# MARY KATHRYN BUSBY

marykathrynbusby@gmail.com ⋄ (+1) 512-264-5579
2766 E. Stratford Drive, Tucson, AZ 85716
www.katbeescience.com

## SPECIALIZATION

**Native Bees, Climate Ecology, Plant-Pollinator Interactions, Conservation, Vizualization**

## EDUCATION

**The University of Arizona** **July 2022**

**Ph.D. - Entomology and Insect Science**
**Minor - Ecology and Evolutionary Biology**

***Dissertation:***
**Extreme Heat in the Nest of a Desert Native Bee, *Xylocopa californica arizonensis* (Hymenoptera: Apidae)**

***Committee:***
**Judith L. Bronstein (Chair), Stephen Buchmann, Goggy Davidowitz, Kathleen Prudic**

---

**The University of Texas at Austin** **December 2009**

**B.S. - Biology: Ecology, Evolution and Behavior**
**B.A. - Fine Arts: Studio Art**

## ACADEMIC POSITIONS

**United States Geological Survey (Wildlife Biologist)** **2020 - Present**

- **Pollinator ecology: Focus on native bee surveys, and Joshua tree - moth interaction**
- **PI: Kathryn A. Thomas, Contact at: kathryn_a_thomas@usgs.gov**

**The University of Arizona (Lab Instructor)** **2016, 2018**

- **MCB 181L: Introductory Biology Lab, Molecular and Cellular Biology**

**The University of Arizona (Teaching Assistant)** **2017 - 2018, 2019 - 2020**

- **Courses: *Ecology*, *Plant and Animal Genetics*, *Insect Discovery***

**The University of Texas: McDonald Observatory (Technician)** **2011 - 2015**

- **Opto-mechanical Technician at Hobby-Eberly Telescope, Research Engineering/Science Associate I**

**Cook Inlet Aquaculture Association (Field Intern)** **July 2010 - September 2010**

- **Student Conservation Association and Americorps**

## PUBLICATIONS

**2023** ***(In press):***

**Busby, M.K., Burkholder, C.M., Bronstein, J.L. (2023). Predator, Prey, and a Plant: Do Carpenter Bees *(Xylocopa californica)* position their nests within sotol *(Dasylirion wheeleri)* leaf rosettes to maximize protection from woodpeckers?. *The Southwestern Naturalist.***

**2022:**

**Jankauski, Mark, Cailin Casey, Chelsea Heveran, M. Kathryn Busby, and Stephen Buchmann. (2022). Carpenter bee thorax vibration and force generation inform pollen release mechanisms during floral buzzing. *Scientific reports*, 12, no. 1: 1-10.**

**2021:**

**Busby, M.K. (2021). Review of *Handbook of Citizen Science in Ecology and Conservation. The Quarterly Review of Biology.***

**2020:**

**Klein, B. A., & Busby, M. K. (2020). Slumber in a cell: Honeycomb used by honey bees for food, brood, heating... And sleeping. *PeerJ*, 8, 1–23. doi: 10.7717/peerj.9583**

**2023** ***(In prep; included here to illustrate research trajectory):***

**Busby, M.K., Buchmann, S.L., Bronstein, J.L. Desert bee thermal ecology: Who will survive a hotter future?**

**Busby, M.K., Davidowitz, G., Bronstein, J.L. Thermal tolerances across life stages indicate differential susceptibility to climate change**

**Busby, M.K., Davidowitz, G., Bronstein, J.L. Nest placement affects microenvironment of developing desert carpenter bee *Xylocopa californica arizonensis* (Hymenoptera: Apidae)**

## AWARDS, GRANTS, AND FELLOWSHIPS

Awards:

**Carruth Award** **2020 - 2021**
***The University of Arizona Graduate College***

- **Awarded annually for graduate student excellence in entomology and insect science**

**Data Visualization Challenge** **2021**
***The University of Arizona Libraries***

- **Recognized for combined boxplot and illustration of carpenter bee nest and woodpecker predation distributions**

**Education Award** **2018**
***The University of Arizona Entomology and Insect Science***

- **Awarded for teaching and outreach**

**Grants:**

**Travel Grant** **2018**
***The University of Arizona Center for Insect Science***

- **Funded travel expenses for the Entomological Society of America Pacific Branch Meeting 2017**

**Fellowships:**

**Data Science Ambassador** **2020 - 2021**
***The University of Arizona Data Science Institute***

- **Connected students with data science help and resources**

**Nancy Willingham Fellowship** **2020 - 2021**
***The University of Arizona Sky School***

- **Awarded to recognize accomplished Sky School Fellows (see below)**

**Sky School Fellow** **2016 - 2020**
***The University of Arizona Sky School***

- **Led K-12 students in developing and conducting inquiry-based research projects in an outdoor setting**

**Biosphere II Outreach Scholar** **Summer 2017**
***The University of Arizona Biosphere II***

- **Led K-12 students in developing and conducting inquiry-based research projects inside the Biosphere II**

**Ecology Internship** **Summer 2010**
***Student Conservation Association/Americorps***

- **See *"Academic Experience"* section for details**

## PRESENTATIONS

***Invited Talks:***

**2023 - M.K. Busby "The Native Bees of Arizona". (presenter) *The Arizona Monarch Collaborative Forestry Training*, Tonto Natural Bridge State Park, AZ. Professional training talk.**

**2023 - M.K. Busby "The Native Bees of Arizona". (presenter) *Cabeza Prieto Natural History Association*, Ajo, AZ.**

**2022 - M.K. Busby "What's Abuzz in the Desert? Arizona's Summer Bees!" (presenter). *Arizona-Sonora Desert Museum*, Tucson, AZ.**

**2022 - M.K. Busby "Diversity of Native Bees in Arizona" (presenter). *Southeast Arizona Butterfly Association*, (Virtual due to Covid-19).**

**2021 - M.K. Busby "The Native Bees of Arizona" (presenter) *The Arizona Native Plant Society*, (Virtual due to Covid-19).**

**2021 - M.K. Busby "The Native Bees of Arizona" (presenter) *Arizona Sonoran Desert Museum*, (Virtual due to Covid-19).**

**2021 - M.K. Busby "The Native Bees of Arizona" (presenter) *Menudo Society*, (Virtual due to Covid-19).**

**2017, 2018 - Busby, M.K. (presenter) *Borton Elementary*, outreach talk on native bees**

**2017, 2019 - Busby, M.K. (presenter) *Broadmoor Broadway Village Neighborhood Workshop*, outreach talk on native bees**

**2017 - M.K. Busby, "Native Bees: How You Can Help Save Our Hardest Working Pollinators" (presenter) *Sun City Oro Valley Homeowner's Association***

***Contributed Talks:***

**2023 - M.K. Busby, and K.A. Thomas. "Environmental and biological factors surrounding the interaction between a Joshua tree, its pollinating yucca moth, and their associated arthropod community". (presenter) *Ecological Society of America*, Portland, OR. Poster affiliated with USGS Southwest Biological Science Center, Tucson, AZ.**

**2022 - M.K. Busby "Scratchboard as a tool for illustrating insects." (presenter) *Entomological Society of America*, Vancouver, BC.**

**2022 - M.K. Busby, "Extreme Heat Effects on a Desert Carpenter Bee (*Xylocopa californica arizonensis*) in Southern Arizona" (presenter). *University of Arizona Entomology and Insect Science*, Tucson, AZ. Dissertation defense.**

**2021 - M.K. Busby, Davidowitz, G., and J.L. Bronstein. "Will carpenter bee (*Xylocopa californica*) nest temperatures exceed larval CTmax?" (presenter) *Society for Integrative and Comparative Biology* (Virtual due to Covid-19).**

**2021 - Jankauski, M., Casey, C., Busby, M.K., and S.L. Buchmann. "Force production and thoracic vibrations during defensive buzzing in carpenter bees (*Xylocopa*: Apidae)" (non-presenter) *Society for Integrative and Comparative Biology* (Virtual due to Covid-19).**

**2020 - M.K. Busby, Davidowitz, G., and J.L. Bronstein. "Thermolimit Respirometry Determines Relative CTmax Among Carpenter Bee Life Stages" (presenter) *Entomological Society of America* (Virtual due to Covid-19).**

**2020 - M.K. Busby, Davidowitz, G., and J.L. Bronstein. "Thermolimit Respirometry Determines Relative CTmax Among Carpenter Bee Life Stages" (presenter) *Society for Integrative and Comparative Biology*, Austin, TX.**

**2019 - M.K. Busby, Davidowitz, G., and J.L. Bronstein. "Will bees survive in a warmer world? Climate Change Effects on the Desert Carpenter Bee, a Critical Ecosystem Pollinator" (presenter) *Society for Ecological Restoration: Southwestern Chapter*, Tucson, AZ.**

**2019 - M.K. Busby, Davidowitz, G., and J.L. Bronstein. "Will bees survive in a warmer world? Climate Change Effects on the Desert Carpenter Bee, a Critical Ecosystem Pollinator" (presenter) *EEB Departmental Seminar, The University of Arizona*, Tucson, AZ.**

**2018 - M.K. Busby, Davidowitz, G., and J.L. Bronstein. "Forecasting the developmental niche of *Xylocopa californica* in a changing thermal world" (presenter) *Entomological Society of America: Pacific Branch Meeting*, Reno, NV.**

**2016, 2018 - M.K. Busby, "Native Desert Bees" (presenter) *University of Arizona Insect Festival 2016***

***Posters:***

**2023 - M.K. Busby and K.A. Thomas. "Environmental and biological factors surrounding the interaction between a Joshua tree, its pollinating yucca moth, and their associated arthropod community". *Ecological Society of America*, Portland, Oregon. Poster affiliated with USGS Southwest Biological Science Center, Tucson, AZ.**

**2022 - K.A. Thomas, Busby, M.K., and A.M. Hoover. "Investigations of the Yucca moth (*Tegeticula antithetica*) interactions with the eastern Joshua tree (*Yucca jaegeriana*)". *Entomological Society of America*, Vancouver, BC. Poster affiliated with USGS Southwest Biological Science Center, Tucson, AZ.**

**2022 - M.K. Busby, Hoover, A.M., and K.A. Thomas. "Native bees in Buenos Aires National Wildlife Refuge: a first survey in a diverse but vulnerable desert grassland" (presenter). *16th Biennial Conference of Science & Management on the Colorado Plateau & Southwest Region*, Flagstaff, AZ. Poster affiliated with USGS Southwest Biological Science Center, Tucson.**

**2020 - C.M. Burkholder, Busby, M.K., and J.L. Bronstein. "Predator, prey, and a plant: Do carpenter bees (*Xylocopa californica*) position their nests within sotol (*Dasylirion wheeleri*) leaf rosettes to maximize protection from woodpeckers?" *Ecological Society of America* (Virtual due to Covid-19), illustrated research poster.**

## MENTORING

**Mentoring** **2017-2022**

- **Mentored 25 undergraduate and high school students between 2017 and 2020, including:**
  - **2018 - 2022 Chloe Burkholder, high schooler (now undergraduate student at The University of Arizona)**
    - **Burkholder's project, entitled The Birds and the Bees: An Analysis of Nesting and Predation, won awards in both 2019 and 2020:**
      - **1st place in the regional science fair's (SARSEF) Animal Sciences category**
      - **The Wildlife Society Conservation Award**
      - **The Tucson Wildlife Center Wildlife Award**
      - **The SARSEF Foundation Scholarship**
    - **Our work on the selective pressures of bird predation on carpenter bee nests is currently in press with *The Southwestern Naturalist***
  - **2020 Grayson Hughes, UA undergraduate student**
    - **Developed independent research project while assisting me with field methods and data transcription**
  - **2020 Meccah Jarrah, UA undergraduate student**
    - **Developed independent research projects while assisting me with field methods and data transcription**
  - **2019 Olivia Valenzuela, Yuma high school senior (now undergraduate student at The University of Arizona)**
    - **7-week full-time apprenticeship through UA's KEYS program**
    - **Produced and presented a research poster describing her carpenter bee experiments**
    - **Joined the U.S. National Guard and began attending the University of Arizona in fall 2020**
  - **2019 Charlotte Snyder, high schooler and later undergraduate at The University of Arizona**
    - **Began work in ecology and technology through Eco-Tech Internship (see *"Service"* section for details)**
    - **Later hired by the UA's Tucson Bee Collaborative to conduct bee sequencing research**
  - **2017 - 2018 Emily Ruth Spindler, MS, then UA honors student (now a Southwest Pesticide Program Specialist with Xerces Society)**
    - **Pollen analysis of carpenter bee nest provisions**
    - **After graduating from UA, Spindler embarked on a whirlwind of tropical field biology projects and worked with T'ai Roulston's pollinator health project at University of Virginia**
    - **Spindler earned her Master's at University of Virginia**

## OUTREACH

**The University of Arizona Sky Center (Sky School Instructor)** August 2016 - May 2020

- Led K - 12 student groups on field research projects

**The University of Arizona: Biosphere II (Outreach Scholar)** July 2017 - July 2017

- Led 6th- and 7th-grade student groups in field and lab research projects

**Satori School (Insect Summer Camp Leader)** July 2016, July 2017

- Designed and delivered insect-related educational content to pre-K and elementary-age students

**Various Public Events (Outreach Presenter)** October 2015 - present

- Developed and presented educational materials at over 25 local STEM outreach events, including designing and exhibiting full-day pollinator content for six years at The University of Arizona's Insect Festival, and at Bisbee Underground, Spring 2018.

## SERVICE

**R workshops (Assistant)** 2016 - 2022
*The University of Arizona Libraries*

- Attended and assisted with weekly 2-hour R workshops led by Jeff Oliver

**Flowing Wells Ecotechnology Intership (Creator)** Summer 2019
*The University of Arizona in collaboration with Flowing Wells High School*

- Designed and executed an ecology and electronics internship
- 15 Flowing Wells High School students learned electronics basics for 4 weeks
- Five students elected to continue the internship beyond their academic year for a total of 11 weekly meetings
- Students built, calibrated, programmed, and deployed electronic devices applied in research to measure carpenter bee nest temperatures

**Creating beautiful visualizations in ggplot (Workshop Leader)** May 2020, 2021
*Research Bazaar at The University of Arizona*

- Designed and delivered online workshops on creating science visualizations in ggplot (R package).

**Workshop: Learn Scientific Computing Skills (Workshop Leader)** November 2020
*The Carpentries at The University of Arizona*

- Collaborated on design and delivery of 3-day data science workshop.
- Content included Unix and programming in R.

**Insect Collection Organization and Digitization (Lab Volunteer)** August 2017 - 2022
*The University of Arizona Insect Collection*

- Organized bee specimens, and photographed and stored images and specimen data for the *Xylocopa*, to be uploaded for use by SCAN, NEON, MABA, and ASAP

**Insect Bioblitz (Participant)** July 2017
*Spring Stewardship Institute*

- 2-week bioblitz focused on surveying insects of the Grand Canyon led by L.E. Stevens

## DATA SCIENCE

**2021 - Certified instructor at The [Data Science, Software, and Library] Carpentries**

**March 2021 - Delivered "Beautiful plots in ggplot" workshop at UA Libraries R Workshop as a guest presenter.**

**November 7-8, 2020 - Instructed at 2-day Software Carpentries workshop**

- **Presented 2-hour live-coding lesson on creating data visualizations with the R tool 'ggplot'**
- **Assisted individuals with troubleshooting during other sessions of the workshop**

**August 2020 - May 2021 - Data Science Ambassador: Selected as student data science representative for University of Arizona's College of Agriculture and Life Sciences (CALS), and University of Arizona's Graduate Interdisciplinary Programs (GIDP).**

- **Addressed direct student inquiries**
- **Collaborated in building resources for students to access university data science resources**
- **Assisted with data science workshops**
- **Participated in executing mutli-day data science events, including Research Bazaar and Women in Data Science**
- **Worked towards development of a D2L page where students can easily reference data science resources**

**May 2020, May 2021 - Led workshop at Research Bazaar 2020 and 2021: A worldwide data science festival.**

- **Developed and presented "Beautiful plots with ggplot2", a 2-hour Zoom workshop on R visualizations, approximately 50 attendants**

***Data science 15-week courses taken:***

- **2015 - R Programming, University of Arizona course led by Tyeen Taylor**
- **2009 - Introduction to Programming, University of Texas course led by Dr. Shyamal Mitra**
- **2008 - Biostatistics, University of Texas course led by Dr. Claus Wilke**

***Workshops:***

- **2016 - 2022 - Attended and assisted with weekly R workshops led by Jeff Oliver, The University of Arizona Libraries**
- **2019 - Python Mini-Workshop: NumPy, SciPy, Matplotlib, SKLearn, Kamel Didan, Software Carpentry at The University of Arizona**

***Projects:***

- **2019 - 2020 - Arduino-based devices for measuring 8 thermocouple inputs**
- **Statistical analyses on all dissertation chapters and other research publications in progress**
- **Species distribution model in R to map carpenter bee ranges as climate changes**

## PROFESSIONAL TRAINING

**USDA Bee Inventory and Management Lab** — **May 2022**
***Pollinator Methods***

- **Week-long course on pollinator research, bee monitoring, and specimen curation led by Sam Droege at Patuxent Research Refuge (Laurel, MD)**
- **In-person five-day course associated with a long-term weekly online bee identification course that took place from 2021 to present**

**The Carpentries (Data Science)** — **2019 - present**
***Certified Instructor***

- **Completed 3-step program towards teaching data science over the course of a semester**
- **Certified to conduct data science workshops for ecologists**

**American Museum of Natural History** — **August 2017, 2018, 2019, 2022, 2023**
***The Bee Course***

- **Annual 10-day course focused on native bee taxonomy**
- **Attended as participant 2017, and as volunteer in subsequent years (attended lectures, assisted instructors, and participated in on-site bee research)**

**Python Mini-Workshop** — **2019**
***The University of Arizona Software Carpentry***

- **NumPy, SciPy, Matplotlib, SKLearn, Kamel Didan**

**Council on International Educational Exchange** — **June - August 2008**
***Monteverde Summer Program, Monteverde, Costa Rica***

- **Conducted independent research on kin recognition and aggression in social spiders (*Anelosimus* spp.)**

**The University of Arizona** — **Summer 2020**
***Online Course Design Boot Camp***

- **Completed training parts 1 and 2 of 2**

## ADDITIONAL RESEARCH EXPERIENCE

***Graduate research lab rotations:***

- **2015: Judith L. Bronstein (Barrel cactus pollinator ecology)**
- **2015: Kirk Anderson (USDA Bee Lab honey bee microbiome)**
- **2016: Stephen L. Buchmann (Carpenter bee nesting ecology)**

***Undergraduate research experience:***

- **2008 - 2010: Honey bee sleep research with graduate mentor Barrett Klein and PI Ulrich Mueller (see *"Publications"* section)**
- **2007: *Heliconius* butterfly research with graduate mentor Catalina Estrada and PI L.E. Gilbert**

## PROFESSIONAL MEMBERSHIPS

**2020 - present: Ecological Society of America**

**2021 - present: Southwestern Association of Naturalists**

**2013 - 2015, 2018 - present: Entomological Society of America, Pacific Branch**

**2019 - 2022: Arizona Native Plant Society, Tucson Chapter**

**2018 - 2022: Guild of Natural Science Illustrators**

**2019 - 2021: Society for Integrative and Comparative Biology**