Plant Pest Diagnostics Branch

California Department of Food and Agriculture

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**Employment & Affiliations**

**Senior Insect Biosystematist**

California Department of Food and Agriculture 2022–Present

Sacramento, California, USA

*Primary Insect Biosystematist (Heteroptera)*, *2023–2024 fiscal year*

**Research Associate**

Entomology and Nematology, University of California 2020–Present

Davis, California, USA

**Associate Insect Biosystematist**

California Department of Food and Agriculture 2020–2022

Sacramento, California, USA

**Postdoctoral Associate**

Entomology and Nematology, University of Florida 2016–2020

Gainesville, Florida, USA

**Education**

**Ph.D.** Entomology 2016

University of California

Riverside, California, USA

**B.S.** Biology (Summa Cum Laude) 2008

University of Arkansas

Little Rock, Arkansas, USA

**Peer-Reviewed Publications** (including accepted & in press)

Forthman, M. (In press). First record of *Pyrrhocoris apterus* (Linnaeus 1758) (Hemiptera: Heteroptera: Pyrrhocoridae) in California, U.S.A. *Pan-Pac. Entomol*.

Forthman, M., Phan, H., Miller, C.W., Kimball, R.T. (In press). Phylogenetic placement of the leaf-footed bug tribes Agriopocorini, Amorbini, and Manocoreini (Heteroptera: Coreoidea) using ultraconserved elements. *Zool. J. Linn. Soc.*, zlae024.

Miller, C.W., Kimball, R.T., Forthman, M. (In press). Evolution of multi-component weapons in the superfamily of leaf-footed bugs. *Evolution*, qpae011.

Forthman, M., Gordon, E.R.L., Kimball, R.T. 2023. Low hybridization temperatures improve target capture success of invertebrate loci: a case study of leaf-footed bugs (Hemiptera: Coreoidea). *R. Soc. Open Sci.*, 10: 230307.

Forthman, M., Downie, C., Miller, C.W., Kimball, R.T. 2023. Evolution of stridulatory mechanisms: vibroacoustic communication may be common in leaf-footed bugs and allies (Heteroptera: Coreoidea). *R. Soc. Open Sci*., 10: 221348.

Adler, K., Schill, A., Stolberg, A., Miller, C.W., Forthman, M. 2022. First record of the bow-legged bug *Hyalymenus subinermis* (Heteroptera: Alydidae) in California, with description of the mimetic immature stages. *Pan-Pac. Entomol*., 98: 138–149.

Forthman, M., Miller, C.W., Kimball, R.T. 2022. Phylogenomic analysis with improved taxon sampling corroborates an Alydidae + Hydarinae + Pseudophloeinae clade (Heteroptera: Coreoidea: Alydidae, Coreidae). *Org. Divers. Evol*., 22: 669–679.

Forthman, M., Lara, R., Meeds, A.W., Rider, D.A. 2022. First record of *Pellaea stictica* (Dallas, 1851) (Hemiptera: Heteroptera: Pentatomidae) in California, U.S.A. *Pan-Pac. Entomol*., 98: 76–80.

Miller, C.D., Forthman, M., Miller, C.W., Kimball, R.T. 2022. Extracting “legacy loci” from an invertebrate sequence capture dataset. *Zool. Scr.*, 51: 14–31.

Forthman, M., Braun, E.L., Kimball, R.T. 2022. Gene tree quality affects empirical coalescent branch length estimation. *Zool. Scr.*, 51: 1–13.

Forthman, M., Gil-Santana, H.R. 2021. Two new species of *Rhiginia* Stål, 1859, with taxonomical notes on species in the “*cruciata*-group” of this genus and an updated key to the New World genera of Ectrichodiinae (Heteroptera, Reduviidae). *Zootaxa*, 4952: 201–234.

Forthman, M. 2021. Two new species of *Abelocephala* (Heteroptera: Reduviidae) from Taiwan. *Zootaxa*, 4920: 278–286.

Forthman, M., Miller, C.W., Kimball, R.T. 2020. Phylogenomics of the leaf-footed bug subfamily Coreinae (Hemiptera: Coreidae). *Insect Syst. Divers.*, 4: 2*.*

Emberts, Z., St. Mary, C.M., Howard, C.C., Forthman, M., Bateman, P.W., Somjee, U., Hwang, W.S., Li, D., Kimball, R.T., Miller, C.W. 2020. The evolution of autotomy in leaf-footed bugs. *Evolution*, 74: 897–910.

Matzinger, E.E., Forthman, M. 2019. Identification key to the genera of the tribe Gonocerini (Insecta: Hemiptera: Coreidae). *UF J. Undergrad. Res.*, 21: 1–7.

Forthman, M., Miller, C.W., Kimball, R.T. 2019. Phylogenomic analysis suggests Coreidae and Alydidae (Hemiptera: Heteroptera) are not monophyletic. *Zool. Scr*., 48: 520–534.

Kieran, T.J., Gordon, E., Forthman, M., Hoey-Chamberlain, R., Kimball, R.T., Faircloth, B.C., Weirauch, C., Glenn, T.C. 2019. Insights from an ultraconserved element bait set designed for hemipteran phylogenetics integrated with genomic resources. *Mol. Phylogenet. Evol*., 130: 297–303.

Chen, D., Braun, E.L., Forthman, M., Kimball, R.T., Zhang, Z. 2018. A simple strategy for recovering ultraconserved elements, exons, and introns from low coverage shotgun sequencing of museum specimens: placement of the partridge genus *Tropicoperdix* within the Galliformes. *Mol. Phylogenet. Evol.*, 129: 304–314.

Forthman, M., Weirauch, C. 2018. Phylogenetic comparative analysis supports aposematic colouration–body size association in millipede assassins (Hemiptera: Reduviidae: Ectrichodiinae). *J. Evol. Biol.*, 31: 1071–1078.

Forthman, M., Weirauch, C. 2017. Millipede assassins and allies (Heteroptera: Reduviidae: Ectrichodiinae, Tribelocephalinae): total evidence phylogeny, revised classification and evolution of sexual dimorphism. *Syst. Entomol*., 42: 575–595.

Weirauch, C., Forthman, M., Grebenikov, V., Baňař, P. 2017. From Eastern Arc Mountains to extreme sexual dimorphism: systematics of the enigmatic assassin bug genus *Xenocaucus* (Hemiptera: Reduviidae: Tribelocephalinae). *Org. Divers. Evol.,* 17: 421–445.

Forthman, M., Weirauch, C. 2016. Phylogenetics and biogeography of the endemic Madagascan millipede assassin bugs (Heteroptera: Reduviidae: Ectrichodiinae). *Mol. Phylogenet. Evol*., 100: 219–233.

Forthman, M., Chłond, D., Weirauch, C. 2016. Taxonomic monograph of the endemic millipede assassin bug fauna of Madagascar (Heteroptera: Reduviidae: Ectrichodiinae). *B. Am. Mus. Nat. Hist.*, 400: 1–152.

Zhang, J., Gordon, E., Forthman, M., Hwang, W.S., Walden, K., Swanson, D., Johnson, K.P., Meier, R., Weirauch, C. 2016. Evolution of the assassin’s arms: insights from a phylogeny of combined transcriptomic and ribosomal DNA data (Heteroptera: Reduvioidea). *Sci. Rep.,* 6: 22177.

Weirauch, C., Berenger, J.M., Berniker, L., Forero, D., Forthman, M., Frankenberg, S., Freedman, A., Gordon, E., Hoey-Chamberlain, R., Hwang, W.S., Michael, A., Udah, O., Watson, C., Zhang, G., Zhang, J. 2014. An illustrated identification key to assassin bug subfamilies and tribes (except Emesinae). *Can. J. Arthropod Ident.*, No. 26.

Forthman, M., Weirauch, C. 2012. Toxic associations: a review of the predatory behaviors of millipede assassin bugs (Hemiptera: Reduviidae: Ectrichodiinae). *Eur. J. Entomol.*, 109: 147–153.

**Pre-print Manuscripts**

Forthman, M., Gordon, E.R.L., Kimball, R.T. 2022. Low hybridization temperatures improve target capture success of invertebrate loci. *bioRxiv.* doi:10.1101/2022.03.02.482542

Miller, C.W., Kimball, R.T., Forthman, M. 2023. Evolution of multi-component weapons in the superfamily of leaf-footed bugs. *bioRxiv*. doi:10.1101/2023.04.24.538071

**Presentations** (\* Invited; † Co-presented)

Forthman, M., Miller, C.W., Kimball, R.T. 2022. Phylogenomic analysis suggests evolutionary convergence of male weapon traits in leaf-footed bugs and allies (Heteroptera: Coreoidea). 7th Quadrennial Meeting of the International Heteropterists’ Society, Barcelona, Spain.

\*Forthman, M., Downie, C. Miller, C.W., Kimball, R.T. 2022. What’s the buzz? Surveying a stridulatory mechanism in “Coreidae” with consideration of recent phylogenomic results. “True Bug Tuesday” virtual event, International Heteropterists’ Society.

†Greenway, G., Forthman, M. 2019. The power of virtual exchange: connecting your classroom to the outside world. Teaching Enhancement Symposium, University of Florida, Gainesville, FL, USA.

Forthman, M., Miller, C.W., Kimball, R.T. 2018. Phylogenomic analysis of the Coreoidea (Hemiptera: Heteroptera) demonstrates non-monophyly of the families Coreidae and Alydidae. 6th Quadrennial Meeting of the International Heteropterists’ Society, La Plata, Argentina.

†Donnelly, A., Forthman, M., Drew, J. 2018. Course-based undergraduate research experience (CURE) initiative. Teaching Enhancement Symposium, University of Florida, Gainesville, FL, USA.

\*Forthman, M. 2018. Legging across Southern Africa. Friends of the Entomology Research Museum, University of California, Riverside, CA, USA.

\*†Miller, C.W., Cirino, L.A., Forthman, M. 2017. Fusing research and education through classroom undergraduate research experiences. Fusing Research and Teaching Conference, University of Florida, Gainesville, FL, USA.

\*†Carlson, P., Cirino, L.A., Forthman, M., Joseph, P., Somjee, U. 2017. Science communication: how to effectively communicate your science. Department of Entomology and Nematology Seminar, University of Florida, Gainesville, FL, USA.

\*Forthman, M., Weirauch, C. 2016. Millipede assassin bugs (Heteroptera: Reduviidae: Ectrichodiinae) show off: evolution of aposematic coloration and extreme sexual dimorphism. International Congress of Entomology XXV, Orlando, FL, USA.

Forthman, M., Weirauch, C. 2015. Showing off: investigating the evolution of aposematism and sexual dimorphism in millipede assassin bugs (Heteroptera: Reduviidae: Ectrichodiinae). 63rd Entomological Society of America Meeting, Minneapolis, MN, USA.

Forthman, M., Weirauch, C. 2014. The systematics of the endemic millipede assassin bugs of Madagascar (Heteroptera: Reduviidae: Ectrichodiinae). Fifth Quadrennial Meeting of the International Heteropterists’ Society, Washington, DC, USA.

Forthman, M., Weirauch, C. 2013. Fragments of time: divergence dating and biogeographic history of Malagasy millipede assassin bugs. 61st Entomological Society of America Meeting, Austin, TX, USA.

\*Forthman, M., Weirauch, C. 2012. Madagascar’s millipede assassin bugs (Hemiptera: Reduviidae: Ectrichodiinae): a treasure trove of diversity. Heteroptera Symposium, 60th Entomological Society of America Meeting, Knoxville, TN, USA.

Forthman, M., Weirauch, C. 2011. Madagascar’s millipede assassin bugs (Hemiptera: Reduviidae: Ectrichodiinae): taxonomy, phylogenetics, and sexual dimorphism. 59th Entomological Society of America Meeting, Reno, NV, USA.

\*Forthman, M. 2011. A predator-prey relationship: Ectrichodiinae and Diplopoda. 2nd International Reduviid Workshop, University of California, Riverside, CA, USA.

**Grants, Fellowships, & Awards**

2023–Present NSF, Division of Environmental Biology, “Collaborative Research: Spatial phylogenomics and diet evolution of the megadiverse plant bugs (Hemiptera: Miridae),” DEB-2317209; PI: Christiane Weirauch, Co-PIs: Jason Bond, Michael Forthman; $1,601,472 (portion to M. Forthman: $37,812)

2020 NSF REU Supplement for CAREER Award IOS-1553100; PI: Christine W. Miller; $19,762 (written by M. Forthman)

2014 Dissertation Year Program Award, University of California, Riverside, CA, USA, $7,200

2014 Nils and Annemarie Møller-Andersen Award, International Heteropterists’ Society, $650

2013 Earle C. Anthony Graduate Student Travel Award, University of California, Riverside, CA, USA,

$500

2013 Graduate Dean’s Dissertation Research Grant, University of California, Riverside, CA, USA,

$650

2013 Outstanding Teaching Assistant Award, University of California, Riverside, CA, USA

2012 Entomological Society of America, SysEB Travel Award, $1,900

2010–2016 Dean’s Distinguished Fellowship, 2010-2016, University of California, Riverside, CA, USA,

$35,566

2010–2016 NSF, Division of Environmental Biology, “Taxonomic expertise in true bugs: systematic and

monographic research on assassin bugs (Heteroptera: Reduviidae),” DEB-093333853; PI: Christiane Weirauch; $749,371 (portion for Ph.D. student support)

**Organizational Memberships**

2021–Present Pan-Pacific Entomological Society, Member

2017 Society of Systematic Biologists, Member

2013–Present International Heteropterists’ Society, Member

2012–2015 Willi Hennig Society, Member

2010–2021 Entomological Society of America,Systematics, Evolution, and Biodiversity Section, Member;

Student Representative on Committee on Student Affairs(2013–2015)

**Meeting, Symposium, & Seminar Organization**

2023–Present California Department of Food and Agriculture Plant Pest Diagnostics Center Seminar Series, Organizer, Sacramento, CA, USA

2017 Entomological Society of America SysEB Section Symposium*,* Co-organizer, “Breaking into the

biobank: promising methods for sequencing DNA from museum arthropod specimens”, Denver, CO, USA

2015 Entomological Society of America Member Symposium*,* Co-organizer, “Synergy in agricultural pest control: use of interdisciplinary approaches to feed a growing population”, Minneapolis, MN, USA

2015 Entomological Society of America Organized Meeting*,* Co-organizer, “Heteropterist Conference”, Minneapolis, MN, USA

2014 Entomological Society of America Member Symposium*,* Co-organizer, “Grand challenge: effective science education with communication”, Portland, OR, USA

2013 Entomological Society of America SysEB Section Symposium*,* Co-organizer, “Pitfalls, malaise, and hoping it all pans out: the state of the art in field collecting methods for insect biodiversity surveys”, Austin, TX, USA

2012 XXXI Willi Hennig Meeting, Organizing Committee, Riverside, CA, USA

**Editorial Service**

2023–Present Subject Editor, Coreoidea, *Journal of the International Heteropterists’ Society*

2020–Present Subject Editor, Hemiptera, *Pan-Pacific Entomologist*

**Journal & Book Referee**

**Journals:** *Archives of Insect Biochemistry and Physiology, Austral Entomology, Biodiversity Data Journal, Cladistics, Development Genes and Evolution, Entomologica Americana, European Journal of Entomology, European Journal of Taxonomy, Insect Systematics and Evolution, Journal of Chemical Ecology, Proceedings of the Entomological Society of Washington, Proceedings of the Royal Society B: Biological Sciences, Systematic Entomology, Zoologischer Anzeiger, Zootaxa*

**Books**: Schuh, R.T., Weirauch, C. (2nd ed.) *True Bugs of the World*. Five chapters on Coreoidea families.

**Workshops & Continuing Education**

2023 TaxonWorks Together 2023, virtual meeting, TaxonWorks Community

2023 Invasive Snail and Slug Virtual Workshop, Washington Invasive Species Council

2023 Executive Academy Program, California Department of Food and Agriculture, Sacramento, CA, USA

2016 Communications Boot Camp for Scientists, American Institute of Biological Sciences, Washington, DC, USA

2016 College of Agriculture and Life Sciences Teacher’s College, University of Florida, Gainesville, FL, USA

2013 Biological Specimen Informatics Short Course, American Museum of Natural History, New York, NY, USA

2012 2nd International Reduviid Workshop, University of California, Riverside, CA, USA

2010 Organization for Tropical Studies: Biodiversity of True Bugs (Heteroptera) Field Course, Costa Rica

**Collection Management**

2020–Present Curator of Heteroptera and Thysanoptera, California State Collection of Arthropods, California

Department of Food and Agriculture, Sacramento, CA, USA

2015–2016 Entomology Research Museum, University of California, Riverside, CA, USA — curated

Cicadellidae collection as part of NSF Advance Digitization of Biological Collections Tri-Trophic Thematic Collection Network

2010–2016 Heteroptera Systematics Lab, University of California, Riverside, CA, USA

2011 Entomology Research Museum, University of California, Riverside, CA, USA — curated

Entomology Teaching Collection

**Teaching**

2018 **Insect Research and Scientific Engagement**, Instructor of record, University of Florida, Gainesville, FL, USA

2017 **Insect Research and Scientific Engagement**, Co-instructor, University of Florida, Gainesville, FL, USA

**Supervisory & Mentorship roles**

2024–Present **Undergraduate Student Internship Program**, California Department of Food and Agriculture, Sacramento, CA, USA — trained and supervised two students in any of the following: taxonomy, specimen digitization, morphological data collection, genitalic dissections, diagnostic resource development, character matrix generation, and biogeographic analyses. Students also received training in scientific research, including research design, ethical conduct in research, laboratory techniques, and science communication.

2016–2022 **Undergraduate Research Supervisor/Mentor**, University of Florida, Gainesville, FL, USA — trained and supervised 24 students in any of the following: insect rearing, host plant collection and documentation, horticulture, insect field collection and curation, taxonomy, specimen digitization, morphological data collection, greenhouse maintenance, experimental induction of autotomy, genitalic dissections, DNA extractions, and phylogenomic analyses. Engaged students in weekly discussions on primary scientific literature, guided students with presenting primary scientific literature to the lab, and mentored students with undergraduate research projects.

2021 **NSF REU Supervisor/Mentor**, California Department of Food and Agriculture, Sacramento, CA, USA — mentored and supervised three students on projects investigating resource allocation decisions made during the development of leaf-footed bugs (Coreidae). Students received training in scientific research, including research design, ethical conduct in research, laboratory techniques, field collection, diagnostics, and science communication.

2014–2015 **Graduate Research Assistant for NSF Advance Digitization of Biological Collections Tri- Trophic Thematic Collection Network**, University of California, Riverside, CA, USA — trained and supervised students in specimen digitization (e.g., slide imaging, georeferencing, specimen data entry), quality checked specimen data entries, supplied herbivorous Hemiptera and

parasitic Hymenoptera specimens with unique specimen identifier labels, and refined workflow to

increase efficiency and quality productivity. Quality checked plant host taxon names and data.

2014 **Undergraduate Research Mentor**, University of California, Riverside, CA, USA — mentored

one student in integrative taxonomic approaches to revise the genus *Xenocaucus* from Eastern Arc Mountains, Tanzania. Training involved specimen curation and digitization, character documentation, DNA extraction, PCR, sequence assembly and alignment, and phylogenetic analysis.

**Outreach**

2023–Present Local school outreach and public tours, California State Collection of Arthropods, California

Department of Food and Agriculture, Sacramento, CA

2023 State Scientist Day, California Association of Professional Scientists, Sacramento, CA

2020, 2023 Biodiversity Museum Day, Bohart Museum of Entomology, University of California–Davis,

Davis, CA

2020 Taxonomic Entomology outreach video, Department of Entomology, Washington State

University, Pullman, WA

2010–2016 University of California–Riverside Department of Entomology outreach program, Riverside,

CA

2006 Education and Outreach Intern at Arkansas Little Rock Zoo, Education and Outreach Division,

Little Rock, AR

**Fieldwork**

Cameroon, Costa Rica, Honduras, South Africa, South Korea, Eswatini, USA (Arkansas, California, Florida, Virginia, Wisconsin)