

## THE CERATOPOGONIDAE INFORMATION EXCHANGE

The CIE, issued twice a year (no subscription fee), was begun in 1967-68 as a newsletter to facilitate communication among workers interested in the Ceratopogonidae. The format is extremely flexible. Contributions may be of any length and deal with any subject having some bearing on the study of ceratopogonids. For example, contributors may report their current interests or plans, observations or techniques of probable value to the readership, requests for addresses, study material or reprints, or any other matter of concern. The newsletter serves also as a bulletin for planning and communicating information on meetings, symposia, workshops and so forth. Finally, there is in every issue a compilation of recent literature in the field. Any person(s) wishing to contribute to the newsletter or to receive future issues by email should contact:

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### CIE No. 102 –December 2018 -The Ceratopogonidae Information Exchange Newsletter

Colleagues,

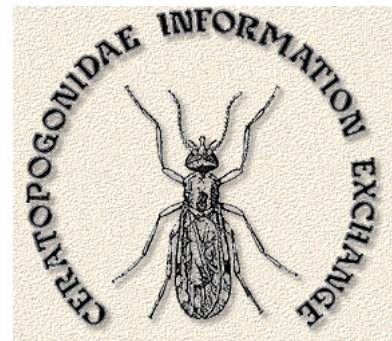
I hope that you will find something useful and interesting in this December, 2018 issue of the CIE Newsletter. The Recent Literature section contains 118 original research papers, reviews, reports and abstracts (including two textbook chapters) representing diverse research areas. I have included figures with striking images from four of these papers on the last page of this issue.

Three papers about species in *Culicoides* (*Monoculicoides*) appear in Recent Literature and it is significant that these represent the areas of morphology ([Shults and Borkent](#)), genomics ([Morales-Hojas et al.](#)), and ecology ([Wong et al.](#)).

If anyone is not listed in the [Directory of Workers](#), please send your contact information (or an update) to me. Please also send copies of your published papers, research summaries, requests for information, etc. for the May, 2019 issue by Friday, May 3<sup>rd</sup>.

With Best Wishes for a Merry Christmas,  
Steve Murphree, Nashville, Tennessee, U.S.A.

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## **New CIE Subscribers, Address Updates**

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## Announcements

### 2019 Field Meeting of North American Dipterists Society (NADS) 3-7 June 2019, Bull Shoals Field Station, Missouri

You are invited to join Dipterists from throughout North America to discuss and collect flies, focusing on taxa from the Ozark Plateau as they meet at the Bull Shoals Field Station, administered by the Department of Biology, Missouri State University. The station is located in Taney County, Missouri, close to the Arkansas border, just south of Kirbyville, Missouri (5 miles) and approximately 10 miles from Branson, Missouri. The station occupies some 5,600 acres and is located in the heart of the Ozarks ecoregion. Please see the Station's website for additional information: <https://bullshoals.missouristate.edu/> or contact David Bowles at [david\\_bowles@nps.gov](mailto:david_bowles@nps.gov) or 417-836-4702.



# WAAVP

27<sup>th</sup> Conference of the World Association for  
the Advancement of Veterinary Parasitology

**JULY 7 - 11, 2019 | MADISON, WI, USA**

The Livestock Insect Workers Conference and the American Association of Veterinary Parasitologists will meet jointly with the World Association for the Advancement of Veterinary Parasitology at its conference July 7-11, 2019 at the Monona Terrace Convention Center (designed by Frank Lloyd Wright) in Madison, Wisconsin. The theme of the Conference is "Sifting and Winnowing the Evidence in Veterinary Parasitology" More information can be found at: <http://www.waavp2019.com/>.

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## Contributions/Requests from Scientists:

**From: Nancy Hinkle, Department of Entomology, University of Georgia, Athens, Georgia, U.S.A.**

John Burton, a fellow who has worked on tabanids for 50 years and attended Biting Fly meetings [A reunion of Ceratopogonidae workers who attended past Biting Fly Workshops was featured in the [December, 2017 issue](#) of this newsletter – Ed.] back in 1970 and 1971 gave me photos of people from those meetings -- Elton Hansens, Paul Catts, Ted Adkins, Jeff Freeman, etc. I have scanned them and would love to share them with people who are interested, but I don't know anyone working on Tabanidae now. An image of Jim Goodwin, who now resides in Dyersburg, Tennessee, appears here.

[Please request this set of images from either Nancy ([nhinkle@uga.edu](mailto:nhinkle@uga.edu)) or myself ([steve.murphree@belmont.edu](mailto:steve.murphree@belmont.edu)) and we will be glad to send them to you.]



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## Recent Literature:

### Taxonomy and Morphology

**Ayala, M. M., and P. I. Marino. 2018.** New records of biting midges of the genus *Culicoides* Latreille (Diptera: Ceratopogonidae) in Argentina. [Revista De La Sociedad Entomologica Argentina 77\(2\): 36-38.](#)

**Bakhoum, M. T., M. Sarr, A. G. Fall, K. Huber, M. Fall, M. Sembene, M. T. Seck, K. Labuschagne, L. Gardes, M. Ciss, G. Gimonneau, J. Bouyer, T. Baldet, and C. Garros. 2018.** DNA barcoding and molecular identification of field-collected *Culicoides* larvae in the Niayes area of Senegal. [Parasites & Vectors 11: 615:1-10.](#)

**Bakhoum, M. T., A. G. Fall, J. Bouyer, T. Baldet and C. Garros. 2018.** Systematics and taxonomy of *Culicoides* Latreille (Ceratopogonidae) in the Afrotropical Region – what are the challenges and what comes next? In: [Abstract Volume of the 9<sup>th</sup> International Congress of Dipterology](#). (A. H. Kirk-Spriggs and B. S. Muller, Eds.). 25-30 November 2018. Windhoek, Namibia, pg. 16.

- Brahma, S. and N. Hazra. 2018.** Taxonomy of *Dasyhelea* Kieffer (Ceratopogonidae) – an Indian perspective. In: [Abstract Volume of the 9<sup>th</sup> International Congress of Dipterology](#). (A. H. Kirk-Spriggs and B. S. Muller, Eds.) 25-30 November 2018. Windhoek, Namibia, pg. 35.
- Chang, Q.-Q., X.-H. Jiang, and X.-H. Hou. 2018.** Geometric morphometric analysis of wing shape variation among three important species of the genus *Culicoides* (Diptera: Ceratopogonidae). [Chinese Journal of Applied Entomology 55: 288-293](#) [in Chinese with English Abstract].
- Dominiak, P., R. Szadziewski and A. Nel. 2018.** A new species of the haematophagous genus *Austroconops* Wirth & Lee (Diptera: Ceratopogonidae: Leptoconopinae) from middle Cretaceous amber of Charente-Maritime, France. *Cretaceous Research* 92:231-239. ([Read Abstract](#)).
- Jiang, X.-H., Q.-Q. Chang, and X.-H. Hou. 2018.** Morphology and ultrastructure of female and male adults of *Culicoides arakawai* (Arakawa) (Diptera Ceratopogonidae). *Acta Entomologica Sinica* 61(4): 498-504 ([Read Abstract](#)).
- Mukhopadhyay, E., S. Hazra, P. Parui, and D. Banerjee. 2018.** A Taxonomic Description of Three New Records of Genus *Culicoides* (Diptera: Ceratopogonidae) from the Sub-Himalayan Foothills of West Bengal. [Munis Entomology & Zoology 13\(3\): 482-489](#).
- Mullen, G. R. and C. S. Murphree. 2018.** Biting Midges (Ceratopogonidae). Chapter 13, pgs. 213-232, In: [Medical and Veterinary Entomology, Third Edition](#), 792 pp. [Mullen, G. R. and L. A. Durden, Eds.] Academic Press (Elsevier, Inc.).
- Navarro, D., H. Rivera, A. Caceres, and J. Rondon. 2018.** Morphological Identification of *Culicoides* spp. Described as Orbivirus Transmitters Trapped in Sheep Farms in Pucallpa, Peru. [Revista De Investigaciones Veterinarias Del Peru 29: 302-309](#) [In Spanish with English Abstract].
- Pudar, D., D. Petric, X. Allene, B. Alten, N. Ayhan, A. Cvetkovikj, C. Garros, T. Goletic, F. Gunay, K. Hlavackova, A. I. Cupina, M. Kavran, T. Lestinova, B. Mathieu, O. Mikov, I. Pajovic, I. Rakotoarivony, J. Stefanovska, S. Vaselek, A. Zuko, and T. Balenghien. 2018.** An update of the *Culicoides* (Diptera: Ceratopogonidae) checklist for the Balkans. [Parasites & Vectors 11: \(462\): 1-10](#).
- Ronderos, M.M., F. Diaz, P.I. Marino and R.L. Ferreira-Kepler. 2018.** Family Ceratopogonidae. Chapter 16.1, pgs. 625-659 In: [Thorp and Covich's Freshwater Invertebrates](#), Fourth Edition, Vol. 3: [Keys to Neotropical Hexapoda](#) [Hamada, N. J. Thorp and D.C. Rogers, Eds.] Elsevier, Inc. ([Read Abstract](#)).
- Saha, P., and N. Hazra. 2018.** On a new species of the genus *Tetrabezzia* Kieffer, 1917 from West Bengal, India, with a key to world species (Diptera: Ceratopogonidae). [Polish Journal of Entomology 87\(3\): 291-300](#).
- Shults, P., and A. Borkent. 2018.** Pupae of the Nearctic species of *Culicoides* Latreille subgenus *Monoculicoides* Khalaf (Diptera: Ceratopogonidae). [Zootaxa 4504\(4\): 451-472](#).
- Spinelli, G.R. and P.I. Marino. 2018.** *Forcipomyia* (*Synthyridomyia*) *murina* (Winnertz, 1852) in South America. Synonymy and Redescription (Diptera: Ceratopogonidae). [Biología Acuática 33:1-7](#).

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**Ecology and Methodology**

- Bakhoum, M. T., M. Sarr, A. G. Fall, K. Huber, M. Fall, M. Sembene, M. T. Seck, K. Labuschagne, L. Gardes, M. Ciss, G. Gimonneau, J. Bouyer, T. Baldet, and C. Garros. 2018.** DNA barcoding and molecular identification of field-collected *Culicoides* larvae in the Niayes area of Senegal. [Parasites & Vectors 11: 615:1-10.](#)
- Barcelo, C., R. Del-Rio and M.-A. Miranda. 2018.** Temperature dependent lifespan and emergence traits of *Culicoides* Latreille species (Ceratopogonidae) under laboratory conditions. In: [Abstract Volume of the 9<sup>th</sup> International Congress of Dipterology](#). (A. H. Kirk-Spriggs and B. S. Muller, Eds.). 25-30 November 2018. Windhoek, Namibia, pg. 20.
- Cazorla, C. G., and R. E. Campos. 2018a.** Synanthropy and Community Structure of Ceratopogonidae from the Northeast of Buenos Aires Province, Argentina. *Journal of Medical Entomology* tly165 [Early View; [Read Abstract](#)].
- Cazorla, C. G., P. I. Marino, F. Diaz, and R. E. Campos. 2018b.** Diversity of Ceratopogonidae (Diptera: Culicomorpha) from the Reserva Natural Integral Punta Lara (Buenos Aires, Argentina). [Revista de la Sociedad Entomologica Argentina 77: 1-13.](#)
- Chang, Q.-Q., X.-H. Jiang, and X.-H. Hou. 2018.** Geometric morphometric analysis of wing shape variation among three important species of the genus *Culicoides* (Diptera: Ceratopogonidae). [Chinese Journal of Applied Entomology 55: 288-293](#) [in Chinese with English Abstract].
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- Cuellar, A. C., L. Jung Kjaer, A. Baum, A. Stockmarr, H. Skovgard, S. A. Nielsen, M. G. Andersson, A. Lindstrom, J. Chirico, R. Luhken, S. Steinke, E. Kiel, J. Gethmann, F. J. Conraths, M. Larska, M. Smreczak, A. Orłowska, I. Hamnes, S. Sviland, P. Hopp, K. Brugger, F. Rubel, T. Balenghien, C. Garros, I. Rakotoarivony, X. Allene, J. Lhoir, D. Chavernac, J. C. Delecolle, B. Mathieu, D. Delecolle, M. L. Setier-Rio, R. Venail, B. Scheid, M. A. M. Chueca, C. Barcelo, J. Lucientes, R. Estrada, A. Mathis, W. Tack, and R. Bodker. 2018.** Monthly variation in the probability of presence of adult *Culicoides* populations in nine European countries and the implications for targeted surveillance. [Parasites & Vectors 11: 608; 1-19.](#)
- De Beer, C.J., S.N.B. Boikanyo and G. J. Venter. 2018.** Development of a standardised protocol for the *in vitro* feeding of field-collected *Culicoides imicola* (Diptera: Ceratopogonidae) from South Africa. In: [Abstract Book of the E-SOVE 21<sup>st</sup> Conference, 22-26 October 2018. Palermo, Italy, p 28.](#)
- De Beer, C.J., G. J. Venter and B. Mans. 2018.** Comparing methods for the assessment of blood meal volume of *Culicoides imicola* (Ceratopogonidae) fed on an *in vitro* feeding system. In: [Abstract Volume of the 9<sup>th</sup> International Congress of Dipterology](#). (A. H. Kirk-Spriggs and B. S. Muller, Eds.). 25-30 November 2018. Windhoek, Namibia, pg. 62.

- Diarra, M., M. Fall, A. G. Fall, A. Diop, R. Lancelot, M. T. Seck, I. Rakotoarivony, X. Allene, J. Bouyer, and H. Guis. 2018.** Spatial distribution modelling of *Culicoides* (Diptera: Ceratopogonidae) biting midges, potential vectors of African horse sickness and bluetongue viruses in Senegal. [Parasites & Vectors 11: 341: 1-15.](#)
- Diaz-Sanchez, S., A. Hernandez-Jarguin, A. Torina, I. G. F. de Mera, A. Estrada-Pena, M. Villar, F. La Russa, V. Blanda, J. Vicente, S. Caracappa, C. Gortazar, and J. de la Fuente. 2018.** Biotic and abiotic factors shape the microbiota of wild-caught populations of the arbovirus vector *Culicoides imicola*. [Insect Molecular Biology 27\(6\): 847-861.](#)
- Elbers, A. R. W., J. L. Gonzales, and R. Meiswinkel. 2018.** Comparing *Culicoides* biting rates in horses and cattle in The Netherlands: potential relevance to African horse sickness epidemiology. *Entomologia Experimentalis et Applicata* 166: 535-544 ([Read Abstract](#)).
- Erram, D., and N. Burkett-Cadena. 2018.** Laboratory studies on the oviposition stimuli of *Culicoides stellifer* (Diptera: Ceratopogonidae), a suspected vector of Orbiviruses in the United States. [Parasites & Vectors 11: 300: 1-11.](#)
- Fiodorova, O. A. 2018.** Physiological age of female blood-sucking midges (Diptera, Ceratopogonidae) in the south of Tyumen Oblast. [Biosystems Diversity 26\(3\): 179-182.](#)
- Fiodorova, O. A., T. A. Khlyzova, and T. E. Savchuk. 2018.** Species composition and places of development of blood-sucking midges (Diptera: Ceratopogonidae) in the subzone of the southern taiga of the Tyumen region. [Ukrainian Journal of Ecology 8\(1\): 573-577.](#)
- Golovatyuk, L. V., T. D. Zinchenko, N. N. Sushchik, G. S. Kalachova, and M. I. Gladyshev. 2018.** Biological aspects of the associations of biting midges (Diptera: Ceratopogonidae) in two saline rivers of the Elton Lake Basin, Russia. *Marine and Freshwater Research* 69(6): 906-916 ([Read Abstract and References](#)).
- Hope, A., S. Gubbins, C. Sanders, J. Barber, F. Stubbins, M. Baylis, and S. Carpenter. 2018.** Sheep breed and shearing influences attraction and blood-feeding behaviour of *Culicoides* (Diptera: Ceratopogonidae) on a UK farm. [Parasites & Vectors 11: 473:1-11.](#)
- Jonsdottir, S., S. B. Stefansdottir, S. B. Kristinarson, V. Svansson, J. M. Bjornsson, A. Runarsdottir, B. Wagner, E. Marti, and S. Torsteinsdottir. 2018.** Barley produced *Culicoides* allergens are suitable for monitoring the immune response of horses immunized with *E. coli* expressed allergens. *Veterinary Immunology and Immunopathology* 201: 32-37 ([Read Abstract](#)).
- Kirkeby, C. 2018.** Observations of female and mixed sex swarming behaviour in *Culicoides* Latreille, 1809 (Diptera: Ceratopogonidae). [Polish Journal of Entomology 87\(2\): 191-197.](#)
- Kline, D. L. 2018.** A surveillance strategy to measure population dynamics of biting Diptera at a horse boarding facility and wildlife refuge in Florida, U.S.A . In: [Abstract Volume of the 9<sup>th</sup> International Congress of Dipterology](#). (A. H. Kirk-Spriggs and B. S. Muller, Eds.). 25-30 November 2018. Windhoek, Namibia, pg. 137.
- Lauermann, T., and E. Kiel. 2018.** Biting midges in the stable environment. *Tieraerztliche Umschau* 73: 109-112 ([Read Abstract](#)).

- Lehiy, C. J., L. M. Reister-Hendricks, M. G. Ruder, D. S. McVey, and B. S. Drolet. 2018. Physiological and immunological responses to *Culicoides sonorensis* blood-feeding: a murine model. [Parasites & Vectors 11: 358: 1-13.](#)
- Luo, Y. P. 2018. Establishing and maintaining colonies of *Forcipomyia taiwana* in the laboratory. [Journal of Vector Ecology 43\(2\): 328-333.](#)
- McGregor, B. L., A. E. Runkel, S. M. Wisely, and N. D. Burkett-Cadena. 2018a. Vertical stratification of *Culicoides* biting midges at a Florida big game preserve. [Parasites & Vectors 11: 505: 1-11.](#)
- McGregor, B. L., T. Stenn, K. A. Sayler, E. M. Blosser, J. K. Blackburn, S. M. Wisely, and N. D. Burkett-Cadena. 2018b. Host use patterns of *Culicoides* spp. biting midges at a big game preserve in Florida, U.S.A., and implications for the transmission of orbiviruses. [Medical and Veterinary Entomology: doi: 10.1111/mve.12331](#) [Early View].
- Meloni, G., M. Cossu, C. Foxi, L. Vento, S. Circosta, E. Burrai, S. Masala, M. Goffredo, and G. Satta. 2018. Combined larvicidal and adulticidal treatments to control *Culicoides* biting midges (Diptera: Ceratopogonidae): Results of a pilot study. [Veterinary Parasitology 257: 28-33.](#)
- Morales-Hojas, R., M. Hinsley, I. M. Armean, R. Silk, L. E. Harrup, A. Gonzalez-Urriarte, E. Veronesi, L. Campbell, D. Nayduch, C. Sasaki, W. J. Tabachnick, P. Kersey, S. Carpenter, and M. Fife. 2018. The genome of the biting midge *Culicoides sonorensis* and gene expression analyses of vector competence for bluetongue virus. [BMC Genomics 19:624:1-16.](#) [this effort was led by the Pirbright Institute (UK) with collaborating scientists – Ed.].
- Mullen, G. R. and C. S. Murphree. 2018. Biting Midges (Ceratopogonidae). Chapter 13, pgs. 213-232, In: [Medical and Veterinary Entomology, Third Edition](#), 792 pp. [Mullen, G. R. and L. A. Durden, Eds.] Academic Press (Elsevier, Inc.).
- Ronderos, M.M., F. Diaz, P.I. Marino and R.L. Ferreira-Keppler. 2018. Family Ceratopogonidae. Chapter 16.1, pgs. 625-659 In: [Thorp and Covich's Freshwater Invertebrates](#), Fourth Edition, Vol. 3: [Keys to Neotropical Hexapoda](#) [Hamada, N. J. Thorp and D.C. Rogers, Eds.] Elsevier, Inc. ([Read Abstract](#)).
- Sloyer, K. E., S. M. Wisely, and N. D. Burkett-Cadena. 2018. Effects of ultraviolet LED versus incandescent bulb and carbon dioxide for sampling abundance and diversity of *Culicoides* in Florida. [Journal of Medical Entomology tjt195](#) [Early View; [Read Abstract](#)].
- Sohier, C., I. Deblauwe, R. De Deken, M. Madder, C. Fassotte, B. Losson, and N. De Regge. 2018. Longitudinal monitoring of *Culicoides* in Belgium between 2007 and 2011: local variation in population dynamics parameters warrant cautious use of monitoring data. [Parasites & Vectors 11: 512: 1-9.](#)
- Toukem, N. K., R. Hanna, S. Kekeunou and A. Fotso. 2018. Insect pollinators of Cocoa, *Theobroma cacao* (L.) (Malvaceae) in Cameroon. In: [Abstract Volume of the 9<sup>th</sup> International Congress of Dipterology](#). (A. H. Kirk-Spriggs and B. S. Muller, Eds.) 25-30 November 2018. Windhoek, Namibia, pg. 282.



- Tratalos, J. A., D. J. Barrett, T. A. Clegg, R. G. O'Neill, G. McGrath, E. A. Lane, and S. J. More. 2018.** Sampling Methodology to Maximize the Efficient Use of National Abattoir Surveillance: Using Archived Sera to Substantiate Freedom from Bluetongue Virus Infection in Ireland. [\*Frontiers in Veterinary Science\* 5: 261: 1-9.](#)
- Venter, G. J., S. N. B. Boikanyo, and C. J. De Beer. 2018.** The efficiency of light-emitting diode suction traps for the collection of South African livestock-associated *Culicoides* species. *Medical and Veterinary Entomology* 32: 509-514. ([Read Abstract](#)).
- Venter, G. J., S. N. B. Boikanyo and C. J. de Beer. 2018.** The effect of site selection on light trap efficiency for the collection of *Culicoides* midges. In: [Abstract Book of the E-SOVE 21<sup>st</sup>Conference, 22-26 October 2018, Palermo, Italy, p 43.](#)
- Vigil, S. L., M. G. Ruder, D. Shaw, J. Wlodkowski, K. Garrett, M. Walter, and J. L. Corn. 2018.** Apparent Range Expansion of *Culicoides (Hoffmania) insignis* (Diptera: Ceratopogonidae) in the Southeastern United States. *Journal of Medical Entomology* 55(4): 1043-1046 ([Read Abstract](#)).
- Walgama, R. S., and T. J. Lysyk. 2018.** Evaluating the Addition of CO<sub>2</sub> to Black Light Traps for Sampling *Culicoides* (Diptera: Ceratopogonidae) in Alberta. *Journal of Medical Entomology* 55(4): 1043-1046 ([Read Abstract](#)).
- Wong, N. D., E. G. McDermott, A. C. Murillo, and B. A. Mullens. 2018.** Field Distribution and Density of *Culicoides sonorensis* (Diptera: Ceratopogonidae) Eggs in Dairy Wastewater Habitats. *Journal of Medical Entomology* 55(2): 392-397 ([Read Abstract](#)).

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## **Bluetongue Virus and Other Pathogens**

- Adami, Y. L., A. M. de Oliveira, R. M. Lanfredi, and M. Maia-Herzog. 2018.** First Report on Surface Aspects of *Mansonella ozzardi* (Spirurida: Onchocercidae) Microfilariae by Scanning Electron Microscopy: Preliminary Results. [\*Revista de Patologia Tropical\* 47: 195-198.](#)
- Adhikari, U. K., M. Tayebi, and M. M. Rahman. 2018.** Immunoinformatics Approach for Epitope-Based Peptide Vaccine Design and Active Site Prediction against Polyprotein of Emerging Oropouche Virus. [\*Journal of Immunology Research\*: Article ID 6718083. 22 pp.](#)
- Aksular, M., E. Calvo-Pinilla, A. Marin-Lopez, J. Ortego, A. C. Chambers, L. A. King, and J. Castillo-Olivares. 2018.** A single dose of African horse sickness virus (AHSV) VP2 based vaccines provides complete clinical protection in a mouse model. [\*Vaccine\* 36\(46\): 7003-7010.](#)
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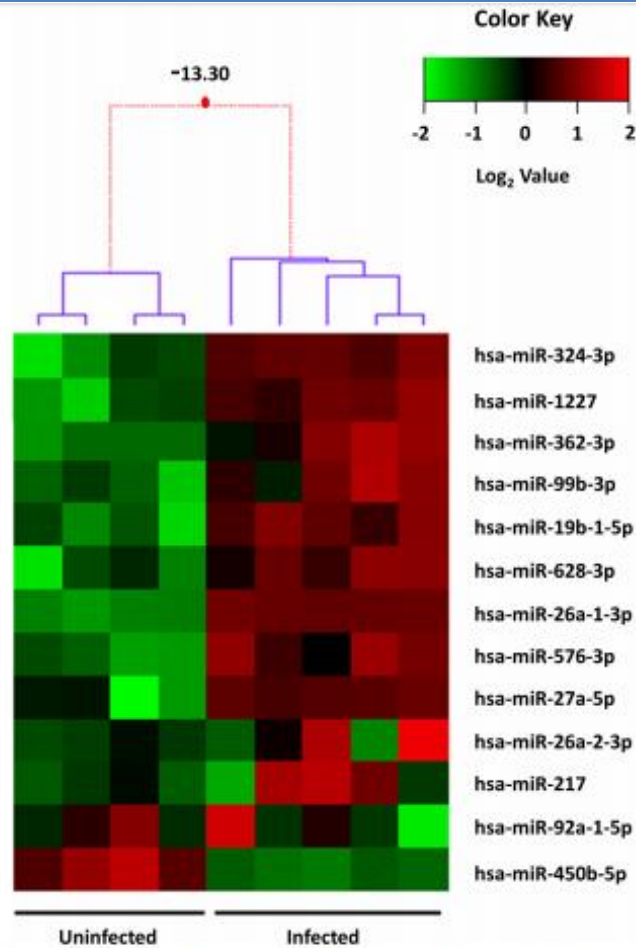
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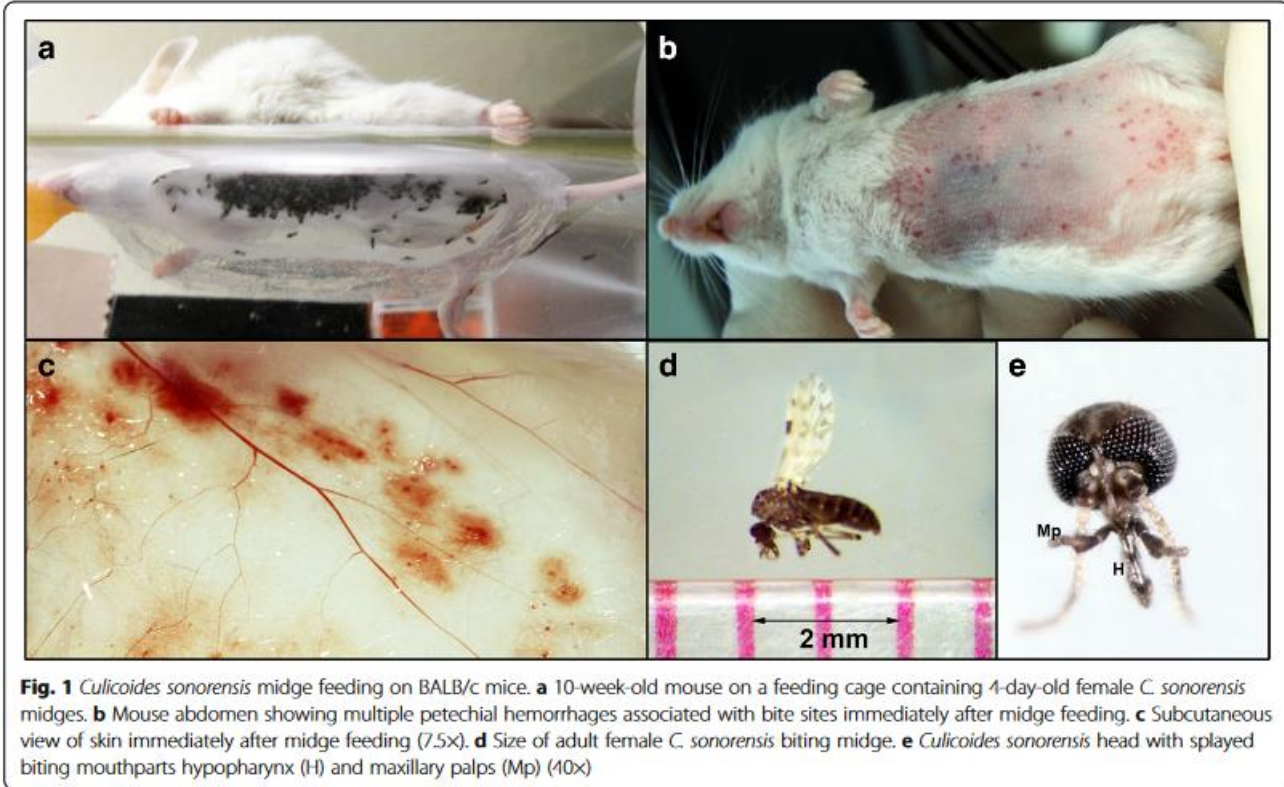




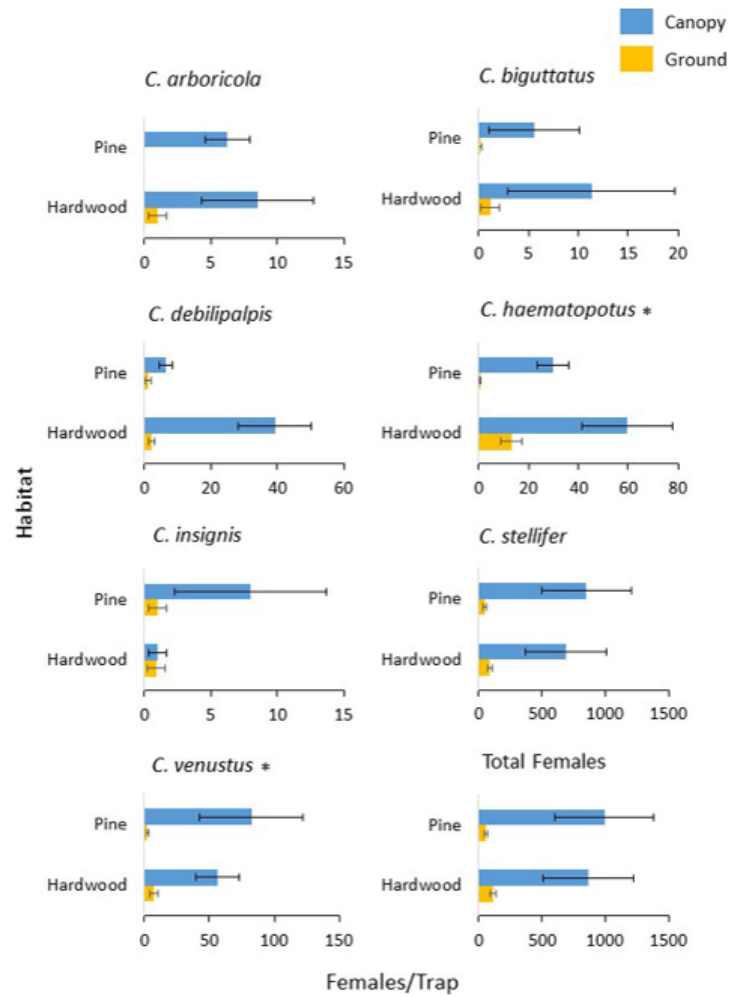
**Fig 2.** Heat map of differentially expressed miRNAs in OROV infected HuH-7 cells. Depiction of the 13 miRNAs differentially expressed in OROV infected cells relative to uninfected cells. Lines represent individual miRNAs and columns represent independent replicates (four mock infected and five OROV infected). Color scale represents normalized expression levels of miRNAs in the two conditions in log<sub>2</sub> scale; red denotes up-regulation and green denotes down-regulation, respectively. Dendrogram representing the 1D clusterization of samples and the 2D map corresponding to the levels of standardized gene expression profiles (z-score). Red dotted lines in the dendrogram indicate weak unions, discouraged by the Bayesian clustering analysis. Values represented in the dendrogram branches correspond to log-odds of the union of corresponding branches. For the purpose of display, missing values of uninfected cells for miR-217, miR-26a-2-3p and miR-92a-5p were predicted by k-nearest neighbors method and imputed after normalization as described in Methods section.

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**Fig. 3** Habitat associations and vertical stratification of *Culicoides* species. Bars represent average females collected by CDC miniature light traps for which greater than 100 total individuals were collected. Asterisks denote a significant interaction between habitat and trap height at alpha = 0.05 (negative binomial regression) in 2017

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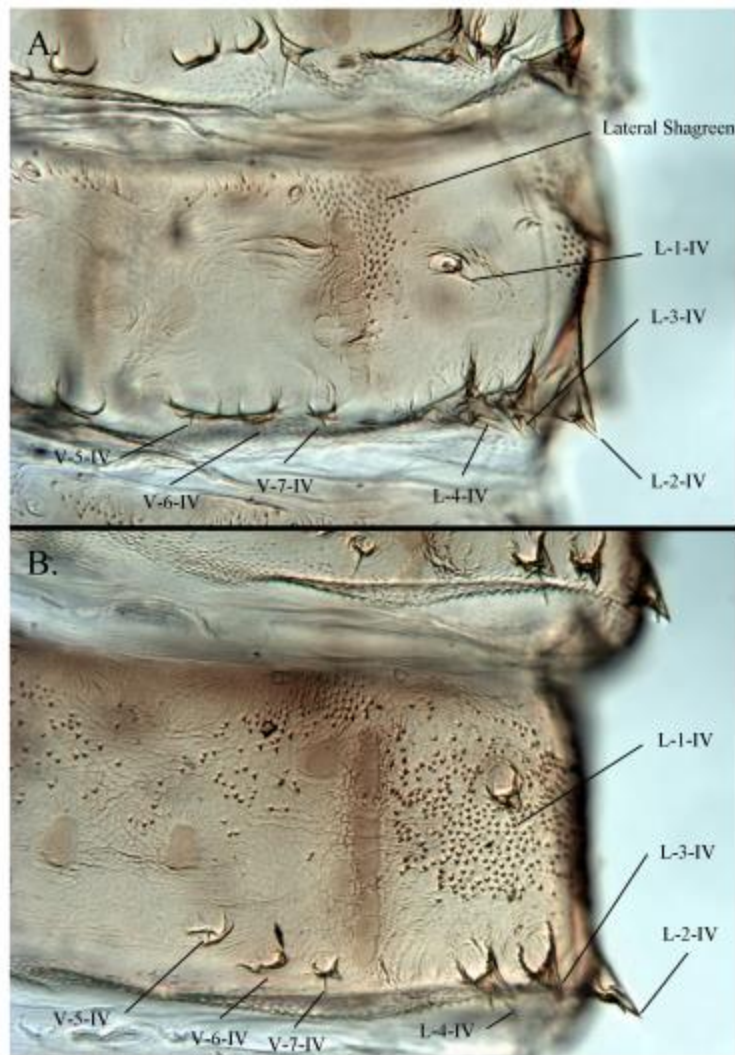


FIGURE 6. Male, lateral and ventral tubercles of abdominal segments 4, in dorsal view (A) *Culicoides occidentalis*, (B) *C. riethi*.

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