palaearctic and the Indomalayan Regions (WIKRAMANAYAKE et al. 2002). Nine *Cheilosia* species have been reported from India, namely *Cheilosia apicalis* BRUNETTI, 1913, *C. grossa* (FALLÉN, 1817), *C. himalayensis* (BRUNETTI, 1915); *C. hirticincta* BRUNETTI, 1915; *C. kalatopensis* NAYAR, 1968, *C. nigroaenea* BRUNETTI, 1915, *C. pilipes* (BIGOT, 1884), *C. plumbiventris* BRUNETTI, 1915, and *C. songarea* (BECKER, 1894) (GHORPADÉ 2014, 2015). In the present study, we describe a new species of *Cheilosia* (*Mon-*

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[*] Corresponding author.

tanocheila) BARKALOV, 2002 collected in the high mountains of the Ladakh region, northwest India.

Material and methods

Area of study. Specimens were collected near the Tso Moriri lake (32°54′ N 78°18′ E) in the region of Ladakh, northwest India in the Jammu and Kashmir State. Hover flies were collected using a hand net between 5685 and 5747 m a.s.l.

Taxonomy protocols. Adults were kept in alcohol and brought to the laboratory, where they were dried using an automated Critical Point Dryer (CPD) Leica EM CPD300 after removing the legs used for the DNA extraction (see below). Only the female ZFMK-DIP-00082456 was kept in alcohol. Male genitalia were detached before the drying process with the CPD. Later, dried specimens were mounted using minuten pins for their morphological study.

Morphological terminology follows THOMPSON (1999), in addition to those relating to male genitalia that follow CLAUSSEN (1998).

Identification and locality labels are indicated with double quotation marks (“ ”), and each line on the label is separated by a double forward slash (//). Handwritten information on labels is indicated in italics. For the paratypes, at the end of each record, between square brackets ([ ]) and separated by a comma, the number of specimens and sex, the holding institution, and the unique identifier or number are given.

The following acronyms were used for the entomological collections where the studied material was deposited:

ISEA – Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia.
ZFMK – Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

Habitus and genitalia photographs of pinned specimens were taken with a Canon EOS 7D camera mounted on a P–51 Cam-Lift (Dun Inc., VA, U.S.A.) and with the help of Adobe Lightroom (version 5.6), and they were composed using the Zerene Stacker 1.04 (Richland, Washington, U.S.A.) software. All measurements are in millimeters and were taken using a reticule in a Leica M165 C microscope. Body length was measured from the anterior oral margin to the posterior end of the abdomen, in lateral view. Wing length was measured from the wing tip to the basicosta.

DNA sequences. One leg from the ethanol preserved specimens (before drying) was used for DNA extraction. Extractions were carried out using the NucleoSpin Tissue DNA Extraction kit (Machery-Nagel, Düren, Germany) following the manufacturer’s instructions; samples were resuspended in 100 µl ultra-pure water. Entire specimens were preserved and labelled as DNA voucher specimens for the purpose of morphological studies and deposited in the entomological collections as cited below.

DNA primers and PCR amplification protocols for the mitochondrial protein-coding cytochrome *c* oxidase subunit I (COI) gene were the same as described in MENGUAL et al. (2012) and ROZO-LOPEZ & MENGUAL (2015). The sequences were edited for base-calling errors and assembled using Geneious R7 (version 7.1.3, Biomatters Ltd.). All new sequences were submitted to GenBank (see ‘Genetics’ section below for the accession numbers).

Results

Cheilosia (*Montanocheila*) *christiani* Mengual & Barkalov, spec. nov.

(Figs 1–15)

Differential diagnosis. From all species known from the Indomalayan Region, the new species differs by the following characters: legs completely black (tibia broadly yellow basally in *C. hirticincta* and *C. nigroaenea*), female frons with long yellow pile and thorax covered with long erect black and yellow pile (in *C. plumbiventris*, female frons with thick black pile and scutum with very short brownish yellow pile).

In the key to *Cheilosia* species of China (Barkalov & Cheng 2004), *C. christiani* **spec. nov.** keys out as *C. altimontana* Barkalov & Cheng, 2004 but differs in many characters. The male of *C. christiani* **spec. nov.** has two vittae of grey pollinosity on the scutum (absent in *C. altimontana*) and scutum and pleuron entirely black pilose (pale and black pilose in *C. altimontana*); while the female of *C. christiani* **spec. nov.** has the frons with long, erected yellow (medially) and black (laterally) pile (frons with long, forward directed, white pile in *C. altimontana*). In the key to *Cheilosia* species of Central Asia (Barkalov 2020), the female of *C. christiani* **spec. nov.** goes to *C. teneripilosa* Barkalov, 2020, but it differs by the completely black basoflagellomere and black tibiae (postpedicel basoflagellomere brownish postero-ventrally and tibiae brownish in basal 1/3–1/2 in *C. teneripilosa*). In the same key (Barkalov 2020), the male of *C. christiani* **spec. nov.** keys out to couplet 19 and it can be distinguished from *C. milkoi* Barkalov, 2005 and *C. zlotini* Peck, 1969 by the shape and size of the gonostylus (Figs 10–13).

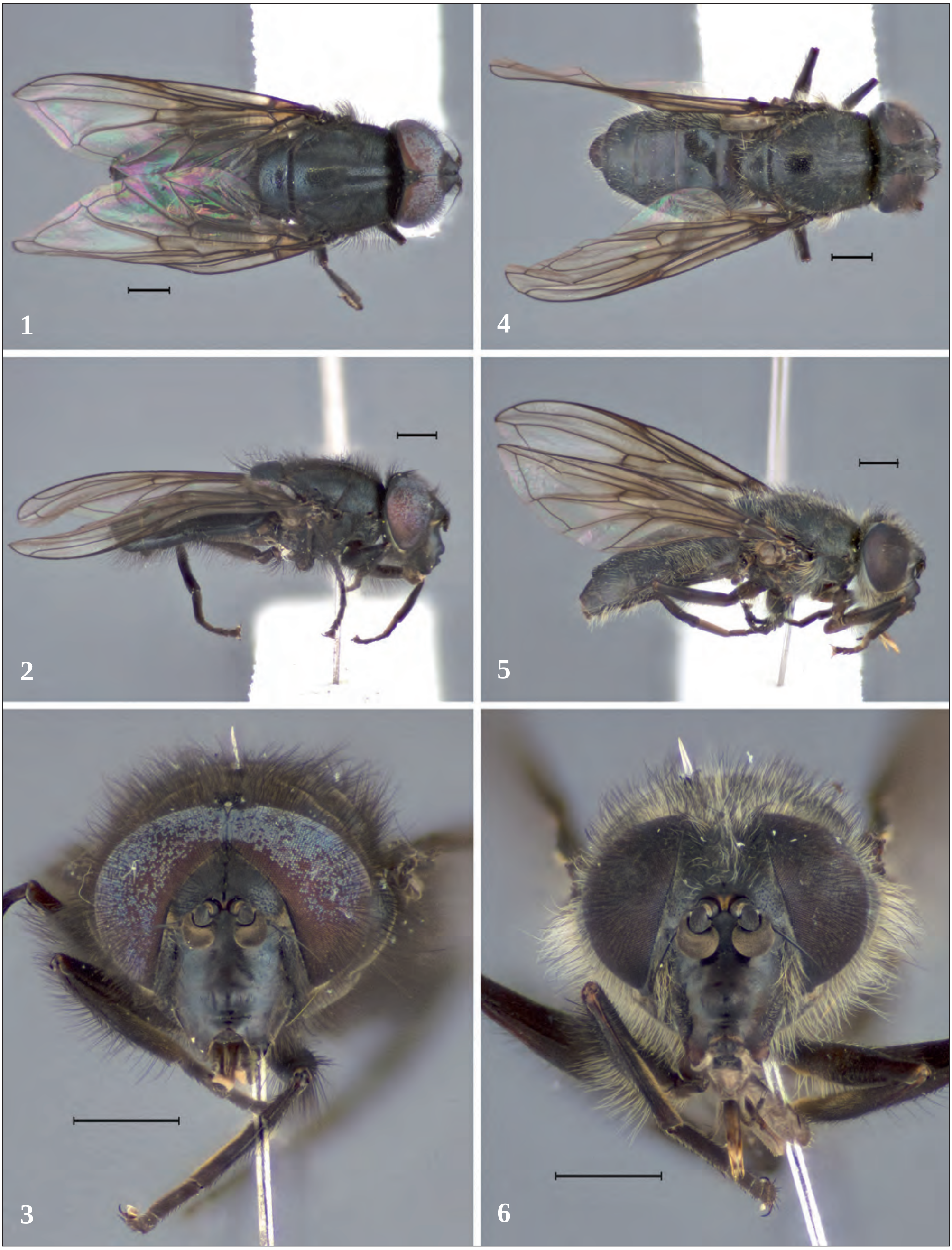
Type locality. INDIA: Jammu and Kashmir State, Ladakh region, near Lake Tso Moriri, 32°59.876’ N 78°26.537’ E, 5747 m.

Examined material. Type material. *Holotype*, male, pinned with genitalia in microvial, deposited in the ZFMK, Bonn, Germany, and labelled: “INDIA: Jammu and Kashmir State // Ladakh, near Tso Moriri (lake) // 32°59.876' N 78°26.537' E, // 5747 m., 21–23.viii.2010. // Leg.: I. Abela-Hofbauerová” “DNA voucher specimen // ZFMK, lab code // D532 // Bonn, Germany” “HOLOTYPE // *Cheilosia* // *christiani* // Mengual & Barkalov, 2021” [red] “ZFMK-DIP-00082458” [barcode]. *Paratypes*: **INDIA: Jammu and Kashmir State:** the same information as the holotype [1 ♀ 1 ♂, ZFMK; ZFMK-DIP-00082456, ZFMK-DIP-00082457]; Ladakh, near Tso Moriri (lake), 5685 m., 20–23.viii.2010. Leg.: I. Abela-Hofbauerová [1 ♀, ZFMK; ZFMK-DIP-00082459]; Ladakh, near Tso Moriri (lake), 32.9° N, 78.3° E, 5053 m., 25–28.viii.2010. Leg.: I. Abela-Hofbauerová [1 ♀, ISEA; ZFMK-DIP-00015972].

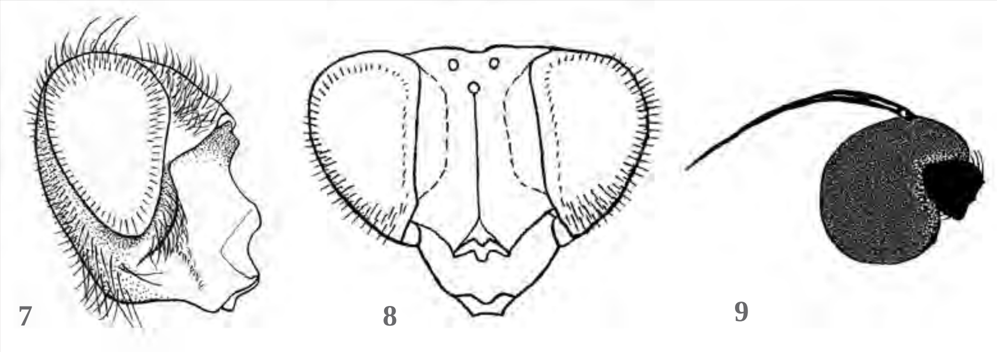
Description

MALE. **Size** (N = 1): Length of body: 8.4 mm; length of wing: 7.8 mm.

Head: Face shiny black, with fine grey pollinosity under the antennal bases, with a stripe of short black pile running from the middle paraface to oral margin; facial tubercle well developed, rounded; paraface very broad, finely grey pollinose near eye, shiny medially, black, with fine brownish pollinose fascia near the level of the antennal base, covered with long dark brown pile; gena broad, covered with grey pollinosity and long dark pile, with some paler pile ventrally. Frontal triangle shiny black, distinctly punctate with grey pollinosity on puncta and ventro-laterally, with a distinct longitudinal groove, with long dark pile; lunule shiny black, antennal pits distinctly separated. Antenna black, basoflagellomere rounded, slightly broader than long, black, with light pollinosity; arista long, shiny, black, without pile. Eyes covered entirely with dense, comparatively long black pile. Ocellar triangle slightly isosceles, covered with black pile. Occiput dark covered with grey pollinosity, broad ventrally and narrowing dorsally, with a dense pollinose vitta along posterior margin of the eye, from the most ventral point to 2/3 of the eye. Vertex with long black pile (Figs 1–3).



Figs 1–3: *Cheilosia christiani* **spec. nov.**, male holotype (ZFMK-DIP-00082458). – **1**: Habitus in dorsal view; – **2**: Habitus in lateral view; – **3**: Head in frontal view. **Figs 4–6**: *Cheilosia christiani* **spec. nov.**, female paratype (ZFMK-DIP-00082459). – **4**: Habitus in dorsal view; – **5:** Habitus in lateral view; – **6:** Head in frontal view. Scale bars = 1 mm.



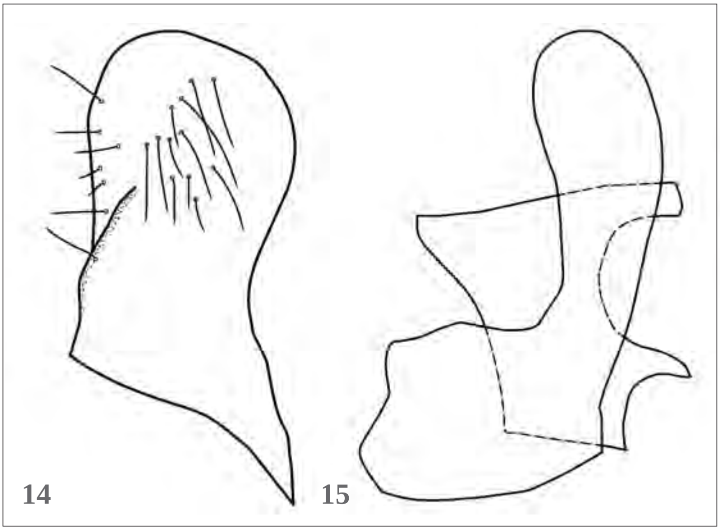
Figs 7–9: *Cheilosia christiani* **spec. nov.**, female paratype (ZFMK-DIP-00015972). – **7**: Head in lateral view; – **8**: Head in dorsal view; – **9**: Antenna.

Thorax: Scutum and scutellum shiny black with fine grey pollinosity, finely punctate, covered with long erect and semi-erect black pile, without distinct bristles, except long, thin black bristles on posterior margin of the scutellum and shorter, thin black bristles on postalar callus. Scutum with two vittae of pale grey pollinosity reaching 2/3 of the scutum from the anterior margin, but not reaching the posterior margin. Scutellum fringe with long black pile. Pleuron black with fine grey pollinosity and long black pile. Katepisternal pile patches narrowly separated anteriorly and broadly separated posteriorly. Metasternum with long black pile. Calypters grey; ventral calypter with long pale pile fringe and dorsal calypter with shorter black pile fringe; plumula short, dark pilose basally and paler pilose apically; posterior spiracular fringes dark. Halter pedicel and capitulum dark. **Wing**: entirely covered with microtrichia, slightly infuscated basally and along veins on basal half; pterostigma dark, long; alula entirely microtrichose; inner angle between veins R_{4+5} and M_1 smaller than 90°.
Legs: entirely black, with long black pile; procoxa without baso-lateral spur. Metafemur with short pile dorsally on basal 1/2, with long pile (longer than hind femur width) on apical 1/2, ventrally with short pile (shorter than hind femur width) with scattered very long pile (longer than hind femur width) (Figs 1–2).
Abdomen: slightly oval, glossy shiny black, finely punctate, with long black pile and (Figs 1–2). Sternites brown, lightly grey pollinose, with long and a few short black pile. **Genitalia**: surstylus approximately two times longer than broad, larger than cercus; gonostyli slightly asymmetrical, with right gonostylus with ventral lobe a little bent dorsally (Figs 11, 13); ventral lobe of the gonostylus (= postgonite) longer than the dorsal lobe of the gonostylus, curved distally inward; sclerite of the distiphallus with two ventral spurs (Figs 10–15).

FEMALE. **Size** (N = 2): Length of body: 8.0 mm; length of wing: 7.8 mm.
Overall quite similar to male, except for normal sexual dimorphism and as follows (Figs 4–9): paraface, gena and ventral half of the occiput with long yellow pile; face shiny black, except a small pale marking on oral margin and a smaller pale macula ventrad to eye, with a stripe of short yellow pile in lower half. Frons comparatively broad, finely narrowed posteriorly, shiny black, with distinct central suture and almost invisible lateral furrows, covered with dense, long yellow pile with scattered black pile laterally; lunula yellowish medially. Vertex with long black and yellow pile. Scutum and scutellum shiny black with fine grey pollinosity, covered with long erect yellow and black pile, without distinct bristles; scutellum fringe with long yellow pile. Scutal pollinosity on anterior margin forming one medial thin vitta and two submedial broader vittae, but with not clear pattern as in the male. Pleuron with long yellow

Figs 10–13: *Cheilosia christiani* **spec. nov.**, male genitalia of the holotype (ZFMK-DIP-00082458). – **10**: Epandrium, surstylus and cercus in lateral view; – **11**: Hypandrium and gonostylus in lateral view; – **12**: Hypandrium, sclerite of the distiphallus and gonostylus in ventral view; – **13**: Hypandrium, sclerite of the distiphallus and gonostylus in latero-dorsal view.

pile. Katepisternal pile patches broadly separated. Metasternum with long yellow pile. Legs dark brown, with coxae, trochanters and basal part of femora, and apex of femora and very basal part of tibiae brown; femora with yellow and black pile, the rest black pilose. Abdominal pilosity entirely yellow.



Figs 14–15: *Cheilosia christiani* **spec. nov.**, male genitalia of the holotype (ZFMK-DIP-00082458). – **14**: Surstylus, outline, lateral view; – **15**: Gonostylus and distiphallus, outline, lateral view.

Remarks. Female specimens of *C. christiani* **spec. nov.** have abundant yellow pile on the body, but males only have black pile.

Etymology. The new species is named after our mentor and colleague F. Christian Thompson to honor and celebrate his immense contribution to the study of flies, especially Syrphidae. Species epithet to be treated as a noun in the genitive case.

Geographical distribution. Only known from the type locality in the Ladakh region, in northwest India.

Ecology. The female ZFMK-DIP-00082459 was collected in an area with *Potentilla pamirica* Th. Wolf, *Astragalus confertus* Bunge, and *Thylacospermum* sp.

Genetics. We successfully sequenced the 5′-end of the COI gene for the holotype (GenBank accession number: OL665125) and two paratypes (ZFMK-DIP-00082457, ZFMK-DIP-00082459; GenBank accession numbers: OL665128, OL665126), with a length of 660–702 bp. In addition, we also obtained the whole COI gene sequence for one female paratype (ZFMK-DIP-00082456), with a length of 1506 bp (GenBank accession number: OL665127). All the obtained sequences were identical in the overlapping region. A blast in BOLD (www.boldsystems.org) revealed that the DNA barcode of our new species is similar to other species, such as the Palaearctic *C. subpictipennis* Claussen, 1998 (96.13 % similarity), *C. montana* Egger, 1860 (96.12 %) or *C. illustrata* (Harris, 1779) (96.58 %), but also quite similar to *C. lashiopthalmus* Williston, 1882 from North America (96.96 %). The closest taxa present in BOLD to *C. christiani* **spec. nov.** are three unidentified specimens of *Cheilosia* collected in Sichuan Province, China (between 97.11 % and 97.43 % similarity).

Discussion

Our new *Montanocheila* species is morphologically similar to *C. altimontana* and *C. teneripilosa* known from China (Xinjiang and Qinghai Provinces) and from Kirgizstan respectively. All these three species inhabit in high mountains from 4190 to 5747 m a.s.l., with *C. christiani* **spec. nov.** reported at the highest altitude. *Cheilosia christiani* **spec. nov.** is genetically close to other species of the subgenera *Montanocheila* and *Floccocheila* Barkalov, 2002, and a close relationship between these two subgenera was already suggested by Claussen (1998) and found by Ståhls & Nyblom (2000), Ståhls et al. (2004) and Vujić et al. (2019).

The type locality of *C. christiani* **spec. nov.** is the same as for *Rohdendorfia bella* Mengual in Mengual & Barkalov, 2019. As mentioned by Mengual & Barkalov (2019), *R. bella* and *C. christiani* **spec. nov.** are oreal elements of the Palaearctic Region, present nowadays in high mountains ecosystems. The dynamics of these ecosystems are poorly understood, but there is consensus on considering them, together with paramos and other high altitude ecosystems, seriously endangered (Terzioğlu et al. 2015; Zamora et al. 2017; Montoya et al. 2021), including their flora and fauna.

Acknowledgements

Our most sincere thanks are due to Inés Abela-Hofbauerová for letting us study the dipterans she collected in the Ladakh region. We thank Claudia Etzbauer for her invaluable help in the molecular lab, and Sander Bot and Gunilla Ståhls for their helpful comments. The work of A. V. Barkalov was supported by the RFFI grant №20-04-00027-a and partly by the Federal Fundamental Scientific Research program for 2021–2025 (0247-2021-0004).

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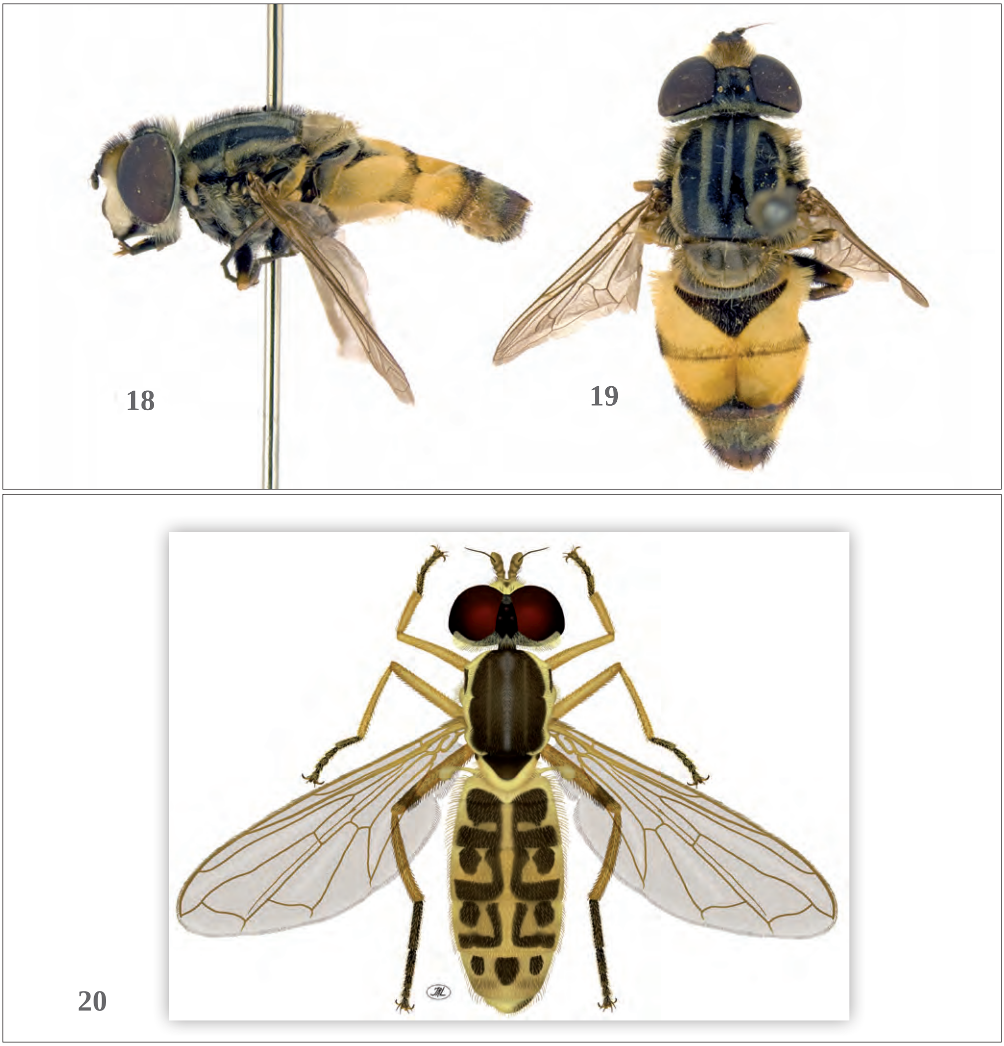
Selected species described by F. Christian Thompson. VI.

Ximo Mengual

Besides being the topic of his PhD dissertation, Chris devoted a lot of time to study the hover flies of the Neotropical Region. In his 1999 masterpiece, together with a key to Neotropical genera, Chris described a new genus and a new species from Peru, *Ohmyia omya* Thompson, 1999. Both names, the genus name and species epithet, are derived from the colloquial expression "Oh, my".

For many of his field expeditions, Chris had the company of his wife Betty. Betty was an active collector in the field and she coauthored a few publications. Among them, Chris and Betty described together a new flower fly from Chile, *Toxomerus schlingeri* Thompson & Thompson, 2007. This species is unique within the genus by its distinctive abdominal pattern and dichoptic males and it was named after his friend Evert I. Schlinger, an eminent dipterist and the founder of the Schlinger Foundation dedicated to the study of entomology and arachnology. Thompsons' field work in Chile was supported by the Schlinger Foundation.



Figs 18–20: Selected species described by F. Christian Thompson. – **18, 19**: *Ohmyia omya* Thompson, 1999, holotype male; – **18**: Habitus, lateral view; – **19**: Habitus, dorsal view; – **20**: *Toxomerus schlingeri* Thompson & Thompson, 2007, habitus, dorsal view. Photos: X. Mengual, drawing by Taina Litwak, from the original publication.

Exploring the intra-tribal relationships of Volucellini (Diptera: Syrphidae) using molecular and morphological characters

[Untersuchungen der Verwandtschaftsbeziehungen der Gattungen innerhalb der Tribus Volucellini (Diptera: Syrphidae) mittels molekularer und morphologischer Merkmale]

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Abstract

The tribe Volucellini (Diptera: Syrphidae: Eristalinae) comprises four genera, *Copestylum* MACQUART, 1846, *Graptomyza* WIEDEMANN, 1820, *Ornidia* LEPELETIER & SERVILLE, 1828 and *Volucella* GEOFFREY, 1762. The monophyly of the tribe was never refuted, but the generic relationships have remained contradictory. This study addresses the intratribal generic relationships using a combined analysis of molecular (mitochondrial COI and nuclear 28S rDNA sequences) and morphological characters of adult and immature stages. Results of the Maximum Likelihood (ML) analysis for the combined molecular and morphological data were congruent with one of the previously proposed hypotheses presented by THOMPSON in 1972. The ML analysis of combined data supports the phylogenetic relationships among the genera as *Graptomyza* + (*Volucella* + (*Copestylum* + *Ornidia*)), with the included members of genera *Copestylum* and *Ornidia* resolved in a polytomy.

Key words: Volucellini, DNA, mtDNA COI, 28S rDNA, morphology

Zusammenfassung

Die Tribus Volucellini (Diptera: Syrphidae: Eristalinae) umfasst vier Gattungen: *Copestylum* MACQUART, 1846; *Graptomyza* WIEDEMANN, 1820; *Ornidia* LEPELETIER & SERVILLE, 1828 und *Volucella* GEOFFREY, 1762. Die Monophylie der Tribus wurde nie angezweifelt. Die Relationen zwischen den in der Tribus vereinten Gattungen blieben allerdings widersprüchlich. Vorliegende Studie befasst sich mit ihren Verwandtschaftsbeziehungen unter Verwendung einer kombinierten Analyse von molekularen (mitochondriale COI- und nukleäre 28S-rDNA-Sequenzen) und morphologischen Merkmalen der Imagines und der Larven. Die Ergebnisse der Maximum-Likelihood-Analyse (ML) für die kombinierten molekularen und morphologischen Daten decken sich mit einer der bereits 1972 von THOMPSON vorgeschlagenen Hypothesen. Die ML-Analyse der kombinierten Daten unterstützt die phylogenetischen Beziehungen zwischen den Gattungen wie folgt: *Graptomyza* + (*Volucella* + (*Copestylum* + *Ornidia*)), wobei die enthaltenen Mitglieder der Gattungen *Copestylum* und *Ornidia* in einer Polytomie aufgelöst wurden.

Stichwörter: Volucellini, DNA, mtDNA COI, 28S rDNA, Morphologie

Introduction

The family Syrphidae (Diptera) presently comprises over 6200 described species (PAPE & EVENHUIS 2019). Syrphid flies are almost worldwide in distribution and are most speciose in the New World tropics. The tribe Volucellini is one of the nine tribes presently recognized in the subfamily Eristalinae (MORAN et al. 2022), one of the four subfamilies of Syrphidae. Volucellini, as traditionally defined (Thompson 1972), comprise the genera *Copestylum* Macquart, 1846, *Graptomyza* Wiedemann, 1820, *Ornidia* Lepeletier & Serville, 1828, *Tachinosyrphus* Hull, 1936 and *Volucella* Geoffrey, 1762. Thompson (1991) placed the monotypic genus *Tachinosyrphus* as a subgenus of *Copestylum*.

The cumulative distribution of the tribe includes all zoogeographical regions except Antarctica, but individual genera are more restricted. *Copestylum* and *Ornidia* are endemic to the New World, *Volucella* is known from the Oriental and Holarctic regions (Thompson 1972), while *Graptomyza* is the most widespread genus, known from the Afrotropical, Oriental, Palaearctic (only Eastern part) and Australasian regions (Whittington 1994). *Ornidia obesa* (Fabricius, 1775) has been introduced by human activity into the Old World tropics and the Pacific and Australasian Regions (Thompson 1991; Whittington & Rotheray 1997; Ramage et al. 2018), and *Copestylum melleum* (Jaennicke, 1867) has been introduced and is established in the Canary Islands (Romig & Hauser 2004). Although *Graptomyza* and *Copestylum* in particular are still poorly understood, the species richness of these four genera is remarkably disparate: *Ornidia* has five species (Thompson 1991; Carvalho Filho & Esposito 2009); *Volucella* 42 species, *Graptomyza* 83 species (Whittington 1992); and *Copestylum* comprises more than 400 species (Rotheray et al. 2009).

The members of the tribe Volucellini are readily distinguished from other eristaline tribes by the possession of a straight or recessive wing vein M_1 in combination with a plumose antennal arista (Thompson 1972). Concerning the larval characters, the tribe is distinguished by the division of the anal segment into anterior and posterior sections, with the anterior section bearing two pairs of fleshy projections or lappets (three pairs in most other eristaline tribes). Additionally, the head skeleton has reduced mandibles that do not protrude as a pair of hooks from the oral cavity (mouth hooks are large and well developed in other eristaline tribes with two pairs of lappets) (Thompson et al. 2010). Larval feeding modes include saprophagy in a wide variety of decaying vegetable matter, and entomophagy in nests of aculeate Hymenoptera in several *Volucella* species (Whittington 1994; Thompson & Rotheray 1998; Rotheray et al. 2005, 2007; Rotheray 2009; Thompson et al. 2010).

Within the Volucellini, *Graptomyza* is perhaps the most morphologically distinctive genus within the adult stage, having dichoptic males and the scutellum with a well-developed, setose depression (Whittington 1992). Adult and larval stages of *Volucella*, *Copestylum* and *Ornidia* are not so morphologically distinct. Adults of *Volucella* have the thorax with the anterior anepisternum pilose, whereas this sclerite is bare in the majority of *Copestylum* and *Ornidia* species.

Diagnoses of the tribe Volucellini

ADULT (adapted from Thompson 1972: 104; some terminology follows Thompson 1999)
Head: Face pilose, usually distinctly tuberculate, rarely straight; oral margin notched anteriorly; facial grooves elongate, long, almost extending to antennal bases; facial stripes differentiated; antennal pits confluent; ocellar triangle small, distinctly anterior to posterior margin of eye; eye pilose; holoptic except dichoptic in *Graptomyza* and *Copestylum* (*Megametopon*) (Giglio-Tos); antenna short, shorter than face, with scape and pedicel always very short; arista usually plumose, rarely sparsely pilose, bare only in *Copestylum* (*Tachinosyrphus*).
Thorax: Usually with distinct bristles; anterior anepisternum pilose; anterior anepimeron pilose; metasternum pilose and underdeveloped; meron with pilose area anteroventral to spiracle. **Legs**: Simple, without spines or basoventral spinose area on metafemur. **Wing**: Crossvein r-m clearly basal, always located basal to middle of cell dm; radial sector with microbristles; vein M_1 straight or recessive, never progressive.
Abdomen: Short, oval or suboval, never elongate, emarginate or petiolate.

LARVA (adapted from Rotheray et al. 2005)
Length 4–30 mm. Anterior and posterior ends truncate or tapered; subcylindrical to dorso-ventrally flattened in cross-section; mouth lacking protruding mouth-hooks; anterior spiracles usually present; anal segment divided into anterior and posterior sections with the anterior section bearing two pairs of fleshy projections or lappets, the posterior section with one pair of lappets, and the base of the antero-dorsal pair of the lappets on the anterior section, bearing a short projection and an apical sensillum; mesothoracic prolegs with crochets present; prolegs and crochets usually present on first six abdominal segments, crochets usually in straight transverse rows, rarely in curved rows; anal segment short or long; larva saprophagous in a wide variety of wet, decaying organic substance.

Phylogenetic relationships

Hull (1949) was the first to classify the volucellines, and in his synopsis of syrphid flies he treated the taxon as the subfamily Volucellinae including two tribes, the Volucellini (*Volucella* [including *Copestylum*], *Megametopon*, and *Tachinosyrphus*) and the Graptomyzini (*Graptomyza*). Thompson (1972) presented Hennigian argumentation scheme analyses based on morphological characteristics mainly of the adult stage of Volucellini, and he found two possible phylogenetic arrangements of the Volucellini genera: i) Volucellini = (*Graptomyza* + *Volucella*) + (*Ornidia* + (*Copestylum* + *Tachinosyrphus*)); or ii) Volucellini = *Graptomyza* + (*Volucella* + (*Ornidia* + (*Copestylum* + *Tachinosyrphus*))) (see also Thompson & Whitehead 1986; Thompson 1991). Whittington (1992) using a slightly different morphological character set presented the relationships as: Volucellini = *Graptomyza* + (*Copestylum* + (*Ornidia* + *Volucella*)). Thus, these hypotheses agree only on the placement of the genus *Graptomyza* as sister to the other Volucellini taxa.

The study of Ståhls et al. (2003) explored the phylogenetic relationships within the Syrphidae using both morphological and molecular characters. They used parsimony analysis under optimization alignment for the combined data under various weighting schemes, and included three *Volucella* and one *Graptomyza* species. The *Volucella* species (with immature stages with different feeding modes) were resolved as a well-supported monophyletic group, while *Graptomyza* was placed as sister group to the non-volucelline taxon *Alipumilio avispas* Vockeroth, 1964, albeit with low support. Hippa & Ståhls (2005) in their study of the phylogenetic utility of adult morphological characters of Syrphidae also included the mentioned Volucellini taxa. Their parsimony analysis resolved the included taxa of *Graptomyza* and *Volucella* as a clade. Young et al. (2016) included representatives of *Graptomyza* and *Copestylum* in their Maximum Likelihood analysis using anchored enrichment sequence data for 343 selected genetic loci, and the monophyly of Volucellini was supported (100 % bootstrap support). Moran et al. (2022) in their eight-gene phylogeny recovered a well-supported Volucellini (only including representatives of *Graptomyza* and *Copestylum*), and discussed elevating the ranks of tribes Cerioidini, Merodontini and Volucellini as recovered in the phylogenetic tree to subfamilial level.

Hence, the phylogenetic relationships of Volucellini, including representatives of all genera, are still in demand. Here, we specifically explore the relationships among the Volucellini genera using a fair representation of the taxonomic diversity of the tribe and DNA sequence data of two gene regions frequently employed in syrphid molecular phylogenetic studies (e.g., Ståhls et al. 2004; Mengual et al. 2008, 2015; Vujić et al. 2008, 2020). These data were analysed under Maximum Likelihood, and in combination with newly generated morphological characters of adult and early stages and including multiple outgroup eristaline taxa.

Material and methods

Taxon sampling

The present study includes 17 species of *Copestylum*, five species of *Volucella*, four of *Graptomyza*, and two species of *Ornidia* (28 taxa in total; Table 1). Representatives of all eristaline tribes were included as outgroups (13 taxa in total), and *Eumerus erythrocerus* Loew, 1858 (Eristalinae: Merodontini) was used to root the trees. The total number of species was 41. Species likely new to science awaiting confirmation and description are denoted with abbreviations (e.g., CR-29 refers to species number 29 from Costa Rica), and were identified as such by F. C. Thompson (Tables 1, 2).

Table 1: Locality data and GenBank accession numbers for specimens used for molecular work and morphological study. NA = Not Available; NS = Not Submitted, because species identity was not possible to assess or bidirectional sequencing failed; URI = Unique Resource Identifier.

Lab codes	Species	Locality data (FMNH Luomus specimen ID URI's included if available)	COI 5'-end + COI 3'-end	28S
MZH_Stahls_ Y2261	*Eumerus erythrocerus* Loew	South Africa: Kwazulu-Natal, Royal Natal National Park, The Crack path, S 28°40'58.7" E 28°56'33.1", 22.II.2016, G. Ståhls leg. http://id.luomus.fi/GM.15475	OP712679	OP730906
MZH_Stahls_ Y1732	*Eumerus compactus* van Doesburg	South Africa: Kwazulu-Natal, Royal Natal National Park, The Crack, 9.XII.2012, A. Vujić leg.	OP712678	NS
MZH_Stahls_ Y1247	*Merodon clunipes* Sack	Greece: Samos island, Kosmadei, N 37°45'41" E 26°39'38", 568 m, 12.VI.2010, S. Rojo, G. Ståhls & A. Vujić leg.	MH521920, HE653244	HE797749
MZH_Stahls_ Y258	*Rhingia campestris* Meigen	Finland: 669:40, N: Sibbo, Hindsby, N 60°21'05" E 25°11'50", 26.V.2004, G. Ståhls leg.	EU431491	AY261744
MZH_Stahls_ Y1354	*Cheilosia illustrata* (Harris)	Finland: Kb: Ilomantsi, Mekrijärvi Res. Station, N 62°46'03" E 30°59'10", 8.VII.2010, G. Ståhls & E. Rättel leg.	MH521946, MH495987	MH426728
MZH_Stahls_ Y190	*Ferdinandea cuprea* (Scopoli)	Finland: Ta: Lammi, Evo, N 61°13'12" E 25°09'01", 15.VI.2004, G. Ståhls leg. http://id.luomus.fi/GJ.2215	MH521924, EU431486	EU431455
MZH_Stahls_ Y1854	*Brachyopa testacea* (Fallén)	Russia: Altay, Teletskoe lake area, N 51°47'29.502" E 87°19'06.11", 23–25.VI.2013, G. Ståhls leg.	KM224508	KM224492
MZH_Stahls_ Y389	*Xylota florum* (Fabricius)	Finland: Terjärv, 26.VII.2006, G. Ståhls leg. http://id.luomus.fi/GJ.2376	OP712682	OP730911
MZH_Stahls_ Y679	*Eristalis tenax* (Linnaeus)	Greece: Lesvos, nr Sikaminia, 11.V.2007, G. Ståhls leg	MH521922, MH549217	MH430044
MZH_Stahls_ Y1824	*Eristalinus taeniops* (Wiedemann)	South Africa: Bergville (Hillside Farm), 6.XII.2012, C. Pérez-Bañón & S. Rojo leg.	OP712683	OP730909
MZH_Stahls_ Y337	*Eurimyia lineata* (Fabricius)	Canada: British Columbia, Vancouver island, Nanaimo, Buttertub Marsh, N 49°10'25" W 123°58'03", 5.V.2005, alt. 63 m, W. van Steenis leg. http://id.luomus.fi/GJ.2248	OP712680	OP730907
MZH_Stahls_ Y1788	*Brachypalpus laphriformis* (Fallén)	Finland: U: Helsinki, Santahamina, 3.VII.2012, S. Kerppola leg.	MH521919, MH495995	MH543335
MZH_Stahls_ Y468	*Somula decora* Macquart	U.S.A.: Northampton Co., NC, 5.V.2005, B. Kondratieff, R. Zuellig, & R. F. Kirchner leg. http://id.luomus.fi/GJ.2454	OP712681	OP730908
MZH_Stahls_ Y224	*Graptomyza robusticornis* van Doesburg	Madagascar: Fianarantsoa Prov., Ranomafana NP, Talatakely region, O. A, 2.XII.2004, X. Mengual leg. http://id.luomus.fi/GJ.2244	EU431484	EU431453
MZH_Stahls_ Y2574	*Graptomyza triangulifera* (Bigot) (*varia* species group)	Uganda: Western Region, Kasese District, Rwenzori Mountains N. P., N 00°20'58.63" E 30°01'46.56", 1740 m, 5.XII.2018, G. Ståhls leg.	OP712697	OP730925
MZH_Stahls_ Y2575	*Graptomyza nigra* Bezzi	Uganda: Western Region, Kasese District, Rwenzori Mountains N.P., along Mahoma Trail, N 00°21'28.85" E 30°01'0.84", 2100 m, 4.XII.2018, G. Ståhls leg.	OP712698	OP730926

Lab codes	**Species**	**Locality data (FMNH Luomus specimen ID URI's included if available)**	**COI 5'-end + COI 3'-end**	**28S**
MZH_Stahls_G422	*Graptomyza longirostris* Wiedemann	Malaysia: Poring, VIII.1999	KM270878	KM270847
MZH_Stahls_Y470	*Copestylum haagii* (Williston)	U.S.A.: New Mexico, Chaves Sagebrush Valley road at Squa Canyon road, N 32.57° W 105.50°, 1–10.V.2004, M. E. Irwin leg.	OP712691	OP730918
MZH_Stahls_S299	*Copestylum fornax* (Townsend)	U.S.A.: Arizona, Cochise Co. Portal, N 31°53.26' W 100°10.25', 12.–17.VII.2002, Malaise trap, M. Hauser leg.	OP712686	OP730912
MZH_Stahls_Y118	*Copestylum macquarti* (Curran)	Argentina: Jujuy prov., 36 km S Jujuy, Arroyo Las Lanzas, Malaise trap in wooded, damp wash, 1278 m, 27.X.–14.XI.2003, S 24°27.25' W 65°17.83', M. E. Irwin & F. D. Parker leg.	OP712684	NA
MZH_Stahls_Y494	*Copestylum marginatum* (Say)	Mexico: Hidalgo, Metztitlan, 26.IX.2005, P266, A. P. Martinez leg.	NS	NS
MZH_Stahls_Y2794	*Copestylum* aff. CR-55	Venezuela: Lara state, P.N. Yacambú, sector “El Blanquito”, roadside, 29.I.2007, G. Ståhls leg.	OP712695	OP730923
MZH_Stahls_Y81	*Copestylum* sp. CR-29	Costa Rica: Heredia, INBio parque, 14.II.2003, F. C. Thompson leg.	OP712687	OP730914
MZH_Stahls_Y507	*Copestylum elizabethae* Hancock & Rotheray	Trinidad: Morne Blue, 1–15.VII.2006, larva ex bromeliad	OP712694	OP730921
MZH_Stahls_Y120	*Copestylum pictum* (Wiedemann)	Argentina: Jujuy prov., 36 km S Jujuy, Arroyo Las Lanzas, Malaise trap in wooded, damp wash, 1278 m, 27.X–14.XI.2003, S 24°27.25' W 65°17.83', M. E. Irwin & F. D. Parker leg.	OP712689	OP730916
MZH_Stahls_Y119	*Copestylum pica* (Schiner)	Argentina: Jujuy prov., 36 km S Jujuy, Arroyo Las Lanzas, Malaise trap in wooded, damp wash, 1278 m, 27.X–14.XI.2003, S 24°27.25' W 65°17.83', M. E. Irwin & F. D. Parker leg.	OP712693	OP730920
MZH_Stahls_Y124	*Copestylum scutellatum* (Macquart)	Chile: Regio IV, Limari Prov., Fray Jorge Nat’l Park, Malaise in picnic area; 12–31.XII.2003, 250 m, , S 30°38.38' W 71° 39.00', M. E. Irwin leg.	OP712690	OP730917
MZH_Stahls_Y2793 (Y357 XM-2008	*Copestylum virescens* (Williston) (*vagum* species group)	Colombia: Dpto Caldas, Manizales, Corrg. Las Palomas, Reserva Natural Río Blanco, 18.II.2006, 2200–2500 m, N 5°04' W 75°26.2', X. Mengual leg.	EU431481	EU431450
MZH_Stahls_Y481	*Copestylum vagum* (Wiedemann)	Colombia: Dpto. Cauca, Corrg. El Tambo, 20 De Julio, 2900 m, 6–8.III.2006, C. Prieto leg.	OP712692	OP730919
MZH_Stahls_S239	*Copestylum vagum* A (*vagum* species group)	Costa Rica: Heredia, INBio parque, 14.II.2003, F. C. Thompson leg.	NS	NS
MZH_Stahls_S240	*Copestylum vagum* B (*vagum* species group)	Costa Rica: Heredia, INBio parque, 14.II.2003, F. C. Thompson leg.	NS	NS
MZH_Stahls_Y080	*Copestylum varians* (Bigot)	Costa Rica: Heredia, INBio parque, 14.II.2003, F. C. Thompson leg.	partial, NS	OP730913
MZH_Stahls_Y2792	*Copestylum* sp. CR-71	Colombia: Dpto Caldas, Manizales. Corrg. Las Palomas, Reserva Natural Río Blanco, 18.II.2006, 2200–2500 m, N 5°04' W 75°26.2', X. Mengual leg.	NS	OP730922
MZH_Stahls_Y2798	*Copestylum emeralda* (Hull)	Peru: Dpto Junín, Chanchamayo Prov., Distrito San Ramón, near La Merced, Fundo Génova, Selva, point #4, 24.III.2008, 1053 m, S 11°05'44" W 75°21'19". Project AECID A/013484/07.	NS	OP730927
MZH_Stahls_Y502	*Ornidia obesa* (Fabricius)	Venezuela: Aragua state, Monumento Natural Pico Codazzi, 2185 m, N 10º 24.387' W 067° 18.559', 25.01.2007, G. Ståhls leg.	OP712688	OP730915
MZH_Stahls_Y2022	*Ornidia therezinhae* Da Silva Carvalho-Filho & Esposito	Brazil: Minas Gerais state, 10.XII.2013, M.N. Morales leg.	OP712696	OP730924

Continuation of Table 1: Locality data and GenBank accession numbers for specimens used for molecular work and morphological study. NA= Not Available; NS=Not Submitted, because species identity was not possible to assess or bidirectional sequencing failed; URI = Unique Resource Identifier.

Lab codes	**Species**	**Locality data (FMNH Luomus specimen ID URI's included if available)**	**COI 5'-end + COI 3'-end**	**28S**
GJAA.1415	*Volucella bombylans* (Linnaeus)	Finland: Enontekiö, Vuontisjärvi, 15.VII.2020, G. Ståhls leg. http://id.luomus.fi/GJAA.1415	OP712685	OP730910
MZH_Stahls_G388	*Volucella inflata* (Fabricius)	Germany: Sachsen-Anhalt, 17.III.1999, F. Dziock leg.	AY261688	AY261734
MZH_Stahls_S585	*Volucella inanis* (Linnaeus)	Finland: N: Helsinki, VIII.2006, G. Ståhls leg.	AY261690	AY261736
MZH_Stahls_Y1974	*Volucella pellucens* (Linnaeus)	Russia: Primorsk region, near Gorno-Taezhnoye biol. stat., N 43°41'43" E 132°09'50", 4.IX.2014, G. Ståhls & E. Rättel leg	MH521923, MH495996	MH445921
MZH_Stahls_S262	*Volucella zonaria* (Poda)	Greece: Lesvos, Vatoussa, 5.V.2001, S. Rojo & C. Pérez-Bañón leg.	EU431493	EU431462

In Uganda, collecting permits were obtained from the Uganda Wildlife Authority (UWA/COD/96/05) and the Uganda National Council for Science and Technology (UNCST) (NS642). None of the collected species occur on red lists or are considered to be endangered/threatened, neither is any ranked in IUCN lists or protected by CITES.

The "Guidance document on the scope of application and core obligations of Regulation (EU) No 511/2014 of the European Parliament and of the Council on the compliance measures for users from the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation in the Union (2021/C 13/01)", the "Paragraph 2.3.3.1. Research and development" states: "Identification of a genetic resource is also to be considered to precede utilization. Taxonomic identification of biological or genetic material, by morphological or molecular analysis, including through the use of DNA sequencing, is not considered to constitute utilization in the meaning of the EU ABS Regulation, as it does not involve the discovery of specific genetic and/or biochemical functionality. There is no difference whether the taxonomic identification points to a previously named entity or an unnamed entity. Taxonomic studies, where they do not look into genetic properties (functionality), are thus not within scope of the EU ABS Regulation."

Table 2: Specimens used for morphological study.

Taxon	**Sex**	**Country, Locality**	**Specimen code**
Cheilosia illustrata (Harris)	male	Germany	USNM ENT 00037131
Rhingia campestris Meigen	male	Netherlands	USNM ENT 00037134
Ferdinandea cuprea (Scopoli)	male	Germany	USNM ENT 00037129
Xylota florum (Fabricius)	male	Denmark	USNM ENT 00037135
Eristalis tenax (Linnaeus)	male	U.S.A., Maryland	USNM ENT 00037132
Eurimyia lineata (Fabricius)	male	Denmark	USNM ENT 00037136
Graptomyza longirostris Wiedemann	male	Philippines	USNM ENT 00037126
Copestylum CR-29	male	Costa Rica	USNM ENT 00075305
Copestylum maquarti (Curran)	male	Mexico	USNM ENT 00037143
Copestylum haagii (Williston)	male	U.S.A., Texas	USNM ENT 00037141
Copestylum fornax (Townsend)	male	U.S.A., Arizona	USNM ENT 00037140
Copestylum marginatum (Say)	male	U.S.A., California	USNM ENT 00037142
Copestylum pictum (Wiedemann)	male	Ecuador	USNM ENT 00037144
Copestylum pica (Schiner)	male	Costa Rica	INBIOCRI002133870
Copestylum scutellatum (Macquart)	male	Chile	USNM ENT 00037139
Copestylum vagum (Wiedemann)	male	Costa Rica	INBIOCRI001116203
Copestylum varians (BiVgot)	male	Costa Rica	INBIOCRI001888082
Ornidia obesa (Fabricius)	male	Dominica	USNM ENT 00037124
Volucella bombylans (Linnaeus)	male	U.S.A., Maryland	USNM ENT 00019365
Volucella inflata (Fabricius)	male	France	USNM ENT 00037149
Volucella inanis (Linnaeus)	male	Czech Republic	USNM ENT 00037145
Volucella pellucens (Linnaeus)	male	Poland	USNM ENT 00037146
Volucella zonaria (Poda)	male	Hungary	USNM ENT 00037147

Molecular data

Adult specimens were used for DNA extraction, and the remains of specimens were preserved and labelled as DNA voucher specimens and deposited in the entomological collections of the Finnish Museum of Natural History Luomus [institutional acronym MZH] (Table 1). DNA was extracted from 1–3 legs of either dry, pinned or ethanol-preserved specimens using the Nucleospin Tissue DNA Extraction kit (Macherey-Nagel, Düren, Germany) following manufacturer's protocols and resuspended in 50 µl of ultrapure water. A large fragment of the mitochondrial cytochrome *c* oxidase subunit I (hereafter COI) and the D2–3 expansion region of the nuclear ribosomal 28S rRNA gene were sequenced. PCR primers and amplification protocols for mitochondrial COI, and nuclear 28S rRNA genes were the same as in MENGUAL et al. (2008, 2015). Amplified DNA was electrophoresed on 1.5 % agarose gels and purified for sequencing with the GFX PCR Purification Kit (Amersham Biotech, Little Chalfont, U.K.). Sanger sequencing was outsourced to the sequencing service laboratory at FIMM, Biomedicum, University of Helsinki. The sequences were edited for base-calling errors and assembled using Sequence Navigator™ version 1.01 (Applied Biosystems, Waltham, Massachusetts, U.S.A.) or Sequencher version 5.1 (GeneCodes, Ann Arbor, Michigan, U.S.A.).

Morphological data

Morphological characters were obtained across the entire body of the adult and final larval instar or puparial stage. F. C. THOMPSON generated a data matrix of 56 characters (23 binary, 33 multistate) of the adult fly (Appendix 1; STÅHLS 2022). The adult characters were scored for ingroup and outgroup taxa mainly by F. C. THOMPSON; a few were also scored by G. STÅHLS. The specimens used for scoring for the adult morphological dataset are partly deposited in the United States National Museum collection (Washington, U.S.A.; Table 2), and some specimens used for molecular analysis were also used for character scoring. G. E. ROTHERAY generated and scored a data matrix of 42 early-stage characters (23 binary, 19 multistate) (see Appendix 2; STÅHLS 2022). The immature samples used for scoring larval characters are deposited in the National Museums of Scotland collection (Edinburgh, U.K.). Morphological terminology follows THOMPSON (1999) for adults and ROTHERAY & GILBERT (1999) for early stages.

Phylogenetic analyses

The 28S rRNA sequences were aligned with MAFFT version 7 (KATOH & STANDLEY 2013) using the E-INS-i algorithm (KATOH et al. 2005). The gap-free COI sequences were manually trimmed to have the same 5'-end start point, and likewise truncated in the 3'-end. Maximum likelihood analyses of DNA data and combined dataset analyses were executed on the IQ-TREE (MINH et al. 2020) web server using IQ-TREE multicore version 1.6.12 (http://iqtree.cibiv.univie.ac.at) (TRIFINOPOULOS et al. 2016). ModelFinder (KALYAANAMOORTHY et al. 2017) as implemented in IQ-TREE was used to identify the most optimal evolutionary models. Branch support was estimated using ultrafast bootstrap (HOANG et al. 2017). Consensus trees, with branch support values shown at nodes, were visualized and rooted in MEGA version X (KUMAR et al. 2018).

Results

Morphological data

The morphology matrix totalled 98 parsimony informative characters. See Appendices 1 and 2 for character descriptions, and STÅHLS (2022) for character matrices.

Molecular data

The mitochondrial COI dataset comprised 1128 nucleotide characters (partially incomplete sequences for two ingroup species). The mean A+T-content of the COI sequences was 71.1 %.

For the sequenced D2–3 fragment of 28S rRNA gene we obtained 560–590 nucleotides (lacking for two ingroup species), and the aligned matrix comprised 631 nucleotide sites. Thus, the aligned molecular dataset comprised 1759 nucleotide sites in total.

Phylogenetic analyses

The best-fit evolutionary model (under both AIC and BIC criterion) for molecular data was GTR+F+I+G4, and the best-fit model for morphological data was MK+FQ+ASC+G4. The log likelihood for the best tree of the combined of the morphology tree was –1,861.9396 (Fig. 1), the log likelihood for the best tree of the molecular data was –15,949.1115 (Fig. 2) and for the combined data –18,543.228 (Fig. 3). Consensus trees are shown with bootstrap values indicated at the nodes (Figs 1–3).

Phylogenetic relationships

Results of the ML analysis for the molecular data only (Fig. 2) and combined molecular and morphological data (Fig. 3) were congruent with the second of the argumentation schemes suggested by Thompson (1972), namely Volucellini = *Graptomyza* + (*Volucella* + (*Copestylum* + *Ornidia*)). In the separate analysis of the morphological data the relationships among the volucelline genera were not satisfactorily resolved, with the members of *Volucella* and *Copestylum* found in several clusters. However we stress that among the volucellines, the larvae and puparia of *Ornidia* are similar to those of *Copestylum*, and most similar to those of the *Copestylum scutellata* group *sensu* Fluke (1951) (Rotheray et al. 2005).

Graptomyza was resolved as sister to the rest of the Volucellini in the preferred tree from the combined analysis (Fig. 3) with high support. *Graptomyza robusticornis* van Doesburg, 1957 from Madagascar was resolved as sister taxon to *G. longirostris* Wiedemann, 1820 from Malaysia in all topologies with high support, and not placed as sister taxon to the two *Graptomyza* species from the Afrotropics.

Volucella inflata (Fabricius, 1794) was sister to the rest of the *Volucella* species (Figs 2–3), a position we have found previously (Ståhls et al. 2003). This species is apparently unusual among *Volucella* in having a saprophagous larva in tree sap exudations (Rotheray 1999). Only seven other *Volucella* species have been reared but they are all associated with nests of social aculeates (Hymenoptera), where they have mixed saprophagous and zoophagous feeding modes; although one species, *Volucella inanis* (Linnaeus, 1758), is a strict zoophage (Rupp 1989).

The included representatives of *Copestylum* were resolved in three clades in the combined analysis (Fig. 3). Our results from the combined dataset are not conclusive about the relationship of *Copestylum* and *Ornidia*.

Discussion

For a genus of its size, second largest within the Volucellini and the most widely distributed, *Graptomyza* is biologically poorly known. Rearing data apparently exist for less than ten species. Whittington (1994) described the puparium of an Australian species, *Graptomyza mitis* Curran & Bryan, 1926 and the puparia of two Afrotropical taxa, *G. signata* (Walker, 1860) and *G. triangulifera* (Bigot, 1883). *Graptomyza signata* has been reared from tomato and unidentified rotting fruit, and *Graptomyza triangulifera* from unidentified seed pods (Whittington 1994). He also indicated that an unidentified Australasian *Graptomyza* species close to *G. flavicollis* Ferguson, 1926 was reared from fallen fruit of *Castanospermum australe* A. Cunn & C. Fraser ex Hook. (Leguminosae) (Whittington 1994). Krivosheina & Krivosheina (1996) reared and described the larva and puparium of the Palaearctic *Graptomyza alabeta* Séguy, 1948. The larva was found in wet decaying sap under bark of

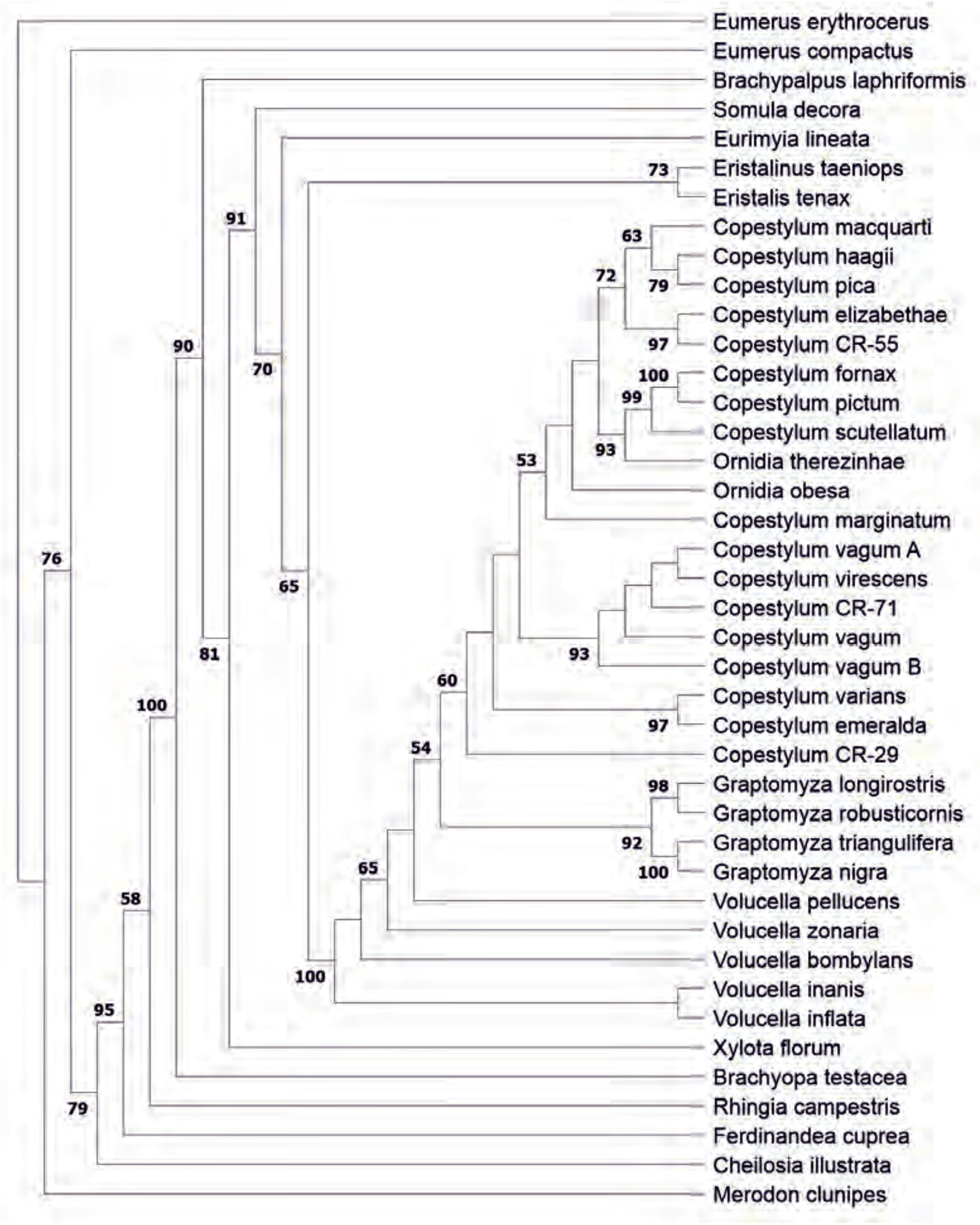

Fig. 1: Maximum likelihood tree for morphological data. Ultrafast bootstrap values >50 % indicated at each node.

fallen trees of *Maackia amurensis* Rupr. (Leguminosae) and *Phellodendron sachalinensis* Rupr. (Rutaceae). More recently, Aracil et al. (2019) described the immature stages of the Afrotropical species *Graptomyza signata* reared from an *Aloe*-like plant. A specimen of the Australasian species *G. brevirostris* Wiedemann, 1820, that we examined in the Smithsonian Institution, was reared from decaying tomato fruits. Thus, decaying tree sap and decaying fruits comprise the recorded larval feeding habits in this genus.

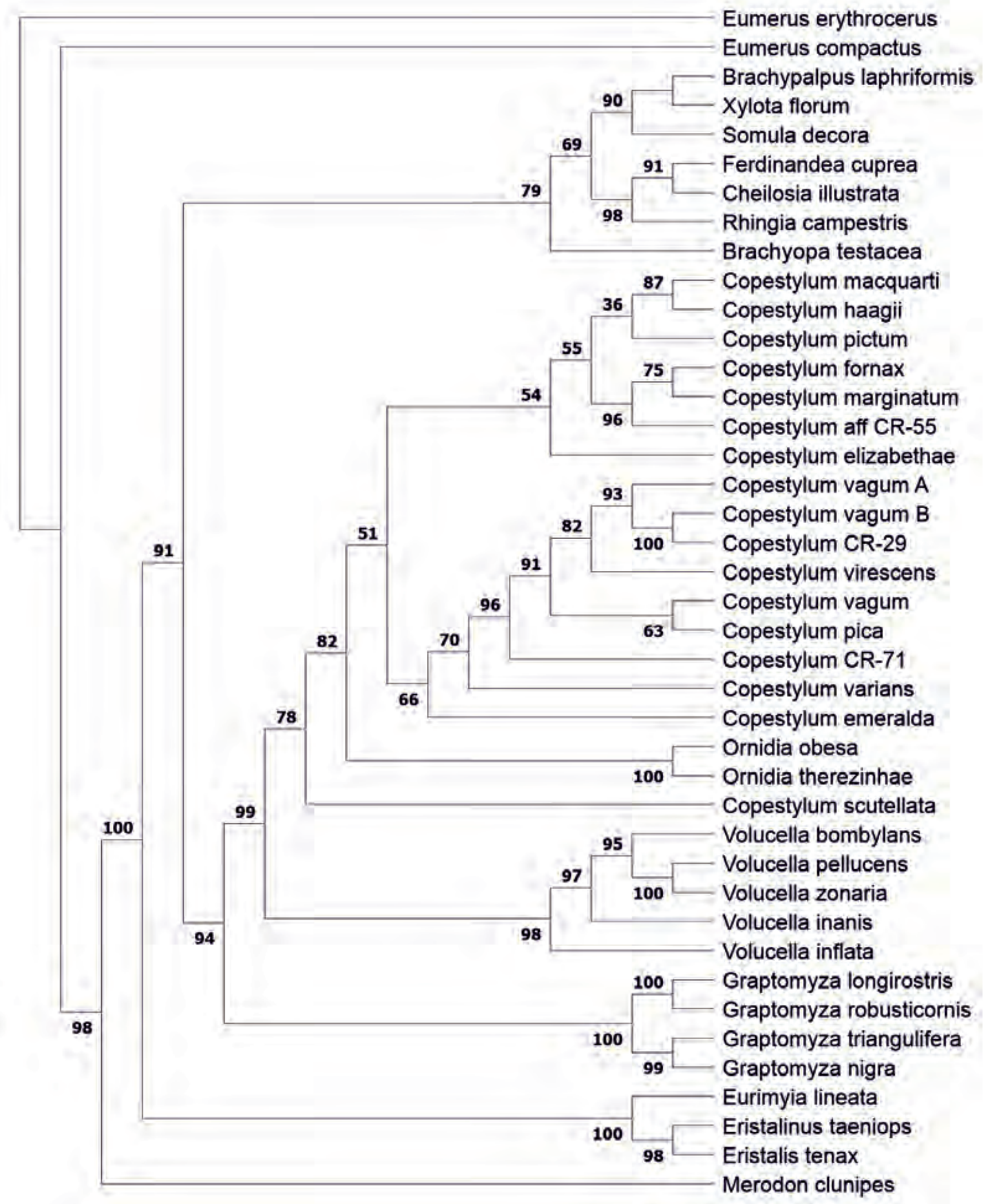

Fig. 2: Maximum likelihood tree for molecular data. Ultrafast bootstrap values >50 % indicated at each node.

We included only a limited representation of the known species diversity of *Copestylum*, hence the intrageneric relationships are only briefly discussed. Within this genus, several authors have recognized different species groups (THOMPSON 2006; ROTHERAY et al. 2007; RICARTE et al. 2015), and there are many generic names synonymized under *Copestylum* that deserve attention and further evaluation. Although the clades resolved in *Copestylum* are broadly congruent with adult morphology and biology, some inconsistencies exist. For example, combined analysis placed *C. varians* (BIGOT, 1875) + *C. emeralda* (HULL, 1944) as basal within *Copesty-*

lum (Fig. 3) whereas the molecular only analysis has this taxon placed two nodes up from the base (Fig. 2). *Copestylum varians* is a member of a small group referred to as the *chalybescens* species group by THOMPSON (pers. comm.). Although most species are distinctive on adult characters, both adult and larval morphology is relatively simple and generalised with respect to other *Copestylum* (ROTHERAY et al. 2009). In Syrphidae, relatively simple, generalised morphology is either associated with secondary losses, or with early-branching taxa (ROTHERAY & GILBERT 1999).

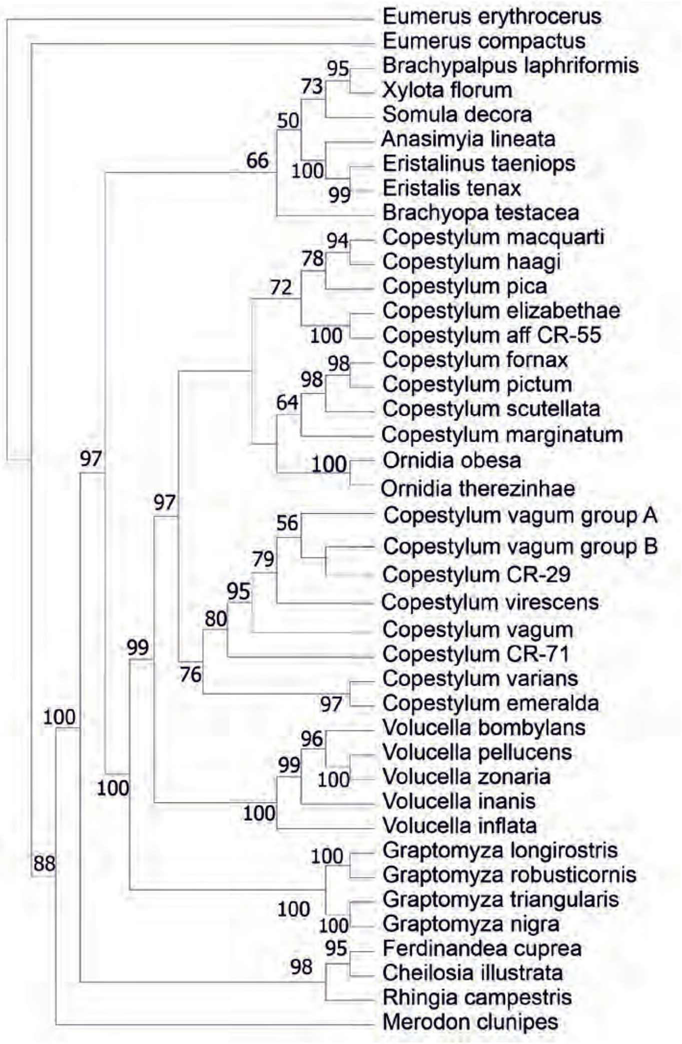

Fig. 3: Maximum likelihood analysis of combined data. Ultrafast bootstrap values >50 % indicated at each node.

The clade in Fig. 3 including *Copestylum emeralda*, taxa of the *varians* species group and species of the *vagum* species group (RICARTE et al. 2015) corresponds mainly to species from closed, forest habitats or forest fringes where breeding occurs in pockets of decay in a wide range of living and dead plants and plant parts (ROTHERAY et al. 2007). The clade from *Copestylum macquarti* CURRAN, 1926 to *Ornidia therezinhae* CARVALHO FILHO & ESPOSITO, 2009 includes *C. elizabethae* HANCOCK & ROTHERAY, 2007, *C. macquarti* and the *Ornidia* species, which can be found in many habitats, while other species are characteristic of open, xeric habitats where breeding occurs in decaying agaves and cacti (ROTHERAY et al. 2009). *Ornidia* species were consistently resolved related to *Copestylum scutellata* (MACQUART, 1842) and other *Copestylum* species (Fig. 3). *Copestylym scutellata* is a member of a large and distinctive species group within *Copestylum*, which is recognisable from various characters such as a scutellum with large, socketed spines (FLUKE 1951). This species group appears to have radiated in open, high-altitude habitats where they breed in decaying cacti (ROTHERAY et al. 2009). The *scutellata* species group shares adult and larval characters with *Ornidia*, such as an inflated postpronotum and a facial tubercle extending laterally to the facial grooves in the adult, and similarities in the posterior breathing tube of the larvae (Rotheray et al. 2005).

Within *Ornidia*, *O. obesa* is particularly common and widespread in comparison with the other four species. Sack (1921) recorded the larva of *O. obesa* from rotting fruits of apple, citrus and breadfruit, and from dung from cesspits. This species can be of concern to public health through carrying harmful bacteria when frequenting latrines (Greenberg 1971; Thompson 1991). Myiasis by *O. obesa* in humans has been reported multiple times in the literature (for a review see Pérez-Bañón et al. 2020). In Costa Rica, larvae of *O. obesa* have been reported in flesh wounds in livestock (F. C. Thompson, pers. comm.), and in Brazil, Martins et al. (2010) reported it from pig carcasses. On the other hand, *O. obesa* can be a useful species as a natural recycler of organic wastes and as a source of protein for domestic animals (Lardé 1989). Many unpublished rearing records exist in collections. Nearly all of them are synanthropic and involve a wide variety of decaying materials, particularly dung and decaying vegetable matter. Morales & Wolff (2010) stated that in Colombia, *O. obesa* is present throughout every stage of composting and is among the most abundant species in this process. Non-synanthropic breeding sites for *O. obesa* include exudations of tree sap (Rotheray et al. 2005). *Ornidia major* Curran, 1930 has been reared from fallen fruits of palm trees (Palmaceae) and from exuding tree sap, while *Ornidia whiteheadi* Thompson, 1991 has been reared from larvae refuse dumps in ant nests of *Atta* Fabricius, 1805 (Formicidae) (Rotheray et al. 2005). Immature stages of *Ornidia therezinhae* remain unknown.

Although our data set has low taxon sampling, it is still comparable to most multi-locus phylogenetic studies in species diversity and definitely larger than most phylogenomic data sets. Our results report an unsatisfactorily resolved relationship between *Copestylum* and *Ornidia*, sometimes in a polytomy or with *Ornidia* embedded in the radiation of *Copestylum*. As the taxon sampling in the present study is not comprehensive concerning the highly speciose genus *Copestylum*, we hypothesize a change of rank of genus *Ornidia* as subgenus of *Copestylum*, but we refrain from taking any systematic action herein. Future studies with increased taxon sampling will help establish relationships within *Copestylum* and *Graptomyza*, and additionally corroborate the placement of *Ornidia*.

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Appendices

Appendix 1: Descriptions of characters and character states of the imagoes.

01. Body length: small < 8 mm long (0); large > 8 mm long (1); very large > 10 mm (2).
02. Body colouration: not obvious for mimicry or crypsis (0); mimicry (1); or crypsis (metallic, shining) (2).
03. Shape of head from above: about 2 × as wide as long (0); more than 2 × as wide as long (1).
04. Distribution of hairs on arista: without hairs or with short hairs (0); plumose (1).
05. Length of third antennal segment: about as long as broad (0); elongate, up to 2 × as long as broad (1); elongate, more than 2 × as long as broad (2).
06. Shape of third antennal segment: oval (0); elongate and parallel sided (1); elongate and broader at base (2).
07. Distance between eyes at level of antenna: about the same (0); < 2 × apart at lower eye margin (1); > 2 × apart at lower eye margin (2).
08. Length of eye contiguity in male: eyes not meeting (0); length of eye contiguity less than length of ocellar triangle (1); length of eye contiguity 1–3 × length of ocellar triangle (2); length of eye contiguity > 3 × length of ocellar triangle (3).
09. Density of eye pilosity: sparse (0); dense (1): missing (2)
10. Distribution of eye pilosity: band down centre of eyes (0); reaching lower margin (1); inapplicable (?).
11. Length of eye pilosity: equal or smoothly changing (0); mixed long and short (1); inapplicable (?).
12. Colour of eye pilosity: unicolorous (0); striped (1); inapplicable (?).
13. Position of facial tubercle: absent (0); below centre of face (1); at centre of face (2).
14. Shape of face between antennae and tubercle: curved in lateral view (0); almost straight in lateral view (1).
15. Dusting of sides of face: with light dusting (0); heavy dusting (1); bare (no dusting) (2).
16. Pruinosity of sides of face: absent/not applicable (0); pruinose patch/stripe (1); covered in pruinosity (2); bare (3).
17. Sides of face, shape: concave (0); straight, at same level (1); inflated (2); convex (tubercles) (3).
18. Anterior view of sides of face: not tapering (0); tapering smoothly from tentorium (1); tapering sharply from cheeks (2).
19. Vittae on face: absent (0); present (1).
20. Colour of facial pilosity: unicolorous (0); mixed (1); absent (2).
21. Postpronotum size: rounded (0); very rounded (1); flattened (2).
22. Notopleuron, number of bulges: absent (0); one (1); two (2).
23. Notopleuron: size of outer bulge raised but not bulging (0); bulging outward like a bubble projecting clear of dorsum (1); absent/not applicable (?).
24. Thoracic bristles: absent (0); present (1).
25. Prescutellar bristles: absent (0); present (1).
26. Length of pile on scutum compared with width of front tibia: shorter (0); longer (1).
27. Composition of pile on scutum: uniform (0); mixed length (1).
28. Constitution of vittae on dorsum: absent (0); pruinosity (1); integumental colour (2); setae (3).
29. Pilosity of anterior anepisternum: pruinose (0); pilose (1); bare (2).
30. Pilosity of posterior anepimeron: pruinose (0); pilose (1); bare (2).
31. Surface of scutellum: without depression (0); with complete depression (1); with depression at apex (2); with concentration of punctures at apex (3).
32. Length of pile on scutellum compared with width of front tibia: shorter (0); longer (1).

33. Composition of pile on scutellum: uniform (0); mixed length (1).
34. Density of pile on scutellum: not densely pilose (0); densely pilose (1).
35. Bristles around scutellum margin: absent (0); complete (1); missing at apex (2).
36. Tubercles supporting apical bristles: small (0); large (1).
37. Colour of scutellum in relation to dorsum of thorax: concolorous (0); not concolorous (1).
38. Posterior apex of middle tibiae: setae not longer than rest (0); setae longer than rest (1) bristles (2).
39. Colour of leg pilosity: unicolorous (0); mixed (1).
40. Density of leg pilosity: not densely pilose (0); densely pilose (1).
41. Size of middle femora: not swollen (0); swollen (1).
42. Extension of CuA_1 beyond apical cross vein: present (0); absent (1).
43. Extension of M_2 beyond apical cross vein: present (0); absent (1).
44. Closure of R_1 (marginal cell): open (0); closed without a bulge (1); closed with a slight bulge (2); closed with a large bulge (3).
45. Shape of upper marginal cross vein M_1: recessive (0); not recessive (1).
46. Microtrichia on wing: covered entirely (0); bare (1); bare at base (2); base and centre bare (3).
47. Appearances of wings: no marks (0); marks (1); infuscated (2).
48. Position of brown marks: one main mark at centre (0); at apex (1); several marks (2);
49. Shape of abdomen from above: subrectangular (0); somewhat wider than long (1); much wider than long (2); quadrate (3).
50. Width of abdominal segments compared to thorax: as wide as thorax (0); wider than thorax (1); much wider than thorax (2).
51. Point of maximum width laterally of abdominal segments: no projecting point (0); anterior shoulders of tergite 2 (1); posterior apex of tergite 2 (2).
52. Colour pattern of tergite 2: no markings (0); pair of spots (1); pale band (2).
53. Curvature of tergite 4: not down curved (0); slightly down curved (1); much down curved (2).
54. Length of tergite 4 in relation to tergite 3: tergite 4 shorter (0); tergite 4 same length or longer (1).
55. Relative length of pilosity on dorsum of tergite 3 as compared with tergite 4: same length (0); tergite 4with longer pilosity (1).
56. Pilosity of tergite 4: equal length (0); unequal length (1).

Appendix 2: Description of immature characters and character states.

01. Projection supporting antennomaxillary organs: the antennomaxillary organs are mounted on projections that vary in length and shape. A short, rounded dome, like a ball cut in half (0); a longer, straight sided cylindrical projection, like a tube (1) or, as (1) but stepped with a wider basal and a narrower apical stage (2).
02. Two staged supporting projection: the apical section may be a single structure (0) or, it is bifurcated (1), if inapplicable coded as unknown (?).
03. Sclerotization of the mandibular lobes: The mandibular lobes are a pair of food-gathering organs next to the mouth, and are a unique apomorphy for the Eristalinae sensu stricto. They are a placed where the fleshy pseudocephalon has fused with the mandibular sclerite, and they have variation in degree of sclerotization (Rotheray & Gilbert 1999). The mandibular lobes may be fleshy (0); black and heavily sclerotized (1) or they may be brown and less heavily sclerotized (2).
04. Position of the mandibular lobes: The position of the mandibular lobes varies in relation to the cavity in front of the mouth. The mandibular lobes may be external to this cavity (0); partially inside (1) or completely inside (2).
05. Vestiture of the dorsal lip: The dorsal lip is another unique apomorphy of the Eristalinae. It is situated between the mouth and the base of the projections bearing antennomaxillary organs and appears as a transverse strip, which may be bare (0) or have setae (1).

06. Protruding mouth hook: The apex of the larval mandible is a mouth hook, which partially protrudes from the mouth (0), is large and almost completely protruding (1) or is reduced and non-protruding (2).
07. Size of the lateral lips: The lateral lips are a unique apomorphy of the Syrphidae and are a pair of dome-shaped, fleshy, food gathering organs on either side of the mouth cavity. By landmark sensilla, they are part of the prothorax (ROTHERAY & GILBERT 1999) and they vary in size and development. They may be slight and little projecting (0), larger and more defined (1) or, well-developed and clearly distinguished (2).
08. Basal vestiture of the lateral lips: The base of the lateral lips coated in various types of setae. Setae may be short (0), elongate and cylindrical in cross-section (1) or, long and flattened (2).
09. Apical vestiture of the lateral lips: The apex of the lateral lips coated in setae that are short (0) or long (1).
10. Vestiture of the anterior fold: Apically, the prothorax curves down to the base of the antennomaxillary organs. This part of the prothorax is well-developed in the Eristalinae and is the anterior fold. It may lack sclerotized setae or spicules (0) or, it may be coated in transverse rows of spicules (1).
11. Size of spicules on anterior fold: The spicules of the anterior fold may be even sized (0) or, variable in size (1), inapplicable coded as unknown (?).
12. Distribution of spicules on anterior fold: The spicules of the anterior fold may occur broadly over the anterior fold (0) or, they may occur in a narrow, transverse band (1), inapplicable coded as unknown (?).
13. Presence of spicules on the dorsum of the prothorax: The dorsum of the prothorax has three, longitudinal lines indented into the integument that are unique to the Syrphidae (ROTHERAY & GILBERT 1999). Between these lines spicules may be absent (0) or, they may be present (1).
14. Presence of anterior spiracles: On the posterolateral margins of the prothorax a pair of anterior spiracles may (0) or, may not be present (1).
15. Number of spiracular openings: The anterior spiracles may have 1 or 2 spiracular openings (0) or, 3 or more openings (1).
16. Length of anterior spiracles: The length of an anterior spiracle may be as long as basally broad (0) or, it may be longer than broad (1).
17. Presence of spicules on the anterodorsal margin of the mesothorax: The anterodorsal margin of the mesothorax may lack transverse rows of spicules (0) or, such spicules may be present (1).
18. Presence of spicules on the lateral margins of the mesothorax: The lateral margins of the mesothorax may lack spicules (0) or, such spicules may be present (1).
19. Number of spicules on the lateral margins of the mesothorax: The number of spicules per group may be up to 10 (0) or, more than 10 (1), if inapplicable coded as unknown (?).
20. Presence of spicules on the anterodorsal margin of the metathorax: The anterodorsal margin of the mesothorax may lack spicules (0) or, spicules may be present (1).
21. Presence of spicules on the lateral margins of the mesothorax: The lateral margins of the mesothorax may lack spicules (0) or, spicules may be present (1).
22. Size of mesothoracic prolegs: The ventral aspect of the mesothorax may have prolegs, i.e., a pair of crochet-rimmed projections with a planta or indented apex. This indentation represents a muscle attachment point, which contracts the proleg. Mesothoracic prolegs may be absent (0); weakly developed (1) or, strongly developed (2).
23. Presence of spicules on the ventral aspect of the metathorax: Spicules may be absent (0); spicules may be aggregated into two groups (1) or, a transverse row of spicules may be present (2).
24. Vestiture of the thorax: Vestiture in the form of setae may coat the thorax and may be short (0) or long (1).
25. Shape of thorax: The outline shape of the thorax may be truncate (0); broadening to apex (1) or, tapering to apex (2).

26. Number of sensilla on ventral aspect of the abdomen: The number of sensilla varies from 2 pairs (0) to 3 pairs (1) per segment.
27. Abdominal locomotory organs: Paired locomotory organs occur on segments 1–6/7 and may appear as simple, raised domes lacking crochets (0), prolegs and crochets (1) or, suckers i.e. centrally indented structures with a distinctly raised rim (2).
28. Presence of prolegs or suckers on abdominal segments: Prolegs and suckers may not be present on the first 7 abdominal segments (0) or, they may be present (1).
29. Number of crochet rows: Crochets may not be organised into rows (0), form 2 rows (1), or, form 3 or more rows (2), if inapplicable coded as unknown (?).
30. Organisation of crochet rows on prolegs: Crochet rows may be aggregated into a group (0); form straight, transverse rows (1) or, form curved rows (2), if inapplicable coded as unknown (?).
31. Numbers of crochets in the primary row: Crochets in the anterior or first row are usually larger than any behind. The number of crochets in the primary row may be up to 5 (0) or, more than 6 (1), if inapplicable coded as unknown (?).
32. Presence of crochets on prolegs: Crochets may be absent on posterior prolegs, segments 5/6–7 (0) or, they may be present on these segments (1), if inapplicable coded as unknown (?).
33. Spicules between or posterior to prolegs: In addition to crochets, spicules may be present between or behind the prolegs (1) or, spicules may be absent (0), if inapplicable coded as unknown (?).
34. Number of lappets on the anal segment: The anal segment usually has tapering, fleshy projections or lappets on the dorsal and/or lateral margins. The anal segment may have 4 pairs (0) or 3 pairs (1) of lappets.
35. Number of sections of the anal segment: The dorsal and lateral margins of the anal segment have more or less continuous indented, transverse lines dividing it into tapering sections. There may be two (0) or three (1) sections.
36. Size of lappets: The posterior, and usually most dorsal, first pair of lappets may be longer than the middle or second pair (0) or, the middle pair may be longer (1), or these pairs of lappets may be equal in length (2).
37. Sensilla on first pair of lappets: In addition to the apical sensilla, an isolated sensilla may be present on the lower lateral margin of the first pair of lappets (1) or, such sensilla may be absent (0).
38. Size of the anal segment: In relation to the length of abdominal segment 6, the anal segment may be slightly longer (0), shorter (1) or, much longer (2).
39. Cross sectional body shape: In cross section the body shape varies from being subcylindrical (slightly wider than deep) (0), to slightly (1) or greatly (2) dorsoventrally flattened or, cylindrical (as wide as deep) (3).
40. Setae on ventrolateral abdominal margin: The lower side of the abdomen may have setae forming a line (1) or such a line of setae may be absent (0).
41. Length of the posterior respiratory process (prp): An almost unique apomorphy of larval Syrphidae is the fusion of the paired posterior spiracles to form a variably long, bulbous to stick-like projection, the prp, on the anal segment. The length of the prp may be about the same as body width (0), shorter (1), slightly longer (2) or much longer (3) than body width.
42. Width of thoracic vestiture: narrow (0), broad (1).

Description of the female of the hover fly species *Spheginobaccha pamela* THOMPSON & HAUSER (Diptera: Syrphidae: Microdontinae)

[Beschreibung des Weibchens der Schwebfliegenart
Spheginobaccha pamela THOMPSON & HAUSER
(Diptera: Syrphidae: Microdontinae)]

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Abstract

Only the male of *Spheginobaccha pamela* THOMPSON & HAUSER (Diptera: Syrphidae) has been described. In the present work, we redescribe the male and describe the female for the first time and provide the first colour photographs for this species.

Keywords: Africa, Afrotropical Region, flower fly, taxonomy

Zusammenfassung

Bislang ist nur das Männchen von *Spheginobaccha pamela* (Diptera: Syrphidae) bekannt. In der vorliegenden Arbeit umschreiben wir das Männchen und beschreiben zum ersten Mal das Weibchen. Erstmals wird die Art mit Farbfotografien dokumentiert.

Stichwörter: Afrika, afrotropische Region, Blumenfliege, Taxonomie

Introduction

The hover fly genus *Spheginobaccha* DE MEIJERE, 1908 (Diptera: Syrphidae) is a rare group of flower flies restricted to the Afrotropical (eight species) and Oriental (ten species) faunal regions (SSYMANK et al. 2021). They are medium to large flies (8.8–19.0 mm in length) (THOMPSON 1974, DIRICKX 1995), with an elongate abdomen, complete transverse suture of the thorax and evenly rounded oral margin. Nothing is known of their biology. The genus was revised by THOMPSON (1974) and since then, only two papers have been published on the Afrotropical species (DIRICKX 1995; THOMPSON & HAUSER 2015), in each of which two new species were described. HULL (1949) was the first to include the genus in the Microdontinae. THOMPSON (1969) excluded the genus from the Microdontinae and later placed the genus in an intermediate position in the Milesiinae (now Eristalinae) (THOMPSON 1972). THOMPSON (1974) placed the genus in its own tribe and as a basal clade in the subfamily Eristalinae. However, its placement within the subfamily Microdontinae and as sister to all other microdontines has now generally been accepted (STÅHLS et al. 2003; ROTHERAY & GILBERT 2011; REEMER & STÅHLS 2013; MENGUAL et al. 2015).

Afrotropical species of *Spheginobaccha* are recorded from Madagascar, Malawi and South Africa. Three species have been described from Madagascar. *Spheginobaccha guttula* DIRICKX, 1995 is only known from the holotype male and the paratype male from Ivondro (MNHN) (DIRICKX 1995), while *Spheginobaccha ruginosa* DIRICKX, 1995 is known from the holotype female and the paratype female from Ivondro (Madagascar) (MNHN) (DIRICKX 1995) and ten additional females (DIRICKX 1995; THOMPSON & HAUSER 2015). *Spheginobaccha stuckenbergi*

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Thompson & Hauser, 2015 was described based on the holotype male from Majunga Analamanitra Forest (CAS), three paratype males with the same data (one at USNM; two at CAS), a paratype male from Namoroka Village, Befatika Andranovary (USNM), two paratype males from Majunga Ambatofolaka, Namoroka, (CAS), and one paratype male from Parc National, Tsingy de Bemaraha, Tombeau Vazimba (CSCA) (Thompson & Hauser 2015). One species, *Spheginobaccha perialla* Thompson, 1974, is known from Malawi and is only known from the holotype male and the allotype female from Mlanje (NHMUK) (Thompson 1974). The four remaining Afrotropical species have been described from South Africa. *Spheginobaccha dexioides* Hull, 1944 was described from the holotype male from Port St Johns in the Eastern Cape Province (Hull 1944). *Spheginobaccha dubia* Thompson, 1974 was described from the holotype male from Geekie's Farm, Karkloof, KwaZulu-Natal (South Africa) (NMSA) (Thompson 1974). *Spheginobaccha rotundiceps* (Loew, 1858) was described from a female from "Caffraria" [Eastern and Northern South Africa, likely KwaZulu-Natal (NHRS?)] (Loew 1858; Hull 1944; Thompson 1974; Thompson & Hauser 2015). Finally, *Spheginobaccha pamela* Thompson & Hauser, 2015 was described based on three males from two localities in the KwaZulu-Natal Province: the holotype (BMSA) and one paratype (NMNH) are from Manguzi Forest Reserve, and the other paratype is from the St Lucia Estuary (CAS). The species was dedicated to Pamela [neé Usher] Stuckenberg, Brian Stuckenberg's wife (Thompson & Hauser 2015).

Given the limited knowledge on many genera of Afrotropical hover flies, additional descriptions of unknown sexes and juvenile stages are valuable additions to our knowledge (e.g., Bellingan et al. 2021; Ssymank & Jordaens 2021). As several characters on the holotype do not correspond to the original description, we redescribe the male of *S. pamela*, describe the female for the first time, and provide high-resolution images of both sexes and of the male genitalia.

Material and methods

The following institution abbreviations are used:

BMSA – National Museum, Bloemfontein, South Africa.
CAS – California Academy of Sciences, San Francisco, U.S.A.
CSCA – California State Collection of Arthropods, Sacramento, California, U.S.A.
KMMA – Koninklijk Museum voor Midden-Afrika, Tervuren, Belgium.
NHMUK – Natural History Museum, London, United Kingdom.
NHRS – Naturhistoriska Riksmuseet, Stockholm, Sweden.
NMSA – KwaZulu-Natal Museum, Pietermaritzburg, South Africa.
MNHN – Muséum national d'Histoire naturelle, Paris, France.
SANC – South African National Collection of Insects, Pretoria, South Africa.
USNM – National Museum of Natural History, Washington, DC., U.S.A.

Morphological terminology largely followed Cumming & Wood (2017) except that we used the suffixes pro-, meso- and meta- to refer to the first, second and third pair of legs or leg parts, respectively. Morphological observations were made with a Leica MZ8 stereomicroscope. Since the original description was very brief and used non-standard terminology, the male was redescribed to allow comparison with the female character states and indicate variation. Body length and wing length ranges given are minimum and maximum values observed in the studied material. Body measurements were taken between the frons and the posterior end of tergite IV; wing measurements were taken between the tegula and the apex of the wing. Stacking images were made using the set-up as outlined in Brecko et al. (2014) and stacking was done with the Zerene Stacker software (https://zerenesystems.com/cms/home). Literature references are given for the original taxon description. For the studied male holotype, text on identification and location labels is given *ad verbatim*. Text is indicated in quotation marks (" ") and each line on the label is separated by a double forward slash (//). Text not given on labels (i.e., collection depository) is given in square brackets ([]).

Taxonomy

Genus *Spheginobaccha* DE MEIJERE, 1908

Spheginobaccha DE MEIJERE, 1908: 327.
Type-species: *Sphegina macropoda* BIGOT, 1883, by monotypy.

Spheginobaccha pamela THOMPSON & HAUSER, 2015

(Figs 1–3, 4 A–D, 5–7)

Differential diagnosis. Of the Afrotropical species, *S. pamela* is most similar to *S. guttula*: males in both species are broadly dichoptic, the postpronotum is yellow (also yellow in *S. stuckenbergi*) and the alula is entirely michrotrichose (also in *S. perialla*). However, *S. pamela* has a rectangular postpedicel (triangular in *S. guttula*); wing microtrichosity more extensive on basal cells with only cell cua partly bare (cells cua, bm and br all partly bare in *S. guttula*), wing veins M_1 and r-m are only slightly sinuous (strongly sinuous in *S. guttula*) and the appendix in wing cell r_{4+5} is proximal to vein M_2 (opposite to vein M_2 in *S. guttula*); abdomen is brown (yellow in *S. guttula*), and it has a concavity in the dorsal margin of the epandrium (evenly curved in *S. guttula*).

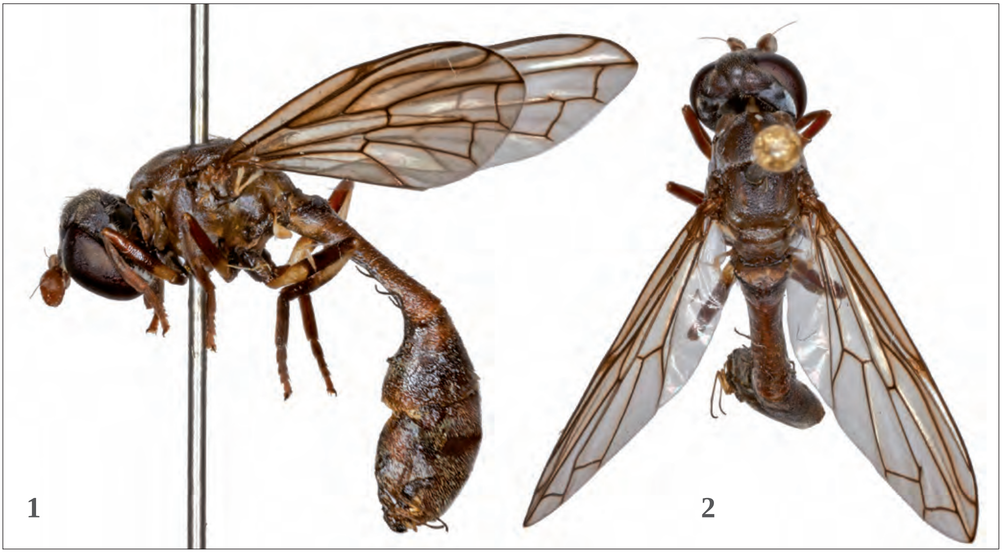
Redescription

MALE (Figs 1–4). **Length**: body (paratypes only), 15.3–15.5 mm; wing (all males), 10.0–10.7 mm.

Head. Frons dark brown, lunule more reddish brown, sparsely white pollinose, face reddish brown, sparsely white pollinose, with a bare patch on the gena; head yellow pilose; eyes broadly dichoptic; antenna light brown; scape and pedicel with black spines around the distal margin, except the inner margin; postpedicel with darker dorsal margin, about 1.5 times as long as broad; arista light brown.

Thorax. Postpronotum dull yellow, yellow pilose; propleuron black anteriorly and ventrally, reddish brown posteriorly, yellow pilose; scutum black except dull yellow marginally, sparsely grey pollinose with dark brown pollinose medial vitta, short yellow brown pilose; postalar callus dull yellow, yellow pilose; scutellum dull yellow, darker at lateral margins, yellow pilose; pleuron mainly dull yellow, white pollinose, reddish brown on posterior anepisternum and with a reddish brown macula below wing base; black maculae at junction of postpronotum and anepisternum, on anterior anepisternum, at anterodorsal corner of wing base and anterior to the posterior spiracle; spiracles dark brown. **Legs**. Coxa black, trochanter dark brown, procoxa and protrochanter pale pilose, meso- and metacoxa and trochanter brown pilose; pro- and mesofemur dark brown except yellow on basal 1/4, metafemur dark brown except yellow on basal 1/3, femur pale pilose on pale areas, brown pilose on dark areas; protibia dark brown basally, reddish brown in apical 1/2, mesotibia dark brown basally, apical 1/3 reddish brown; metatibia yellow on basal 1/2, brown apically; tibia brown pilose; tarsi brownish black except apical tarsomere reddish, dark brown pilose. **Wing**. Light brown along veins, paler to hyaline on membrane, giving the impression of a darker anterior section reaching to vein R_{4+5} where the veins are closer together (though a pale patch is still visible in cells r_1 and r_{2+3}). Cell sc conspicuously hyaline basally. Veins M_1 and r-m only slightly sinuous and the appendix in cell r_{4+5} is proximal to vein M_2. Wing evenly microtrichose except cell cup (anal), which is bare centrally and microtrichose along the margins only, most extensive apically; alula about twice as long as broad at distal end, narrower proximally; calypter white; halter dull yellow, darker basally.

Abdomen. (missing from holotype, based on photographs of paratypes) Elongate, petiolate, tergite (hereafter T) 2 three times longer than posterior width, narrowest point is 4/5 of the



Figs 1–3: Paratype male of *Spheginobaccha pamela,* USNMENT 01789952. – **1**: Lateral view; – **2**: Dorsal view; – **3**: Frontal view of head. Length of wing ~ 10 mm.

posterior width; T1 dark brown with a thin band of reddish brown distally, T2 reddish brown, T3 reddish brown in proximal 1/3, dark brown distally and T4 dark brown; 1st tergum golden brown pilose, with longer pile laterally; 2nd tergum mainly light brown pilose; 3rd tergum darker brown pilose, paler pilose basolaterally, greyish white pollinose basolaterally; 4th tergum golden brown pilose; genitalia white pilose, cerci small, slightly rounded apically, with long brown pile; epandrium with concave inner dorsal margin, inner margin unevenly curved.
Variation. One specimen with appendix on subcoastal near apex extending into cell sc on left wing.

Description

FEMALE (Figs 5–7) (based on specimens from Manguzi Forest Reserve, other variation noted).
Length: body, 13.9–15.7 mm; wing, 10.5–12.3 mm.
Most easily separated from the male by the usual sexual dimorphism (i.e., external genitalia) and the paler pile on T3. Generally darker than male, otherwise similar except as noted below.
Head. Face dark brown (whole head reddish brown in specimen from Kosi Bay), specimens from St Lucia with more extensive pale pollinosity on face; antenna reddish brown; scape and pedicel with darker apical margins, with black spines around the distal margin, except the inner margin.

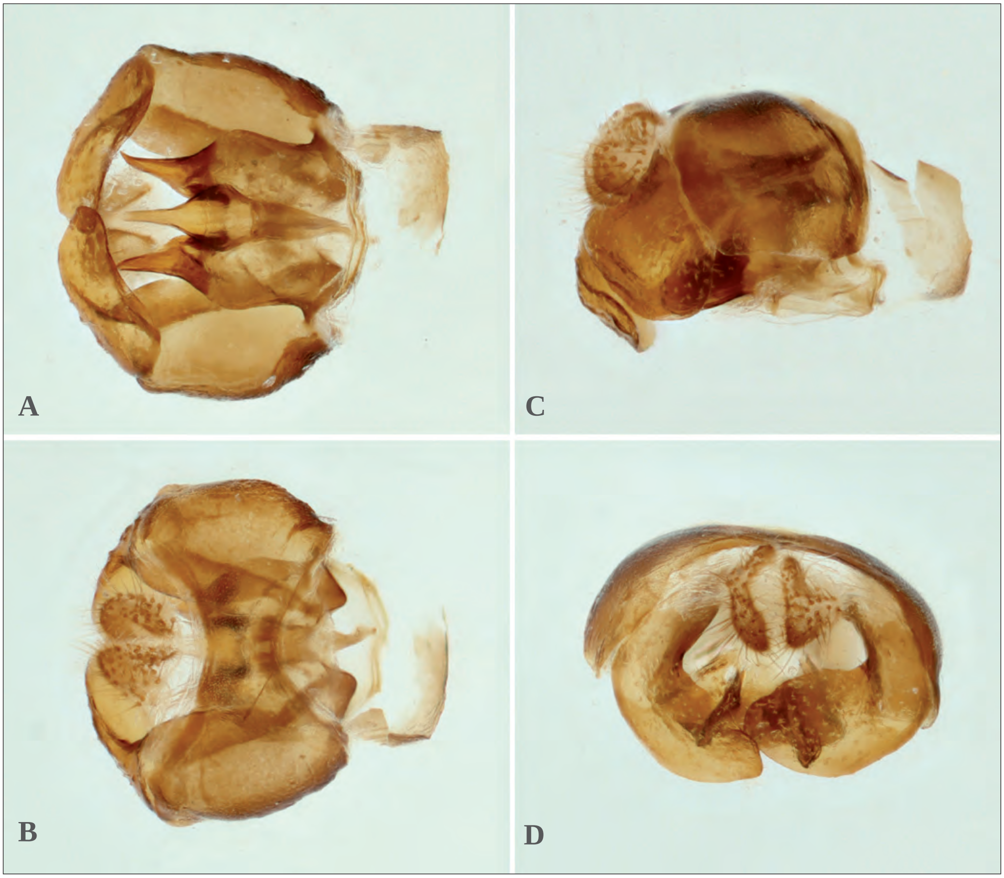


Fig. 4 A–D: *Spheginobaccha pamela*, genitalia of holotype male, BMSA (D) 30059. – **A**: Ventral view; – **B**: Dorsal view; – **C**: Lateral view; – **D**: Apical view.

Thorax. Scutum black except dull yellow to brown marginally; scutellum brown, darker at lateral margins; pleuron mainly reddish brown (paler in St Lucia specimens), white pilose, dark brown on posterior anepisternum and with a dark brown macula below wing base. **Legs**. Meso- and metacoxa dark brown pilose; pro- and mesotibia brown pilose; metatibia dark brown pilose; tarsi brown pilose. **Wing**. Vein R_{4+5} with appendix in cell r_{2+3} in some St Lucia specimens. Subcosta with appendix near apex in either cell c, cell sc, both cells or neither cell (left and right wings vary in five of seven females examined). Specimens from St Lucia range from almost completely infuscate to completely hyaline wings.

Abdomen. 3rd tergum with a greyish white pollinose band in basal third.

Material examined. *Holotype* ♂: "RSA: KwaZulu-Natal // Manguzi Forest Reserve // 26°59'32'' S 32°43'25'' E // 13–17.xii.2010, 61 m // A. H. KIRK-SPRIGGS" "Malaise Traps // indigenous // sand forest" "Entomology Dept. // National Museum //P.O. Box 266 // Bloemfontein 9300 // South Africa" "Holotype // *Spheginobaccha* // *pamela* // THOMPSON 2011" "BMSA(D) // 30059". *Paratypes*. **SOUTH AFRICA**: **KwaZulu-Natal**: 1 ♂, Manguzi Forest Reserve, –26.992222, 32.723611, 13–17.xii.2010, A. H. KIRK-SPRIGGS, BMSA(D) 30058, USNMENT 01789952 (USNM); **KwaZulu-Natal**: 1 ♂, St Lucia Estuary, 10.ii.1974, W. W. MIDDLEKAUFF (CAS).

Other material. **SOUTH AFRICA**: **KwaZulu-Natal**: 2 ♀♀, Manguzi: Manguzi Forest Reserve, sand forest, –26.99071, 32.71831, 14.iii.2022, Terence BELLINGAN, Kurt JORDAENS, John MIDGLEY (KMMA);

Figs 5–7: Female of *Spheginobaccha pamela*, NMSA-Dip 211826. – **5**: Lateral view; – **6**: Dorsal view; – **7**: Frontal view of head. Length of wing ~ 11 mm.

KwaZulu-Natal: 1 ♀, St Lucia: iGwalagwala trail, coastal forest, –28.385062, 32.410205, 17–21.i.2022, Terence BELLINGAN, John MIDGLEY, NMSA-Dip 211826 (NMSA); **KwaZulu-Natal**: 2 ♀♀, St Lucia: iGwalagwala trail, coastal forest, –28.385062, 32.410205, 7–10.iii.2022, Terence BELLINGAN, Kurt JORDAENS, John MIDGLEY, NMSA-Dip 212616, NMSA-Dip 212617 (NMSA); **KwaZulu-Natal**: 1 ♀, Kosi Bay: Lake View Lodge, swamp forest, –26.95813, 32.81673, 11–13.iii.2022, Terence BELLINGAN, Kurt JORDAENS, John MIDGLEY (KMMA); **KwaZulu-Natal**: 1 ♀, Kosi Bay Nature Reserve, –26.966, 32.8, 8–11.ii.2022, E. GROBBELAAR, collected at light (SANC).

Spheginobaccha dexioides HULL, 1944

Spheginobaccha dexioides HULL, 1944: 131.
Spheginobaccha dexioides HULL, 1944 of: THOMPSON 1974: 279; SMITH & VOCKEROTH 1980: 496; DIRICKX 1998: 129; WHITTINGTON 2003: 602; REEMER & STÅHLS 2013: 148.

Material examined. **SOUTH AFRICA**: **KwaZulu-Natal**: 1 ♂ 1 ♀, Gillitts, Pinetown District, 26.xi.1970, B. R. STUCKENBERG, P. J. STUCKENBERG, NMSA-Dip 059235, NMSA-Dip 059236 (NMSA); **Eastern Cape**: 1 ♂ Port St. Johns 20–25.xi.1961, B. R. STUCKENBERG, P. J. STUCKENBERG, NMSA-Dip 059237 (NMSA).

Spheginobaccha rotundiceps (LOEW, 1858)

Ocyptamus rotundiceps LOEW, 1858: 376.
Ocyptamus rotundiceps LOEW, 1858 OF: LOEW 1860: 365; KERTÉSZ 1910: 167.
Spheginobaccha rotundiceps (LOEW, 1858) of: THOMPSON 1974: 277; SMITH & VOCKEROTH 1980: 496; DIRICKX 1998: 130; WHITTINGTON 2003: 602; REEMER & STÅHLS 2013: 148; THOMPSON & HAUSER 2015: 774.

Material examined. **SOUTH AFRICA**: **KwaZulu-Natal**: 1 ♂, Injisuthi Nature Reserve, –29.124722, 29.44, 21–23.iii.2013, J. G. H. LONDT, A. LONDT, NMSA-Dip 075210 (NMSA); **KwaZulu-Natal**: 1 ♀, Little Switzerland, –28.411389, 29.047222, 1–4.ii.2011, J. G. H. LONDT, A LONDT, NMSA-Dip 075211 (NMSA); **Eastern Cape**: 1 ♂, Katberg Pass: Top, –32.44785, 26.64682, 17.ii.2021, T. A. BELLINGAN, J. BALMER, NMSA-Dip 206951 (NMSA).

Discussion

We redescribe the male of *Spheginobaccha pamela* and provide the first description of the female including details of the variation in the species. Given the low numbers of known specimens of Afrotropical *Spheginobaccha*, such information is not readily available for many species to make comparisons (see THOMPSON & HAUSER 2015). Of the eight Afrotropical species, both sexes are now known for only four (*S. dexioides*, *S. periala*, *S. pamela* and *S. rotundiceps*). We have examined males and females of three of these species (*S. dexioides*, *S. pamela* and *S. rotundiceps*), and the pattern of microtrichosity on the wings appears to be a good indicator of conspecificity. Based on this, *S. guttula* and *S. ruginosa* are likely to represent different species, even though they share the same type locality. A thorough revision of the genus is still needed to document the degree of variation in other species and more accurately delineate the species. While the majority of observed features showed little if any variation, the presence of auxiliary veins on the wing proved highly variable, in particular those on the subcosta. Until the degree of morphological variation in other species is documented, the taxonomic relevance of this variation is not clear.

Given the general paucity of recent *Spheginobaccha* specimens, *S. pamela* proved to be surprisingly common, with one female being collected in January 2022 and five in March 2022. The type series was collected in December and February and the specimen from SANC in February, suggesting that the species is active throughout the wet season (November to

March). Thompson (1974) also examined Afrotropical specimens collected between November and January, making the specimens from March the latest wet season specimens in the literature. Females were collected either sitting on leaves less than 2 meters above the ground, flying along forest paths or in dense forest.

Some inconsistencies were noted between the original description of *S. pamela* (Thompson & Hauser 2015) and the type series studied by us: Figs 4–6 in Thompson & Hauser (2015) appear to match the holotype and not the paratype, and the locality of these specimens is in South Africa, not Madagascar as indicated in the legend of the Figs 4–6 in Thompson & Hauser (2015). Additional colour photographs of the holotype are included in Jordaens & de Meyer (2022). Natural degradation of specimens may include the integument becoming lighter. Specimens collected in 2022 were all dark, but the holotype (collected in 2010) is lighter and the specimen from SANC (collected in 1990) even lighter. This colour change was not due to storage in ethanol, as both specimens were pinned in the field (Grobbelaar pers. comm. 2022; Kirk-Spriggs pers. comm. 2022). The paratypes do not appear to have become paler over time. As the original description only included black and white images, we cannot confirm that the holotype was darker when described.

Providing the first description of the female of *S. pamela* and colour photographs of the species will improve our ability to identify this species when collected in future. *Spheginobaccha pamela* females key correctly in the key provided by Thompson & Hauser (2015), so no updated key is provided.

Acknowledgements

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Selected species described by F. Christian Thompson. VII. Ximo Mengual

In 1983 Heikki Hippa and Chris Thompson described a new flower fly genus from the Andean Cordillera, *Meropidia* Hippa & Thompson, 1983, together with three new species. In the original publication it was stated that the holotype female of *Meropidia rufa* Thompson, 1983 was deposited in the American Museum of Natural History (New York, U.S.A.), but in 2011 Ximo Mengual photographed the holotype female at the National Museum of Natural History (Washington D. C., U.S.A.).

Figs 21, 22: *Meropidia rufa* Thompson, 1983, holotype female. – **21**: Habitus, lateral view; – **22**: Habitus, dorsal view. Photos: X. Mengual.

The ICZN code-compliant authorship for nominal species and genera-group names of Diptera (Insecta) with special reference to MEIGEN (1822)

Die ICZN-konforme Urheberschaft für festgelegte Arten- und Gattungsnamen innerhalb der Diptera (Insecta) unter besonderer Bezugnahme auf MEIGEN (1822)

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Abstract

In the present work, I discuss the authorship of nominal species and genus-group names in MEIGEN (1822) and argue that the names are nowadays not always stated as possibly intended by MEIGEN, due to the strict rules of the ICZN (1999). I suggest that the rules of the ICZN have been applied too strictly for pre-1900 publications and even for some more recent ones. Authors have used different ways to acknowledge the contribution of colleagues, sometimes giving the name of the colleague only after the specific epithet, sometimes stating they described the species, and in other cases stating they both provided the name and the description. Only in the latter two cases does the ICZN attribute authorship of the colleague(s) in question for that species name. Here I show that this interpretation is not widely known and suggest that the ICZN should recognize the authorship if the contributor's name is given after the specific epithet without further explanation. Furthermore, I discuss how to recognize the author of nominal species and genus-group names and suggest adding unique author identifiers to each newly described species name.

Key words: species, genus, HOFFMANSEGG, MEGERLE, WIEDEMANN, THOMPSON

Zusammenfassung

In der vorliegenden Arbeit wird die Urheberschaft von Art- und Gattungsnamen bei MEIGEN (1822) diskutiert. Die Argumentation beinhaltet, dass den Erkenntnissen des Verfassers vorliegender Arbeit zufolge manche Namen, bedingt durch die strikten Regeln des ICZN (1999), aus heutiger Sicht nicht immer das beinhalten, wie es möglicherweise von MEIGEN beabsichtigt war. Dies ist vermutlich für eine ganze Reihe von Namen, auch solchen von anderen Autoren nach 1900 vergebenen, der Fall. Autoren haben unterschiedliche Wege gewählt, um den Beitrag von Kollegen zu würdigen. Bei diesen Dedikationen (Widmungen) haben sie manchmal den Namen des Kollegen nur nach dem spezifischen Epitheton angegeben, manchmal angegeben, dass sie die Art beschrieben haben, und in anderen Fällen, dass sie sowohl den Namen als auch die Beschreibung bereitgestellt haben. Nur in den beiden letztgenannten Fällen weist das ICZN die Urheberschaft des/der betreffenden Kollegen(s) für diesen Artnamen zu. Es wird hier gezeigt, dass diese Interpretation nicht allgemein bekannt ist. Deshalb wird vorgeschlagen, dass das ICZN die Urheberschaft anerkennen sollte, wenn der Name des Beitragenden ohne weitere Erklärung nach dem Artepitheton angegeben wird. Darüber hinaus wird diskutiert, wie man den Autor nomineller Art- und Gattungsnamen erkennt und vorgeschlagen, jedem neu beschriebenen Artnamen eindeutige Autoridentifikatoren hinzuzufügen.

Stichwörter: Art, Gattung, HOFFMANSEGG, MEGERLE, WIEDEMANN, THOMPSON

Introduction

The names of species and genera and their authorship are an essential element of biology, and the correct application of agreed rules and procedures is necessary for clear communication. To help meet this aim, the International Commission on Zoological Nomenclature (ICZN) was created and a set of rules governing zoological nomenclature established, the International Code of Zoological Nomenclature (ICZN 1999; also known as The Code) (https://www.iczn.org/the-code/the-code-online/). Due to emendations of the rules set by the ICZN there has always been a need for papers dealing with the correction of nomenclatural discrepancies, especially during recent decades (e.g., O'Hara et al. 2011; Evenhuis et al. 2008; Evenhuis & Pont 2004, 2013).

In the early days of taxonomy most works were written by one person and authorship of the species was rather straightforward (Linnaeus 1758; Harris 1776–1780; Fallén 1816). For works with two or more authors each new species is attributed to all authors (e.g., Schönrogge et al. 2002; Hippa et al. 2015; van Steenis et al. 2019; Mengual et al. 2020; Ricarte et al. 2020), except where clearly stated otherwise (e.g., Czerny & Strobl 1909; Hippa & Thompson 1994; Ricarte et al. 2012). The development of scientific techniques and collaborations has led to an increasing number of multi-author papers describing new species (Santos et al. 2017). Papers with five or more authors are not uncommon and in many cases different authors contribute to the descriptive part, leading to authorship for the species being one or more subsets of that paper in an increasing number of instances (Nedeljković et al. 2015; van Steenis et al. 2016; Radenković et al. 2018; Grković et al. 2019). In order to be able to trace the original publications of such species it is essential to attribute the authors and its reference correctly. Several papers contain species where authors of species names are one or more subsets of that of the paper, and authorship for species may even include people that are not authors of the paper itself (e.g., Thompson & Torp 1986; Mengual 2012; Young et al. 2020), stressing the importance of correct attribution of authorship.

While reading publications on Syrphidae I noted that some species described in Meigen (1822) were attributed to Meigen, 1822 while others to Megerle *in* Meigen, 1822 or Wiedemann *in* Meigen, 1822, even in recent papers (Thompson 1981; Maibach et al. 1994; Evenhuis & Pont 2013). This prompted the author to study the original work by Meigen (1822) and other works from the same period in order to confirm the Code-compliant authorship affiliation of certain species of Syrphidae. Here only some examples from Meigen (1822) are presented, but in case of a change in The Code, this work as well as many others needs to be re-read to establish the new Code-compliant authorship.

Additional examples from recent literature are used to indicate that the rules of the ICZN are not well known and it is argued that the rules need to be adjusted to reflect the aim of many of these authors. Suggestions are made to simplify the rules and to avoid confusion in the future.

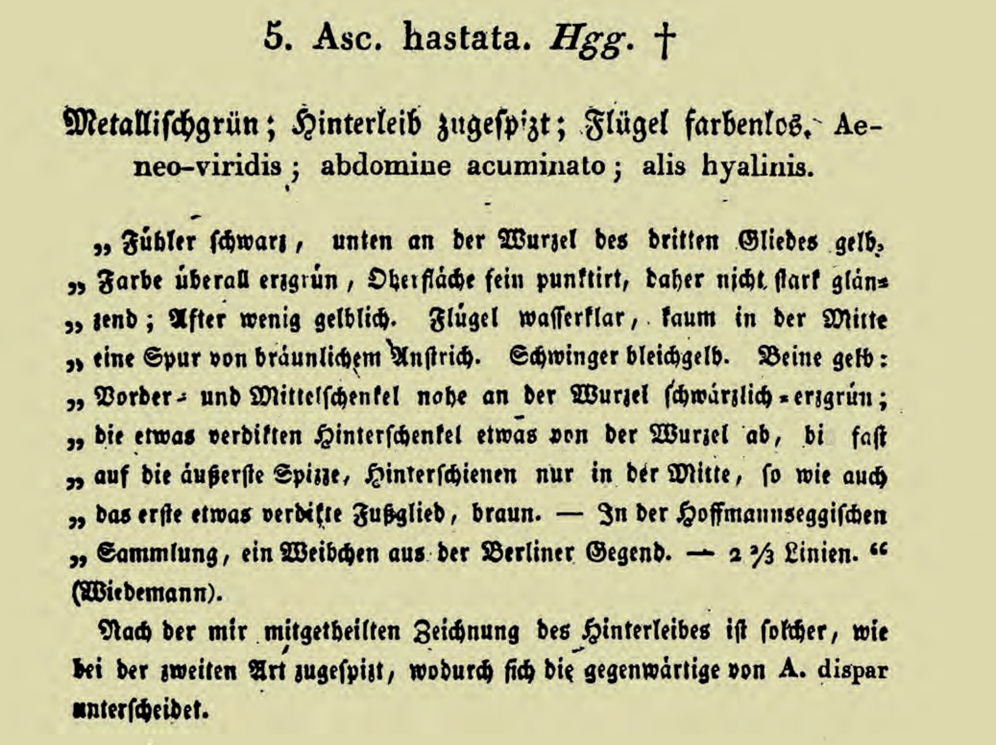
Material and methods

A study of Meigen's and Wiedemann's publications was undertaken along with other 19th century literature citing Meigen (1822). More recent literature concerning the works of Meigen and Wiedemann and particular species was consulted to give additional information on the accreditation of authorship for species. Mostly large works like catalogues and revisions are cited here rather than an extensive list of available literature. In addition, more recent literature has been studied where the same issue concerning the authorship of species names is apparent. The spelling of the name of Count Hoffmansegg with one "n", as outlined by Pont (1996), is adopted here. A selection of recent works on Syrphidae has been incorporated to exemplify the current authorship problem about the strict rules of the ICZN "Article 50. Authors of names and nomenclatural acts". A short summary of these rules is given here: the author of a name is the person who first publishes it. In a multi-author paper it should be made clear if only one or any other combination of co-authors is responsible for the nomenclatural act. If a person, other than one of the authors of the work, is responsible for both the name and meeting the criteria of availability other than actual publication, this other person is the author of the name, while it is necessary to explicitly state the identity of that other person in the work itself.

Results

The work of MEIGEN, 1822

For species names and descriptions, MEIGEN (1822) used abbreviations for the authors. Species which were already named are accompanied by one or more references given after the German and Latin diagnosis. The newly described species do not have any such reference and should be attributed to MEIGEN if no abbreviation is given after the name of the species. The following abbreviations are used: HGG. = HOFFMANSEGG, MEG. = MEGERLE, and WIED. = WIEDEMANN. A dagger is sometimes used after the species name or its author, indicating that the species was not seen by MEIGEN and that its description was given by another author, which is indicated by quotation marks at the beginning of each line (Fig. 1). The author of the description is given in parentheses at the end of the species text. This author, in many cases WIEDEMANN, has not necessarily been given as the authority of the name by subsequent authors.



5. Asc. hastata. *Hgg.* †

Metalliſchgrün; Hinterleib zugeſpizt; Flügel farbenlos. Aeneo-viridis; abdomine acuminato; alis hyalinis.

„ Fühler ſchwarz, unten an der Wurzel des dritten Gliedes gelb,
„ Farbe überall erzgrün, Oberfläche fein punktirt, daher nicht ſtark glän-
„ zend; After wenig gelblich. Flügel waſſerklar, kaum in der Mitte
„ eine Spur von bräunlichem Anſtrich. Schwinger bleichgelb. Beine gelb:
„ Vorder- und Mittelſchenkel nahe an der Wurzel ſchwärzlich-erzgrün;
„ die etwas verdikten Hinterſchenkel etwas von der Wurzel ab, bis faſt
„ auf die äußerſte Spizze, Hinterſchienen nur in der Mitte, ſo wie auch
„ das erſte etwas verdikte Fußglied, braun. — In der Hoffmannseggiſchen
„ Sammlung, ein Weibchen aus der Berliner Gegend. — 2 ⅔ Linien. "
(Wiedemann).

Nach der mir mitgetheilten Zeichnung des Hinterleibes iſt ſolcher, wie bei der zweiten Art zugeſpizt, wodurch ſich die gegenwärtige von A. dispar unterſcheidet.

Fig. 1: Page copy of MEIGEN (1822: 189). *Ascia hastata*, dagger and quotation marks.

It is not always clear which of the generic names are new in Meigen (1822). However, when the abbreviations Hgg. or Meg. are used, it is clear that the genus name is newly proposed and that Meigen honoured Hoffmansegg or Megerle, respectively.

Several of the 19th Century works use the genus and authorship attribution as indicated by Meigen (1822) after the respective names throughout (e.g., Macquart 1834; Gimmerthal 1847; Walker 1849; Rondani 1857). Some works mention the authorship for several nominal species as Wiedemann *in* Meigen (e.g., Peck 1988; Speight 2020), because Wiedemann gave the description of these species. The abbreviated name accompanying the species name is, in many cases, not Wiedemann but either Hoffmansegg or Megerle. In other works only some nominal species are assigned to Hoffmansegg, Megerle or Wiedemann, e.g., *Epistrophe nitidicollis* (Megerle *in* Meigen, 1822), *Lejogaster tarsata* Megerle *in* Meigen, 1822, *Merodon aeneus* Megerle *in* Meigen, 1822, *Orthonevra elegans* (Wiedemann *in* Meigen, 1822), *Pelecocera tricincta* Hoffmansegg *in* Meigen, 1822 (Reemer et al. 2009; Ricarte & Marcos-García 2017; Mengual et al. 2020), but hardly any of the genera have been assigned to Hoffmansegg (e.g., Schiner 1862; Strobl 1902; Thompson et al. 1976; Vockeroth & Thompson 1987; Peck 1988; Torp 1994; Vujić et al, 2020b), except for *Criorhina* Hoffmansegg (Meigen, 1822: 236) and *Pelecocera* Hoffmansegg (Meigen, 1822: 340) by Rondani (1857). In other publications the author attribution is not used consistently; at first it is attributed to one author and another time to another author, e.g., in Thompson (1981) *Ascia hastata* was attributed to Meigen on page 471 and on page 474 to Wiedemann *in* Meigen, 1822.

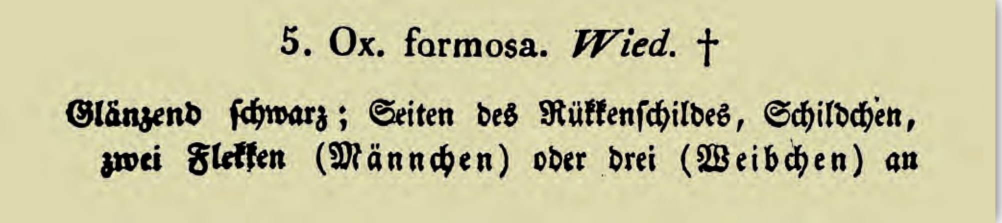
It is possible that the main reason why hardly any subsequent author has used these alternative authors for the species described in Meigen (1822) is the motive outlined by Pont (1996): "Meigen sometimes used manuscript names that he found on specimens sent to him for study by his friends, e.g., *Musca caesarion* "Hoffmansegg". It should be noted that these are citations of manuscript names and not of manuscript descriptions, and the author of the names is Meigen himself in all these cases". A manuscript name often refers to a name which would not be available following The Code, and thus, these manuscript names should be suppressed or otherwise stated to be described by Meigen in 1822. Meigen himself wrote the following about this: "Arten, die ich selbst nicht gesehen habe, ist ein † beigesetzt; Beschreibungen, die nicht von mir selbst herrühren, ist der Name des Verfassers beigefügt" ["The species, which I did not see myself, are marked with a dagger. For the descriptions, which I did not make myself, the name of the author is given"] (Meigen 1818: VIII). Further, Meigen (1818: 13) wrote: "III. Schnakenmükke AEDES *Hoffmgg.*" ["III. Crane fly AEDES *Hoffmgg.*"], "1. *Aed. cinereus* Hoffmgg. †" and "Diess ist alles, was mir hr. Justizrath Wiedemann von dieser Art bemerkt hat, die ich weiter nicht kenne. – Den Gattungsnamen hat der hr. Graf v. Hoffmansegg, in dessen Sammlung sie sich befindet, aus dem Griechischen Aedes beschwerlich gebildet." ["This is all what the judicial councilor Mr. Wiedemann commented to me of this species, which I do not know further. – The genus name was composed by Mr. Count v. Hoffmansegg, in whose collection this species is, with difficulty from the Greek Aedes]. This means that the description of the species "*cinereus*" was given by Wiedemann, but the name of the genus was provided by Hoffmansegg. From the first section it is not absolutely clear what Meigen's intentions were with giving "Hoffmgg." after the genus or species name. It is clear that the person who made the description, not the name *per se*, is mentioned. The second section clearly states that the name *Aedes* was not only a manuscript name but it was a name given by Hoffmansegg to a certain set of species and was even followed by some kind of etymology. This can only mean that Meigen honoured Hoffmansegg for his work and it can be deduced that Meigen attributed Hoffmansegg as author of this genus.

In several cases in Meigen (1822) this rule applies, e.g., *Stratiomys decora* Wiedemann *in* Meigen (Meigen 1822: 144) with the description provided by Wiedemann. However, in the case of *Clitellaria pacifica* Hoffmansegg (Meigen 1822: 121), with the description by Wiedemann, it could be concluded that Meigen took the name from Hoffmansegg and the description from Wiedemann. So in this case none of the authors provided both the name and the description, which means that Article 50.1.1 does not apply here ["50.1.1.: However, if it is clear from the contents that some person other than an author of the work is alone responsible both for the name or act and for satisfying the criteria of availability other than actual publication, then that other person is the author of the name or act. If the identity of that other person is not explicit in the work itself, then the author is deemed to be the person who publishes the work."].

Nothing explicit is stated in the rules concerning this problem. In the case of *Stratiomys decora* it could be argued that Wiedemann provided the name and it is clearly stated that Wiedemann provided the description. Here the correct author of the name in the sense of the ICZN is Wiedemann *in* Meigen, 1822. For *Clitellaria pacifica* Hoffmansegg it is clear that Hoffmansegg provided the name and, but Article 50.1.1 requires that he also published it. In addition, it is clearly stated in Meigen (1822) that Wiedemann gave the description. In this particular case it can be argued there are several possible authors of the name in the sense of, any combination of the following three authors: Hoffmansegg who gave the name, Meigen who published it and Wiedemann who gave the description, although Evenhuis & Pont (2013) attribute this species to Wiedemann only. However, if it is assumed that the species names, or more precisely the specific epithets, of the above-mentioned species were not given by Wiedemann and Hoffmansegg respectively, the problem of ambiguity remains. *Stratiomys decora* could then be regarded as the name given by Meigen while its description is given by Wiedemann, and thus the authors of the name could then be Meigen & Wiedemann *in* Meigen, 1822.

For the species *Microdon micans* Wiedemann (Meigen, 1822: 165), Evenhuis & Pont (2013) interpreted that the absence of a dagger and a description without quotation marks indicate that it was named and described by Meigen, i. e., that Wiedemann is not the author of the name but instead it is Meigen. The species *Oxycera formosa* Wied. (Meigen, 1822: 127) illustrates this ambiguity as the dagger (Fig. 2) indicates that it was unknown to Meigen. The description on page 128, however, is not within quotation marks nor is the name of the describer given (Fig. 3), indicating that Meigen made the description, but based on what? This species is not listed by Evenhuis & Pont (2013) as a species described by Wiedemann, which can be true under the following three assumptions: firstly, Meigen made the description; secondly, the dagger was erroneously placed; and thirdly, the name is not from Wiedemann but from Meigen so "Wied." was erroneously placed too.

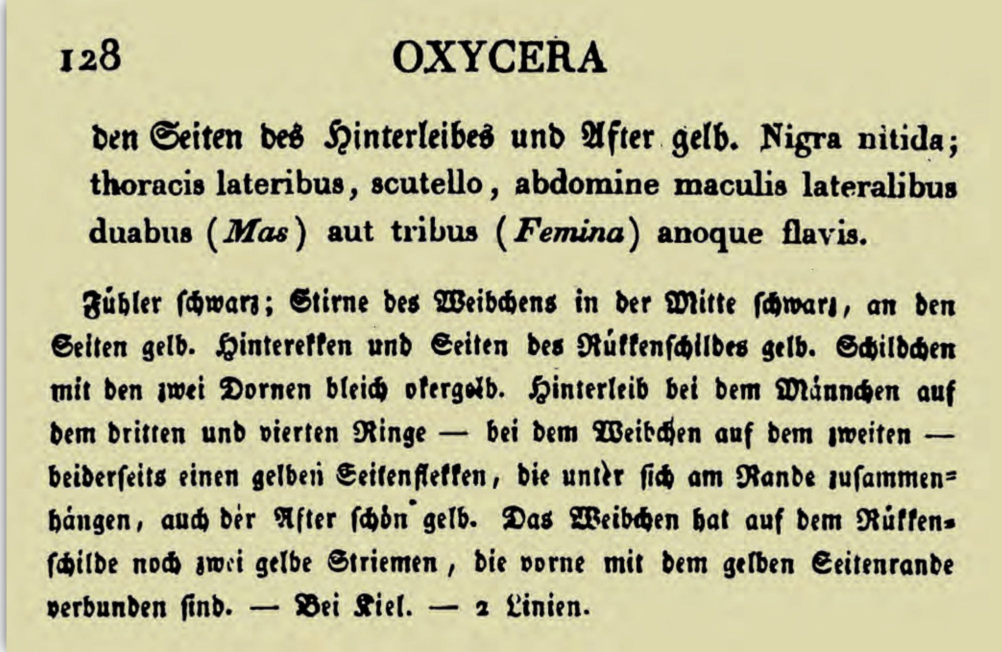
As previously explained, it is evident from Meigen (1818) that he honoured his friend Hoffmansegg by giving him the authorship of the genus *Aedes*, even if it is not clearly stated that Hoffmansegg described the genus and thus published the name. The same goes for the genus *Criorhina*, "B Wollige: (*Criorhina* Hgg.)" published in Meigen (1822: 236) as seen from Meigen (1838: 115) where it is stated "*Criorhina* Hoffmgg." indicating Meigen attributed the genus name *Criorhina* to Hoffmansegg and not to himself. A further clue of this opinion is the paper of Wiedemann (1830: 54) where it is stated "*Cyphomyia auriflamma* Hffg." followed by the diagnosis and "Wiedem. Zoolog. Magaz. III. 54. 21." at the end. This can only mean that Wiedemann (1819: 54) published the species "*Cyphomyia auriflamma* Hgg" and attributed this name to Hoffmansegg, even if Wiedemann described it. So, in other words, it seems Wiedemann gave priority to the person who gave the name (Hoffmansegg) above the person who made the description (Wiedemann). As Wiedemann and



5. Ox. formosa. *Wied.* †

Glänzend ſchwarz; Seiten des Rükkenſchildes, Schildchen, zwei Flekken (Männchen) oder drei (Weibchen) an

Fig. 2: Page copy of Meigen (1822: 127). *Oxycera formosa*, dagger.



128 OXYCERA

den Seiten des Hinterleibes und After gelb. Nigra nitida; thoracis lateribus, scutello, abdomine maculis lateralibus duabus (*Mas*) aut tribus (*Femina*) anoque flavis.

Fühler ſchwarz; Stirne des Weibchens in der Mitte ſchwarz, an den Seiten gelb. Hinterekken und Seiten des Rükkenſchildes gelb. Schildchen mit den zwei Dornen bleich okergelb. Hinterleib bei dem Männchen auf dem dritten und vierten Ringe — bei dem Weibchen auf dem zweiten — beiderſeits einen gelben Seitenflekken, die unter ſich am Rande zuſammenhängen, auch der After ſchön gelb. Das Weibchen hat auf dem Rükkenſchilde noch zwei gelbe Striemen, die vorne mit dem gelben Seitenrande verbunden ſind. — Bei Kiel. — 2 Linien.

Fig. 3: Page copy of Meigen (1822: 128). *Oxycera formosa*, missing quotation marks.

Meigen were good friends (Morge, 1974), Meigen might have shared the same ideas about authorship of species names.

ICZN rule

The fourth edition of The Code (ICZN 1999) came after the publication of Meigen (1822) and it could be argued that these rules do not reflect the true intentions of these previous authors. However, one would expect that recent authors are aware of these rules, or at least the editors of the journals in which new species are published. Unfortunately this does not seem to be the case as even some members of the ICZN have published species names that should not be attributed to them based on the current rules, as shown in some examples below.

The Code states that any author, not being one of the authors of the paper, should be clearly mentioned as the author of both the description and the name (species epithet or genus-group names). In the case of a multi-authored paper in which not all authors contribute to the description of a species, it is sufficient to state the name of the author(s) after the species name, without giving explicit information on which authors contributed to the description. It is not clear on what assumption this last provision is based, but most likely on the assumption that each species description is a separate paragraph within the paper and that the authors of each paragraph are indicated by the names given after the epithet. In this last provision, however, it could be argued that it is not clear who contributed to the description of the species as it is not clear that each species description is indeed a separate paragraph. In fact, the species descriptions form part of the results and as such it can be difficult to argue each description is a separate paragraph.

Some examples of authorship of species names that differ from the authorship of the work itself

Diptera: Mythicomyiidae: *Reissa roni* EVENHUIS & BÁEZ *in* GREATHEAD & EVENHUIS, 2001, where in the material and methods it is stated that "Authorship of new taxa described in this paper is …, except for … *R. roni*, which are attributed to EVENHUIS and MARCOS BÁEZ of Universidade La Laguna, Tenerife, Canary Islands" where it is clear that EVENHUIS & BÁEZ are the authors of the name.

Diptera: Dolichopodidae: *Thinophilus meieri* GROOTAERT & EVENHUIS *in* GROOTAERT, 2018, where in the material and methods a subparagraph is given: "**Citation**. All the species herein described as new are the responsibility of the author of this paper, with the exception of *Thinophilus meieri*, the authorship of which should be GROOTAERT & EVENHUIS *in* GROOTAERT." The Code assumes that GROOTAERT & EVENHUIS are the authors of the name although it is not defined who "EVENHUIS" is.

Diptera: Keroplatidae: *Platyroptilon wui* CAO, XU & EVENHUIS *in* XU et al. 2007, where nothing was stated on the contribution of EVENHUIS. In this case the authors are CAO & XU.

Diptera: Syrphidae: *Sphegina atrolutea* LUCAS *in* THOMPSON & TORP, 1986, where after the description of the species the following is stated: "LUCAS discovered a new species …. and has graciously provided us with the description and name of his new species". In the material section and the acknowledgments more information can be found on who "LUCAS" is, i.e., Mr. J. A. W. LUCAS, Rotterdam. The Code will most likely give LUCAS as the author of the name.

Diptera: Syrphidae: *Xela* THOMPSON & VOCKEROTH *in* THOMPSON, 1999 (= *Cepa* THOMPSON & VOCKEROTH *in* THOMPSON, 2007; new replacement name for *Xela*), where after the description of the genus is stated: the name should be attributed "to both of us as VOCKEROTH equally contributed to the diagnosis and naming of this taxon". The Code assumes that THOMPSON & VOCKEROTH are the authors of the name although it is not defined who "VOCKEROTH" is.

Diptera: Syrphidae: *Austalis* THOMPSON & VOCKEROTH *in* THOMPSON, 2003, where J. R. VOCKEROTH is mentioned in the introduction and: "Also, as we both recognized that the bright metallic Oriental-Australian species were unique, the name and concept of *Austalis* must be recognized as belonging to both of us". Here, as there is a reference given where both THOMPSON and VOCKEROTH are co-authors, the person "VOCKEROTH" is traceable and the name is attributed to THOMPSON & VOCKEROTH.

Diptera: Syrphidae: *Afrostoma* SKEVINGTON, THOMPSON & VOCKEROTH *in* THOMPSON & SKEVINGTON, 2014, where in the acknowledgments "VOCKEROTH first recognized that a central African species represented a new group". There is no information on the fact that VOCKEROTH contributed to the name or its description and according to the Code the authors of the name are SKEVINGTON & THOMPSON.

Diptera: Syrphidae: *Substalis* (as subgenus of *Kerteszomyia*) Thompson & Vockeroth *in* Thompson, 2017, where Vockeroth is mentioned in the introduction, but not in direct connection with the name or its description: "Fifty years ago (1971). Dick Vockeroth reassessed the classification .. *Substalis* was his genus 5. We then agreed to do a comprehensive revision .. sorry that work has never been completed". According to the Code the author of the name is Thompson.

Diptera: Syrphidae: *Argentinomyia talamanca* Thompson *in* Montoya & Wolff, 2020, where nothing is mentioned about Thompson except in the acknowledgments where he is thanked for his continuous support. Here Thompson cannot be the author of the name and it should be attributed to Montoya & Wolff.

Diptera: Syrphidae: *Asiobaccha aea* Mengual & Thompson *in* Mengual, 2016, where the Acknowledgements contain: "I sincerely thank F. Christian Thompson for comments, support, guidance and best-practice advice during so many years, as well as for sharing his knowledge on syrphid flies and for co authorship in some of the new species reported here", as well as a statement that Thompson is from the USNM. In this case the Code is not clear enough to decide if Thompson can be the co-author of the species as it is not explicitly stated for which species he is co-author.

Diptera: Syrphidae: *Citrogramma australe* Thompson *in* Mengual, 2012, where nothing is stated about the contribution of Thompson neither to the name nor to the description, and in the material examined section for this species it is stated "det X. Mengual". In this case the author of the species would be Mengual as he is the author of the paper.
And *Citrogramma currani* Ghorpadé *in* Mengual, 2012, where "description" is written in the heading directly after the name of the species: "The description of *C. currani* as well as the diagnosis and the etymology are written by K. Ghorpadé …. to fit in this work. The studied material and remarks are written by me". This should be interpreted as Ghorpadé made the name available and he alone is the author of the name.
And *Citrogramma distinctum* Thompson *in* Mengual, 2012, where only the following remark is made: "Thompson studied *Citrogramma* material … many years ago. He found two different new species, *C. schlingeri* and *C. distinctum*, but never published them. When this revisionary work was started, he kindly offered this material to be included and new studied material was included". In this case the Code will state Mengual as author of the name
And *Citrogramma frederici* Mengual & Ghorpadé *in* Mengual, 2012, where a remark is made: "Later, Ghorpadé sent the female specimen, which was identified by him as a new species too. Thus both of us appear as co-authors". In this the name will most likely be assigned to Mengual & Ghorpadé.

In this paper (Mengual 2012) the family name of Ghorpadé is given but not his address.

Diptera: Syrphidae: *Merodon hoplitis* Hurkmans *in* Vujić et al., 2012, where in the remarks it is noted: "Hurkmans recognized this new species and named it *hoplitis* in the unpublished manuscript that he handed to the authors Vujić and Radenković to complete. The original description of Hurkmans is modified here to be comparable with descriptions of other species from this group". Here it is not clear if this name should be interpreted as a manuscript name, or if it is accepted that Hurkmans provided both the name and the description.

Diptera: Syrphidae: *Merodon chrysurus* Hurkmans & Vujić *in* Vujić et al., 2020a, where a clue is given in the type material on the authorship of the species: "Type material …. 'HOLOTYPE of *Merodon*/*chrysurus* Hurkmans/et Vujić'." This is another example of confusion as it is clearly the intention of the author of the paper to attribute the name to Hurkmans and Vujić, however when following the Code only Vujić is the correct author.

Diptera: Syrphidae: *Psilota bicolor* Young & Ferguson *in* Young et al., 2020, where it is explicitly stated that *P. bicolor* was a manuscript name by Ferguson so he only gave the name, but not its description in which case only Young is the author of the name. In the same paper several species are attributed to Thompson & Young (e.g., *Psilota apiformis* and *P. azurea*) without indication of authorship in the description but a note in the acknowledgments: "F.C. Thompson wrote early version of a manuscript key, provided unpublished works, initially recognized the five species authored Thompson and Young, provided a conspectus of the fauna in 1995". In this case it is difficult to apply the Code and most likely the authorship of the names will be attributed to Young only.

Discussion

In this paper certain elements of the complexity of the ICZN rules have been addressed and, as with all rules, they will be interpreted differently by different readers. Moreover, it seems clear that not all, or maybe in fact most, researchers are not well aware of the rules concerning the appointment of authorship. Even ICZN committee members have published names where their authorship does not follow the rules (Thompson & Skevington 2013; Thompson 2017). In some other publications, names have been attributed to Thompson or Evenhuis, both of whom should know the rules, for which this attribution does not comply with the ICZN rules (Xu et al. 2007; Montoya & Wolff 2020). In other papers the name of a person who contributed to the species name and its description is provided, although nothing is recorded about their initials or sex, let alone their address. Here the word "identity" comes into focus. In order to be able to identify authors of names who are not authors of the paper it would be good to add their family name, initials and even an address. In the current electronic time with rules to register new species through ZooBank (http://zoobank.org/) a ZooBank author registry code could be sufficient. For example, in the case of Jeffrey H. Skevington publishing a new species and attributing it to van Steenis, it would not be sufficient to state "Mr. van Steenis is responsible for both the name and description of the new species." Both Jeroen and Wouter van Steenis are active syrphidologists and publishing together with Jeffrey H. Skevington, both live in the Netherlands as well, so more is needed to identify either of us. Another issue is the location within the publication to place the statement concerning which person is responsible for both the name and the description. Currently it is done in many different ways and the reader needs to go through the entire manuscript to detect if the authorship attribution has been done correctly, and that the author can be correctly identified by giving initials, family name and their address. In other words, the rules are not as clear as they should be to make authorship attribution a straightforward process.

A further question relates to the application of these rules for works written well before the rules became established. The example of Meigen (1822) examined in detail above illustrates this problem admirably (see the recommendations at the end of this section).

Hopefully this paper has shown that Article 50.1.1 needs to be re-evaluated since its interpretation does not appear to be widely known and that, in many cases, the intention of the authors was to attribute the authorship of a new name to a person, who is not author of the publication. This was mostly done by giving the name of the intended authors after the new name of the genus or species. This assumption concerning the species described in Meigen (1822) is clearly demonstrated by Wiedemann, Macquart, etc., using the names given after the genus or species name as the author of the species. For most of the recent literature, the concerned authors can still be asked what their intentions were, and for some (Mengual and Young pers. comm.) it is certain that both the name and the description of some of the species published in their papers (Mengual 2012; Young et al. 2020) were given by the person not listed as author of the paper.

The entomological community is hereby encouraged to contribute to the debate about the complexities of Article 50.1.1 and what, if any, modifications are desirable to clarify these rules. Also, to what extent should any modification apply to our legacy literature written before these rules came into effect, or later publications not complying with Article 50.1.1.

In the light of the passing away of F. Christian Thompson I believe it would be honorable to amend the current ICZN rules and attribute the names as given in the examples below to him too. As such, I ask that authorship of nominal species and genus-group names is given to either the author(s) of the publication; to the mentioned person(s) as given after the name of the species; or to the person(s) who provided the description, even in the case where person(s) is/are not listed among the author(s) of the publication. This should be followed until clearer rules are implemented by the ICZN and communicated to zoologists and especially to the editors of zoological journals. This implies that all the examples given above in the present study will keep the authorship for the people listed after the species or genus-group names or for the author(s) of the description itself. The following examples of the species in the work of Meigen (1822) will then become as follows: *Epistrophe nitidicollis* (Megerle *in* Meigen, 1822), *Lejogaster tarsata* Megerle *in* Meigen, 1822, *Merodon aeneus* Megerle *in* Meigen, 1822, *Orthonevra elegans* (Wiedemann in Meigen, 1822), *Pelecocera tricincta* Hoffmansegg *in* Meigen, 1822, *Criorhina* Hoffmansegg *in* Meigen, 1822 and *Pelecocera* Hoffmansegg *in* Meigen, 1822, *Neoascia hastata* (Hoffmansegg & Wiedemann *in* Meigen, 1822). The examples from recent literature will be for example, *Platyroptilon wui* Cao, Xu & Evenhuis *in* Xu et al. 2007; *Argentinomyia talamanca* Thompson *in* Montoya & Wolff, 2020; *Citrogramma australe* Thompson *in* Mengual, 2012.

These are the recommendations following the discussion above:

- The rules should be changed in a way that each new species description is seen as a separate paragraph in the entire work. The first mentioning of an author is meant as the author of this entire part. Additional authors named in connection to the new name or its description should also count as author of the paragraph.
- This should apply to past and present works.
- For present works more detailed information is needed for authors of separate paragraphs who are not co-author of the entire work.
- One suggestion is, in accordance with the ZooBank (http://zoobank.org/) guidelines, to prescribe that the LSID number of each publication co-author as listed in ZooBank needs to be given after the title.
- Additionally, the name, initial(s), address and possible affiliation of each author of a species name, who is not a co-author of the entire work, should be given either in the material and method section or in the acknowledgments together with her/his ZooBank LSID number.

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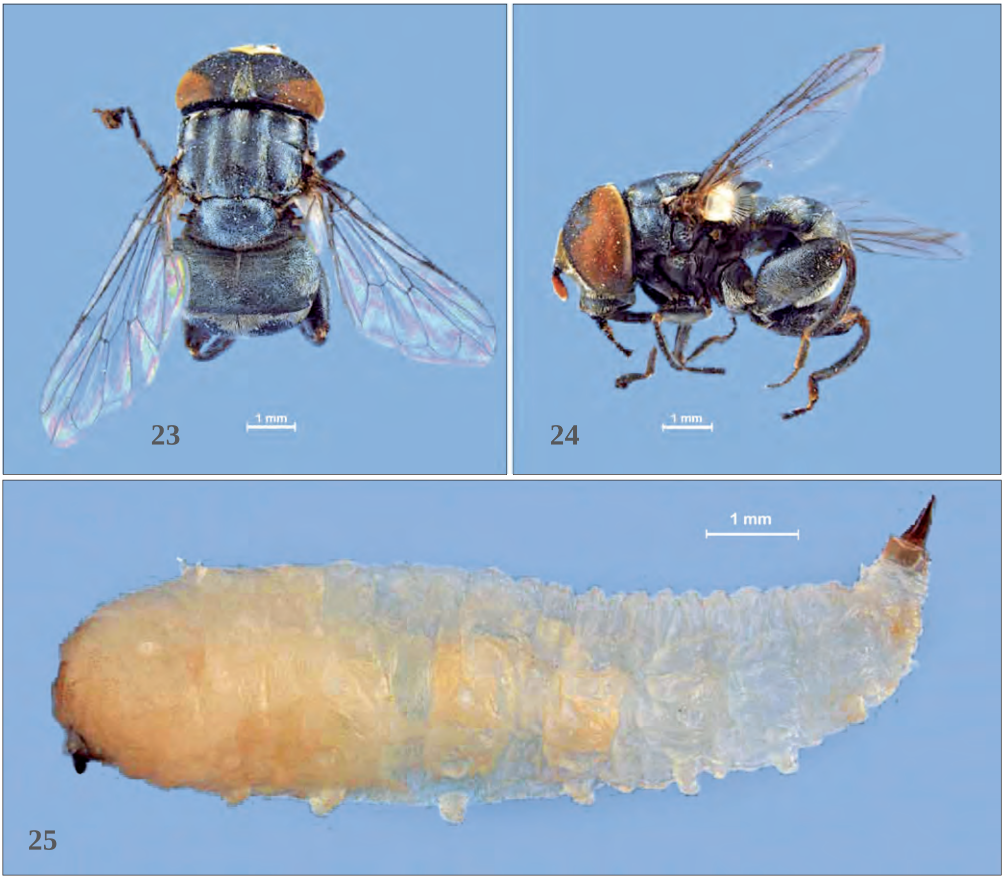
Selected species described by F. Christian Thompson. VIII.

Ximo Mengual

In 2009, together with Brazilian colleagues, Chris described a "very long-known" flower fly species, *Alipumilio athesphatus* Thompson in Morales et al., 2009. In the publication of his PhD (Thompson 1972), Chris already said that he found several new species of *Alipumilio* Shannon, 1927 and figured out the male genitalia of a so-called *Alipumilio* species 1 Thompson. In a manuscript from Chris, the same species has one of the famous Thompson's codes, *Alipumilio* 67–4, which denotes that it was the fourth (new or unknown to him) species recognized in 1967. Other researchers interpret these codes as 'new species', but sometimes they are only temporary name-holders until Chris could find a name for the taxon in question. A few decades later, that "species 1" was finally published as *A. athesphatus*, together with its larval morphology and ecology.



Figs 23–25: *Alipumilio athesphatus* Thompson in Morales et al., 2009. – **23**: Male, dorsal view; – **24**: Male, lateral view; – **25**: Third instar larvae, lateral view. From the original publication, modified.

Publications of F. Christian THOMPSON

[Publikationen von F. Christian THOMPSON]

Ximo MENGUAL[1], Neal L. EVENHUIS[2], Kurt JORDAENS[3] and Jeffrey H. SKEVINGTON[4]

[1] Bonn, Germany [2] Honolulu, Hawaii, U.S.A. [3] Tervuren, Belgium [4] Ottawa, Canada

We have compiled a list with all the publications of F. Chris THOMPSON, excluding his presentations to congresses and symposia that appear only in abstract or program volumes. Chris's publications while he was an employee of the U.S. Department of Agriculture (from 1974 to 2008) can be accessed via the Smithsonian Institution repository at https://repository.si.edu/handle/10088/2752 under his name, including later publications until 2011. For every publication, whenever a digital file of the publication is available, we give either a link to the Biodiversity Heritage Library, a Digital Object Identifier or DOI, or a link to the Smithsonian Institution repository. The asterisk after the year of the publication denotes 'not peer-reviewed' work.

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F. Christian Thompson Electronic Resources

For an overview of the history of the Biosystematic Database of World Diptera (BDWD) and Systema Dipterorum (SD), please refer to Evenhuis et al. (2023; this volume pages 19–30). Here we compile the contributions of F. Chris Thompson in other formats such as CD-ROMs and web sites.

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Selected species described by F. Christian THOMPSON. IX. Ximo MENGUAL

Microdon subpetiolatus THOMPSON, 2020 was the last species described by Chris. This flower fly is known from the island of Sri Lanka by only two males. With hyaline wings, black body and pale yellow legs, the species can be distinguished from other microdontines recorded on Sri Lanka by the long antennae, vein R_{4+5} with a posterior appendix extending into cell r_{4+5}, vein M_1 straight, and scutellum without spines.

26

27

Figs 26, 27: *Microdon subpetiolatus* THOMPSON, 2020, paratype male. – **26**: Habitus, dorsal view; – **27**: Habitus, lateral view. From the original publication.

Annex

The Taxonomic Working Group (TWIG) of the Biodiversity Resources Development Project at the Centro Juvenil Tropical, near Rincón, Costa Rica from 10–11 August 2001. Front row, kneeling, left to right: Greg DAHLEM, Manuel ZUMBADO, Jeff SKEVINGTON, Matt BUCK, Brian BROWN, Álvaro HERRERA and Valery KORNEYEV. Back row, standing, left to right: Steve MARSHALL, Guillermo CHAVERRI, Kevin BARBER, Graham ROTHERAY, Geoffrey HANCOCK, Larry QUATE (facing away), Dick VOCKEROTH, Art BORKENT, Mª Ángeles MARCOS GARCÍA, Jeff CUMMING, Elvia ZUMBADO, Chris THOMPSON, Monty WOOD, Norm WOODLEY, Elena KAMENEVA, Vladimir BEREZOVSKIY, Wayne MATHIS, Diane MATHIS and John VARGAS.

Evert SCHLINGER and Chris THOMPSON at the International Congress of Dipterology in Brisbane, Australia on 23 August 2002, ICD5 29 September–4 October 2002.

From left to right: Thomas Pape, Chris Thompson, Gail Kampmeier, Christine Lambkin and Frederik Torp Petersen at the 5th International Congress of Dipterology in Brisbane, Australia on 24 August 2002.

Chris Thompson collecting during the "Primer taller de identificación de Syrphidae (Diptera) del Neotrópico" in Cali, Colombia. The photo was taken at Cerro San Antonio, the type locality of *Palpada prietorum* Mengual, 2008 — a species collected by Chris that day, 24 February 2006. Photo: X. Mengual.

From left to right: Nancy CARREJO, Catalina GUTIÉRREZ, Carlos RUIZ and Chris THOMPSON at the páramo Nevado del Ruíz, Colombia above 3800 meters a.s.l. in February 2006. Photo: X. MENGUAL.

From left to right: Chris THOMPSON, Wayne MATHIS and Greg DAHLEM at the North America Diptera Society meeting in Silver City, New Mexico, U.S.A. on 14 August 2007.

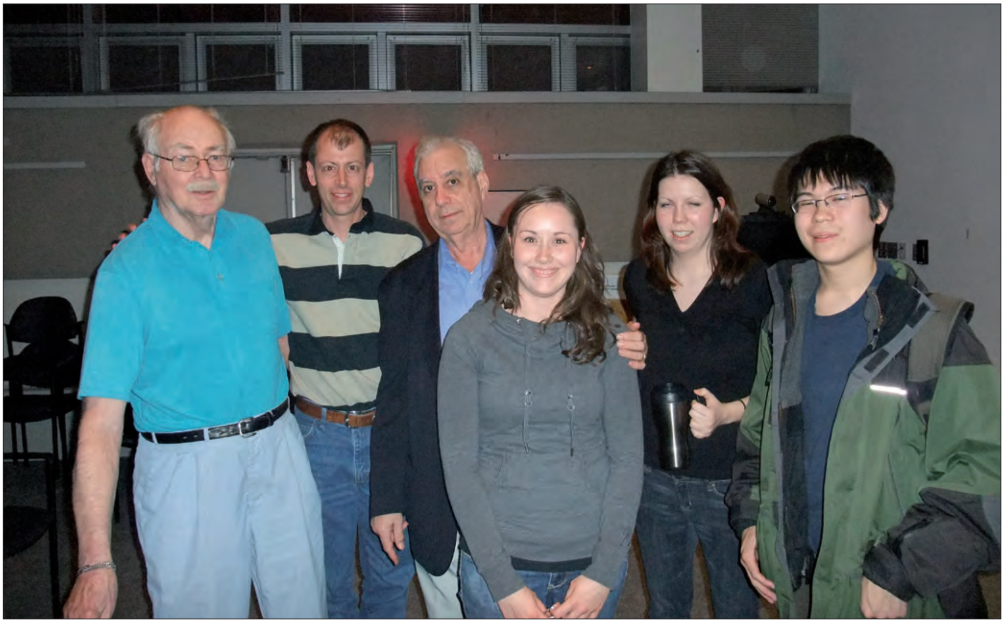
At the North American Diptera Society Meeting, 16 August 2007. From left to right: Chris Thompson, Marjolaine Giroux, Diane Mathis, Sheila Morita, John Stireman (obscured), Grace Wood (facing away), Norm Woodley (facing away), Torsten Dikow and Wayne Mathis.

From left to right: Menno Reemer, Gunilla Ståhls and Chris Thompson at the 5th International Symposium on Syrphidae in Novi Sad, Serbia on 21 June 2009. Photo: J. van Steenis.

From left to right: Chris THOMPSON, Ximo MENGUAL, Santos ROJO and Antonio RICARTE (facing away) at the 5th International Symposium on Syrphidae in Novi Sad, Serbia from 18–22 June 2009. Photo: J. SKEVINGTON.

Left: Chris THOMPSON at the 5th International Symposium on Syrphidae in Novi Sad, Serbia on 21 June 2009. **Right**: Chris THOMPSON with Joseph Moisan DESERRES (and Andrew YOUNG looking away) at the Canpolin-sponsored course on Syrphidae that Chris and Jeff SKEVINGTON taught at the Canadian National Collection of Insects (CNC) from 15–24 February 2010.

Richard (Dick) Vockeroth and Chris Thompson at the CNC on 17 February 2010.



From left to right: Richard (Dick) Vockeroth, Jeff Skevington, Chris Thompson, Michelle Locke, Heather Cumming and Andrew Young at the CNC on 17 February 2010.

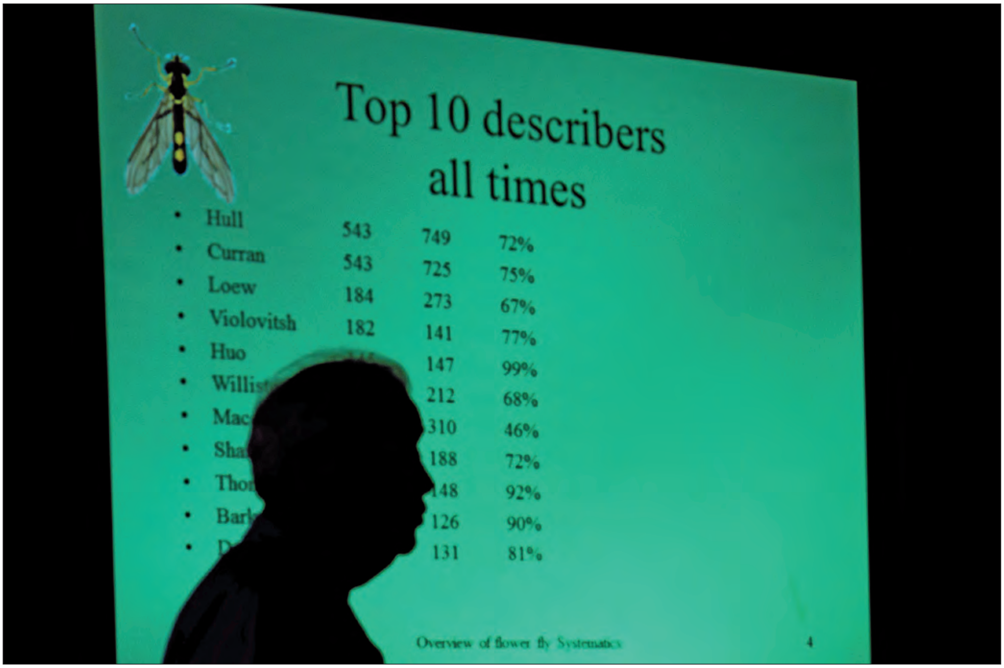
Chris Thompson with Gustavo Hormiga, November 2013, teaching the course 'Principles of taxonomy: Documenting biodiversity' at The George Washington University (GWU), Washington, D.C. Chris was Adjunct Professor at the GWU.

Participants of the Syrphoidea symposium in the 8th International Congress of Dipterology in Potsdam, Germany on 15 August 2014. From left to right, in front row: Axel Ssymank (on knee), Frederico Kirst (on knee), Mirian Morales, Chris Thompson, Gunilla Ståhls, Gisela Merkel-Wallner, Kurt Jordaens and Antonio Ricarte. Second row, left to right: Ho-Yeon Han, Augusto Montoya, Adriana Pereira, John Smit, Gerard Pennards, Jeff Skevington, Unknown, Łukasz Mielczarek, Santos Rojo, Peter Vogtenhuber and Ximo Mengual. Back row, left to right: Adam Tofilski and Menno Reemer.

From left to right: Chris Thompson, Nevena Veličković and Ante Vujić at the 8th International Symposium on Syrphidae in Monschau, Germany from 4–8 June 2015.

From left to right: Martin Hauser, Francis Gilbert and Chris Thompson at the 8th International Symposium on Syrphidae in Monschau, Germany from 4–8 June 2015. Talking at the back, Ximo Mengual and André van Eck.

Chris THOMPSON talking about Syrphidae fossils with Grigory POPOV at the 8th International Symposium on Syrphidae in Monschau, Germany from 4–8 June 2015. Photo: G. NÈVE.



Chris THOMPSON during his talk at the 8th International Symposium on Syrphidae in Monschau, Germany from 4–8 June 2015. Note his record of 148 described species at that time, of which 92 % remain valid. Photo: G. NÈVE.

Message

from the desk of
Chris Thompson

18 January 2001

Dear friends:

Enclosed are reprints of those paper which were printed last year. Not as many as I wanted, but this year should be much better. There are 3 currently in press and another 4 in the review process and it is only January!

The work on Costa Rican flower flies is at the point where we will be turning out a 3 or 4 papers each year for the next couple years. Our current count is 479 species of which 271 species need names! Most of them are in the big genera *Copestylum* and *Ocyptamus* and so far we have been doing the small genera.

On other fronts, the Australian work is slow but coming. The *Austrophilus* paper should be published soon and the *Austalis* manuscript is about done. The other new genera will be done in a conspectus-type of paper, perhaps later this year.

The BioSystematic Database of World Diptera is now finally fully operational. Please go to our Diptera WWW site and check it out. Look under names at www.diptera.org

Please acknowledge their receipt, or else your name may be dropped from my mailing list.

Cheers

Chris

A letter from Chris Thompson to his colleagues presenting the news on his work on Costa Rican Syrphidae, publications and manuscripts back then, 18 January 2001. The fly illustrating the heading of the letter, drawn by Gustavo Hormiga, is a species that was published a few years later, *Anu una* Thompson, 2008 (see page 188).

Index

The German "Zusammenfassungen" are not included in the Index. The same is true for the chapter "Contents", the lists of collections studied, the listings of "Examined material", the "Acknowledgements" and lists of sources ("Literature").

F. Christian Thompson (1944–2021) or Chris, as most of us knew him, made an influential contribution to dipterology. Most of us are familiar with one of his major legacies, *Systema Dipterorum*, the largest maintained database for the taxonomy and nomenclature of Diptera. With his tireless and dedicated work spanning seven decades, Chris brought modernity to dipterology introducing the use of computers in taxonomy, creating databases, and with the distribution of CD-ROM media in publications and the use of the web to disseminate systematic information. This volume compiles 18 original articles on several dipteran families and a list of Chris's publications to honour his contribution to dipterology.

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