

## CURRICULUM VITAE

### Carrie A. Kiel

PhD - Rancho Santa Ana Botanic Garden – 1500 North College Ave  
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### RESEARCH INTERESTS

Plant evolutionary biology, systematics, comparative methods, phylogenomics, morphometrics, plant anatomy, conservation, taxonomy, and biogeography.

### PROFESSIONAL PREPARATION

University of Pittsburgh - Pittsburgh, PA—Environmental Studies, Degree: B.A., **1997–2001**.

Claremont Graduate University - Claremont, CA—Degree: Botany M.S., **2007–2010**.

Thesis title: The *Mirandea* clade (Acanthaceae, Justicieae, *Tetramerium* Lineage): Phylogenetic signal from molecular data and micromorphology makes sense of taxonomic confusion caused by remarkable diversity of floral form (advisor: Lucinda A. McDade).

Claremont Graduate University - Claremont, CA— Degree: Botany Ph.D., **2010–2016**.

Dissertation title: Unraveling relationships among the morphologically diverse and taxonomically complex 'justicioid' lineage (Acanthaceae) and the evolution of androecial form in New World *Justicia* (advisor: Lucinda A. McDade).

### PROFESSIONAL APPOINTMENTS

Postdoctoral Researcher, Rancho Santa Ana Botanic Garden, **July 2016–present**.

Projects include: (1) Floral evolution in *Justicia* and examining species relationships using phylogenomic data, comparative methods, and morphology (2) Biogeographical patterns and diversification rates in the *Tetramerium* lineage (3) Evolution of floral color in *Ruellia*: Quantifying floral spectral reflectance data and examining evolutionary patterns using RADseq data (4) Elucidating relationships and revising classification of Justicieae (5) Phylogenetic relationships among *Barleria* (6) New treatment of Costa Rican *Justicia* (7) Phylogenomics of *Monechma* (justicioids).

Visiting Assistant Professor, Claremont McKenna College – Keck Science Department, **January 2018–June 2019**.

Graduate Research and Teaching Assistant, Claremont Graduate University / Rancho Santa Ana Botanic Garden. **2007–2016**.

Responsible for molecular labwork and phylogenetic / genomic data assembly and analyses on several NSF funded projects on *Iris*, *Passiflora*, Poaceae, Acanthaceae and Polemoniaceae. I also worked with the Conservation Program assisting with rare plant reports, mapping, collections, and rare plant surveys. Served as a Teaching Assistant for Plant Anatomy and Morphology, Cell Biology, and the Summer Research Institute for Undergraduates.

Lab Manager – Interim, Molecular and Anatomy Labs, Rancho Santa Ana Botanic Garden, **2012; 2019**.

Trained students in laboratory techniques and safety, maintained equipment, supplies and stock chemicals, conducted Garden's contract sequencing, managed billing, and organized proper hazardous waste disposal.

Collections Manager - Interim, The Academy of Natural Sciences at Drexel University, **2006–2007**.

Responsible for the maintenance of the general, types, and special collections (~1.5 million specimens) in the herbarium, management of loans and collection digitization projects, integrated pest management, supervision of student assistants and volunteers, and participated in various outreach projects

Curatorial & Research Assistant, The Academy of Natural Sciences at Drexel University, **2002–2007**.  
Assisted in herbarium collection preservation, re-housing the collection, loan management, and grant writing. Conducted molecular lab work for an NSF funded project on Acanthaceae.

Research Intern and Field Assistant, Frick Environmental Center, Pittsburgh, PA, **2000–2001**.  
Conducted work in rare plant conservation, weed eradication, and outreach to K-4 students.

### **LARGE GRANTS**

**2018–2022. National Science Foundation** (DEB-1754845): Collaborative Research: New World *Justicia* s.l.: A microcosm for understanding covariation of floral traits and pollinators in a phylogenomic context. PIs: C. Kiel, L. McDade, E. Tripp, A. Fisher. **\$558,163 to Kiel**.

### **SMALL GRANTS AND AWARDS**

**2018.** Bok Tower Gardens – Rare plant conservation studies – \$5000

**2015–2016.** Bok Tower Gardens – Rare plant conservation studies – \$5000

**2015–2016.** Alumni Fellowship Award – Rancho Santa Ana Botanic Garden

**2015.** American Society of Plant Taxonomists – George R. Cooley Award for Best Contributed Paper in Plant Systematics

**2013.** Botanical Society of America – Graduate Student Research Grant – \$500.

**2012.** US Fish and Wildlife Service – Award for Rare Plant Conservation.

**2011.** Torrey Botanical Society – Graduate Student Field Research Fellowship – \$2500.

**2011.** Claremont Graduate University – C. Raymond and Marion Buck – Educational Fellowship Award.

**2009.** American Society of Plant Taxonomists – Graduate Research Grant – \$900.

**2008.** GIGI Foundation – Rare Plant Conservation Grant – \$2500.

**2008.** California Native Plant Society, San Diego Chapter, Conservation Grant – \$1000.

**2008–2013.** Claremont Graduate University –Travel / Materials Grant – \$1800 (\$300 per year listed).

### **PUBLICATIONS (peer reviewed)**

**In press.** Darbyshire, I., **Kiel, C.A.**, Daniel, T.F., McDade, L.A. & Luke, Q. Two new genera of Acanthaceae from tropical Africa. *Kew Bulletin*.

**2019.** McDade, L.A., Hammel, B.E. & **Kiel, C.A.** New species, new combinations, and new synonymies towards a treatment of Acanthaceae for the Manual de Plantas de Costa Rica. *Aliso*: 36(1): 27–45.

**2019.** Darbyshire, I., Fisher, A.E., **Kiel, C.A.** & McDade, L.A. Phylogenetic relationships among species of *Barleria* (Acanthaceae, Lamiales): Molecular data reveal complex patterns of evolution and support a revised classification. *Taxon*.

**2018.** **Kiel, C.A.**, Daniel, T.F. & McDade, L.A. New World 'justicioids' (Justicieae: Acanthaceae): major lineages, morphological patterns and widespread incongruence with classification. *Systematic Botany* 43: 459–484.

**2018.** McDade, L.A., Daniel, T.F. & **Kiel, C.A.** The *Tetramerium* lineage revisited: phylogenetic relationships reveal polyphyly of many New World genera accompanied by rampant evolution of floral morphology. *Systematic Botany* 43: 97–116.

**2017.** **Kiel, C.A.**, Daniel, T.F., Darbyshire, I. & McDade, L.A. Unraveling relationships in the morphologically diverse and taxonomically challenging 'justicioid' lineage (Acanthaceae, Justicieae). *Taxon* 66: 645–675.

**2015.** Fisher, A. E., McDade L. A., **Kiel C. A.**, Khoshravsh R., Sage, T.L. & Sage R.F. Phylogenetics of *Blepharis* (Acanthaceae) and the origin of C4 photosynthesis in *Blepharis* section *Acanthodium*.

*International Journal of Plant Sciences* 176: 770–790.

- 2014. Kiel, C.A.** & McDade, L.A. The *Mirandea* clade (Acanthaceae, Justiceae, Tetramerium Lineage): Phylogenetic signal from molecular data and micromorphology makes sense of taxonomic confusion caused by remarkable diversity of floral form. *Systematic Botany* 39: 950–964.
- 2012.** McDade, L.A., Daniel, T.F., **Kiel, C.A.** & Borg, J.A. Phylogenetic placement, delimitation and relationships among genera of the enigmatic Nelsonioideae (Lamiales: Acanthaceae). *Taxon* 61: 637–651.
- 2012. Kiel, C.A.** A conservation plan for *Frankenia palmeri* (Palmer's frankenia) (Frankeniaceae). Rancho Santa Ana Botanic Garden Occasional Publications, Number 12. viii + 14 p.
- 2011. Kiel, C.A.** & R.J. Little. 2012. Frankeniaceae, pp. 808. In B.G. Baldwin, D.H. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti and D.H. Wilken [eds.], *The Jepson Manual: Vascular Plants of California* 2<sup>nd</sup> ed., University of California Press, Berkeley, CA, USA.
- 2008.** McDade, L.A., Daniel, T.F., & **Kiel, C.A.** Towards a Comprehensive Understanding of Phylogenetic Relationships Among Lineages of Acanthaceae s.l. (Lamiales). *American Journal of Botany*. 95: 1136–1152.
- 2008.** Daniel, T.F., McDade, L.A., Manktelow, M. & **Kiel, C.A.** Phylogenetics, biogeography and the evolution of pollinator relationships in the *Tetramerium* lineage. *Systematic Botany* 33: 416–432.
- 2006. Kiel, C.A.,** McDade, L.A., Daniel, T.F. & Champluvier, D. Phylogenetic delimitation of Isoglossinae (Justiceae: Acanthaceae) and relationships among constituent genera. *Taxon* 55: 683–694.
- 2005.** McDade, L.A., Daniel, T.F., **Kiel, C.A.** & Vollesen K. Phylogenetic relationships among Acantheae (Acanthaceae): major lineages present contrasting patterns of molecular evolution and morphological differentiation. *Systematic Botany* 30: 834–862.

Manuscripts and floral treatments in review:

- (1) Acanthaceae - New Manual of Vascular Plants of Northeastern United States and Adjacent Canada.–**C.A. Kiel** & E.A. Tripp.
- (2) *Justicia* (Acanthaceae) of Costa Rica: treatment for Manual de Plantas de Costa Rica, B. E. Hammel and M. Grayum [eds.].

Manuscripts in prep:

- (1) The evolution of androecial form in New World *Justicia*: Anther complexity and associations to floral form. – to be submitted in August 2019 to *Molecular Phylogenetics and Evolution* –**Kiel, C.A.** & McDade, L.A.
- (2) Justiceae II – to be submitted in July 2019. – McDade, L.A. & **Kiel. C.A.**
- (3) Phylogenomic relationships of *Monechma*. – Kiel, C.A., Darbyshire, I., McDade, L.A., Ashroth, C., & Tripp, E.A.

Web publications:

McDade, L.A. and **Kiel, C.A.** - Acanthaceae. Tree of Life Web Project.  
<http://www.tolweb.org/Acanthaceae>

**TEACHING EXPERIENCE**

**Visiting Assistant Professor**, Claremont McKenna College, Keck Sciences Department, **Spring 2019**. BIO 156L Genomics and Bioinformatics (including lab), upper division undergraduate course: Designed and implemented new curriculum. The goal of this course was to equip students with the knowledge and

skills to handle, analyze, visualize, and interpret various types of genomic data. The students applied these techniques to address important biological questions and they discussed current trends in genomic science through a review of relevant literature. Taught collaboratively with Dr. Findley Finseth and Nico Medina, PhD Candidate.

**Visiting Assistant Professor**, Claremont McKenna College, Keck Sciences Department, **Spring 2018**. BIO 44 Introduction to Biology (including lab), undergraduate course: Developed curriculum for majors and non-majors. This class covered broad topics in evolution and phylogenetics, diversity and the history of life on Earth, plant biology, ecology, population biology, and conservation.

**Instructor**, Rancho Santa Ana Botanic Garden, **Summer 2013, 2014, 2018**. Summer Research Institute, graduate / undergraduate course. This is an intensive two week course for graduates and undergraduates that teaches molecular (DNA extraction, PCR, sequencing), anatomical, and SEM techniques. For these courses I also helped design curriculum and coordinate fieldtrips.

**Teaching Assistant**, Claremont Graduate University, **Spring 2013**. Plant Anatomy and Morphology, graduate / undergraduate course. Designed the curriculum including quizzes and exams for the laboratory portion of the course, trained students in SEM, microtomy, staining, and sectioning, and conducted guest lectures for two classes.

**Workshop Instructor**, Pomona College, Dept. of Physics, PAYS Program, **Summer 2013–2016**. Introductory Botany, high school. Taught introduction to plant collections, What is a herbarium?, and basic botany.

**Workshop Instructor**, Rancho Santa Ana Botanic Garden, **2013–2017**. “Botany in a Day”, adult learners. Designed curriculum and led a two-day workshop on important California plant groups, basic plant taxonomy and morphology, plant identification, and California habitat diversity.

**Teaching Assistant**, Pomona College, Dept. of Biology, **Fall 2008**. Cell Biology, undergraduates course. Conducted two class lectures and assisted in laboratory sessions and evaluation of student projects and exams.

## **MENTORING**

### **Undergraduate students mentored**

- Corine Astroth, Scripps College (ddRADseq library prep, bioinformatics, comparative methods, SEM, and anatomical methods)
- Wilfrido Batista, Pitzer College (molecular lab work)
- Ana Gao, Scripps College (phylogenetics, molecular lab work)
- Joaquina Hernandez, Citrus College (now Cal Poly Pomona College) (comparative methods, SEM, morphology)
- Sagrika Sri Jawadi, Scripps College (phylogenetics, molecular lab work)

## **CONTRACT WORK**

**2015 – current**: Population genetics studies to support the federal listing of rare and endangered species. In collaboration with Bok Tower Gardens, FL.

## **LABORATORY EXPERIENCE AND DATA ANALYSES**

- (1) 16 years experience in molecular lab research designing and implementing both individual and collaborative research projects, and lab management; **skills include**: DNA extraction, PCR, primer design, cloning, Sanger and Illumina MiSeq/HiSeq sequencing, genomic library preparation, RADSeq, Hyb-Seq, and plastome sequencing.
- (2) Microscopy: SEM, compound, and dissecting.
- (3) Anatomical techniques: tissue embedding, microtomy, and staining.
- (4) Data Analyses: R, Python, Unix, de novo and reference-guided assemblies for phylogenomics.

## **NATURAL HISTORY COLLECTIONS AND BOTANIC GARDEN WORK**

(1) **Museum Curation Work:** Specimen preservation, management of data capture and specimen imaging projects, loan management, integrated pest management, tours, outreach, grant writing assistance, and general education at PH Herbarium (2002-2007); I have visited and provided determinations in Acanthaceae at many national and international herbaria (2008-present).

(2) **Botanic Garden Service:** Exhibit design and creation, conducted tours and plant ID workshops, public outreach, conservation program assistance: including rare plant reports, vegetation mapping, rare plant assessment, and worked various donor events at Rancho Santa Ana Botanic Garden.

## **FIELDWORK**

Experience in fieldwork both nationally and internationally with botanical collections from Alabama, California, Florida, New Jersey, Pennsylvania, Texas, Costa Rica, Mexico, and Kenya. These collections are housed at worldwide herbaria. Field studies are planned for Colombia, Costa Rica, and Mexico in 2019 and Brazil and Bolivia in 2020.

## **PROFESSIONAL PREPARATION WORKSHOPS**

**2018.** Introduction to Python Workshop – University of California at Riverside

**2017.** HPCC Cluster (Biocluster) Workshop – University of California at Riverside

**2016.** Creating Rubrics and Assessments - *Preparing Future Faculty*: Claremont Graduate University.

**2016.** Student Learning Outcomes (SLOs) & Aligning Assessments to Outcomes – *Preparing Future Faculty*: Claremont Graduate University.

**2015.** Hyb-Seq mini workshop on Next-Generation Sequencing Marker Development: Rancho Santa Ana Botanic Garden.

**2015.** Programming for Everybody: Python (4 weeks), Coursera.org.

**2014.** R Programming (4 weeks), Coursera.org.

**2014.** Understanding Learning and Motivation and Changing Contexts in Higher Education – *Preparing Future Faculty*: Claremont Graduate University.

**2013.** Reflective Practice & Teaching Philosophy – *Preparing Future Faculty*: Claremont Graduate University.

## **INVITED SEMINARS**

**2019.** New World *Justicia* s.l.: A microcosm for understanding covariation of floral traits and pollinators in a phylogenomic context. – Ohio University, Athens, OH.

**2017.** Diversification rates and pollinator mediated trait evolution in New World *Justicia* - The University Club, Claremont, CA.

**2016.** Unraveling relationships in the species rich 'justicioid' lineage and pollinator mediated trait evolution in New World *Justicia* – California State University, Long Beach, CA.

**2016.** Unraveling relationships in the species rich 'justicioid' lineage and pollinator mediated trait evolution in New World *Justicia* – University of Pittsburgh, Pittsburgh, PA.

## **PAPERS AND POSTERS PRESENTED AT SCIENTIFIC MEETINGS**

**2004.** Phylogenetic patterns among New World Acantheae: Widespread polyphyly and poor resolution present a marked contrast with Old World Acantheae. Botany 2004, Snowbird, UT (L.A. McDade, T.F. Daniel, C.A. Kiel).

**2004.** Phylogenetic Relationships within the Subtribe Isoglossinae (Acanthaceae). Botany 2004, Snowbird, UT (C.A. Kiel, T.F. Daniel, L.A. McDade).

**2005.** Bird Pollination has evolved multiple times in the *Tetramerium* group (*Tetramerium* Lineage,

Justicieae, Acanthaceae). Botany 2005, Austin, TX (C.A. Kiel, M. Manktelow, T.F. Daniel, K. Andreasen, P.-H. Holmqvist, L.A. McDade).

**2005.** Molecular phylogenies reveal multiple origins for distinctive pollen types in Acanthaceae. Botany 2005, Austin, TX (L.A. McDade, C.A. Kiel, T.F. Daniel).

**2006.** Relationships among the major lineages of Acanthaceae s.l.: The Big Picture. Botany 2006, Chico, CA (L.A. McDade, T.F. Daniel, C.A. Kiel).

**2006.** The species-rich and biologically diverse “justicioids” (Acanthaceae: Justicieae): phylogeny, biogeography, and morphological evolution. Botany 2006, Chico, CA (C.A. Kiel, L.A. McDade, T.F. Daniel).

**2007.** Justicieae revisited: Increased taxon sampling and characters support a new lineage and more “justicioid” Diclipterinae. Botany 2007, Chicago, IL (L.A. McDade, C.A. Kiel, T.F. Daniel).

**2008.** Species richness in Acanthaceae: a phylogenetic perspective. Botany 2008, Vancouver, BC, Canada (L.A. McDade, C.A. Kiel, T.F. Daniel, E.A. Tripp).

**2009.** Relationships, character evolution, and biogeographic patterns in the phylogenetically pivotal lineage Nelsonioideae (Acanthaceae s.l.). Botany 2009, Snowbird, UT (L.A. McDade, T.F. Daniel, G. Ocampo, J. Zúñiga, C.A. Kiel).

**2009.** Relationships among “justicioids” (Acanthaceae): strong support for some surprising aspects of relationships. Botany 2009, Snowbird, UT (C. Kiel, L.A. McDade, T.F. Daniel).

**2010.** The *Mirandea* Clade (Acanthaceae): New taxonomic, morphological, and phylogenetic insights. Botany 2010, Providence RI (C.A. Kiel, L.A. McDade, T.F. Daniel).

**2010.** The *Tetramerium* Lineage (Acanthaceae: Justicieae) revisited: A story of taxonomic polyphyly and parallel evolution of floral morphology. Botany 2010, Providence, RI (L.A. McDade, C.A. Kiel, T.F. Daniel).

**2011.** Making sense of massive polyphyly of the genus *Carlwrightia* (Acanthaceae: Justicieae: *Tetramerium* Lineage). Botany 2011, St. Louis, MO (L.A. McDade, T.F. Daniel, C.A. Kiel).

**2011.** Unraveling relationships among the morphologically diverse and taxonomically complex New World Justicioids. Botany 2011, St. Louis, MO (C.A. Kiel, L.A. McDade, T.F. Daniel).

**2013.** Diffuse co-evolution between hummingbirds and New World Plants? Botany 2013, New Orleans, LA (E. Tripp, C.A. Kiel, L. A. McDade).

**2013.** Floral transcriptions in Acanthaceae: understanding macroevolutionary constraints on color transitions. Botany 2013, New Orleans, LA, (E. Tripp, L. A. McDade, C. A. Kiel, T. Glenn).

**2013.** Trait evolution and floral diversification of Neotropical *Justicia* (Acanthaceae). Botany 2013, New Orleans, LA, (C.A. Kiel, L. A. McDade, E. Tripp).

**2015.** The evolution of androecial form in the ‘justicioid’ lineage (Acanthaceae). Botany 2015, Edmonton, (C.A. Kiel & L.A. McDade).

**2016.** Diversification rates and floral form evolution in the ‘justicioid’ lineage. Botany 2016, Savannah, GA.

**2017.** New World *Justicia* (Acanthaceae): A microcosm for understanding covariation of floral traits and pollination systems in a phylogenetic context. Botany 2017. Ft. Worth, TX.

**2018.** How many ways are there to make a purple flower? Botany 2018. Rochester, MN. (L.A. McDade, C.A. Kiel, N. Medina, M. Lujan, Y. Zhuang, M. Schreiber, H. Stone, E. Berbeo, & E. Tripp).

## **SERVICE AND OUTREACH**

**Review Panel:** National Science Foundation – 2019 virtual panel.

**Ad-hoc Manuscript Reviews:** *Aliso*, *American Midland Naturalist*, *Annals of Botany*, *Botanical Journal of the Linnean Society (UK)*, *Journal of Botanical Research Inst. of Texas*, *Kew Bulletin*, *Molecular Ecology*, *Nordic Journal of Botany*, *Novon*, *Plant Ecology and Evolution*, *Proceedings of the California Academy of*

*Natural Sciences, Systematic Botany, and Taxon.*

**Society Service:** Treasurer and Board Member at Large: Southern California Botanists **2009–present**; Treasurer and Secretary of Philadelphia Botanical Club **2005–2007**; Graduate Student Member of American Society of Plant Taxonomists (ASPT) Collections Committee **2011–2014**; ASPT Promotions Committee **2015–present**.

**Outreach:** Volunteer training and public educational K-12 outreach programs: Claremont High School 2018; Pomona College **2014 – present**; Rancho Santa Ana Botanic Garden **2007–present**; Academy of Natural Sciences of Drexel University **2002–2007**.

### **SOCIETY MEMBERSHIPS**

American Society of Plant Taxonomists, Botanical Society of America, California Native Plant Society, Philadelphia Botanical Club, Torrey Botanical Society, Society for Systematic Biology, and Southern California Botanists.