

# Mario A. Sandoval-Molina

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🌐 mariosandovalm

## Education

### Cornell University-Ecology and Evolutionary Biology

NY, USA

PHD CANDIDATE.

Present

- Thesis: Ecology and evolution of plant defenses in the Mimosoid clade: thigmonasty, physical and chemical defenses.
- Committee: André Kessler, Miguel Piñeros, Molly Womack

### Cornell University-EEB Department

NY, USA

MASTER OF SCIENCE.

2022- 2025

- Non-Thesis degree.
- Committee: André Kessler, Miguel Piñeros, Molly Womack

### Instituto de Ecología (INECOL)-Departamento de Ecología Funcional

Veracruz, México

MASTER OF SCIENCE IN ECOLOGY. GPA: 9.27/10

2019

- Thesis: Interaction between ants, herbivore insects and extrafloral nectaries in *Opuntia robusta*: a test of the defensive function.
- Committee: MK, Janczur, JG, García-Franco, C, Díaz-Castelazo, and Rodolfo Dirzo.

### Universidad Autónoma del Estado de México (UAEM)

Estado de México, México

BACHELOR OF SCIENCE DEGREE IN BIOLOGY. GPA: 8.20/10

2014

- Thesis: Morphology and anatomy of extrafloral nectaries of *Opuntia robusta*.
- Committee: MK, Janczur, and H, Zavaleta-Mancera.

## Research Experience

### Principal Researcher

THE DISTRACTION FUNCTION OF EXTRAFLORAL NECTARIES: KEEPING ANTS AWAY FROM FLOWERS AND PREVENTING

Puebla, Mexico. 2017 - 2018

DISRUPTION OF POLLINATION IN *Ferocactus recurvus*

- Tested the Distraction Hypothesis in the field by conducting an ant-exclusion experiment in *F. recurvus* plants in Tehuacán-Cuicatlán Valley, México.
- Funded by the Cactus and Succulents Society of America.

MORPHOLOGY, ULTRASTRUCTURE AND FUNCTION OF EXTRAFLORAL NECTARIES

Puebla, Mexico. 2017 - 2018

- Analyzed the morphological and ultrastructural characteristics of extrafloral nectaries from two cactus species in Tehuacán-Cuicatlán Valley, México. Examined their function in association with ants and pollinators in the field.
- Funded by the Cactus and Succulents Society of America.

DEFENSE AGAINST HERBIVORES IN *Myriocarpa longipes* (URTICACEAE)"

Veracruz, Mexico. 2019 - 2020

- Principal Investigator: Dr.Mariusz Janczur
- Conducted field work related to analyzing the effect of ants and domatia position on herbivore damage of *Myriocarpa longipes*.

MORPHOLOGICAL AND ANATOMICAL DESCRIPTION OF EXTRAFLORAL NECTARIES OF *Opuntia robusta*

COLPOS, Mexico. 2015

- Conducted laboratory work using different microscopical techniques, such as TEM, SEM, and light. This was part of a research internship at Colegio de Postgraduados.

### Collaborator

EVOLUTION OF DEFENSE AGAINST HERBIVORES IN PLANTS: AN OPTIMAL MODEL ALLOCATION AND FIELD STUDY

Hidalgo, Mexico. 2012 - Present

- Principal Investigator: Dr.Mariusz Janczur
- Conducted field work related to collect tissues for secondary metabolite analysis, arbuscular mycorrhizal fungi, measuring plant defensive traits and seed set of *Opuntia robusta* plants.

### Volunteer Research Assistant

OPTIMAL DEFENSE THEORY IN *Mimosa pudica*

Cornell University. Apr 2021 - Dec 2021

- Collaborators: Dr. André Kessler
- Greenhouse work analyzing leaf movement, and response to herbivory.

PLANT-POLLINATOR INTERACTION NETWORKS

Cornell University. Apr 2021 - Sept 2021

- Collaborators: MSc. Zaidee Powers
- Collected and identified insect pollinators in the botanic garden and natural areas. Performed plant-pollinator interaction network analysis.

## Publications

### PEER-REVIEWED PUBLICATIONS:

1. **Sandoval-Molina, M. A.**, Gónzales-Camarena, E., Rosas-Sánchez J., Janczur M. K. The Distraction Function of Extrafloral Nectaries: Keeping Ants Away From Flowers and Preventing Disruption of Pollination in *Ferocactus recurvus*. *Arthropod-Plant Interactions*. DOI: <https://doi.org/10.1007/s11829-025-10173-x>
2. **Sandoval-Molina, M. A.**, Gracia-Franco, J. G., Díaz-Castelazo, C. and Janczur M. K. (2023) Plant sex change the outcome of ant-plant interactions in a facultative myrmecophytic cactus. *Functional Ecology*, 00, 1– 13. DOI: <https://doi.org/10.1111/1365->

3. **Sandoval-Molina, M. A.**, Lugo-García, B. R., Mendoza-Mendoza, A. D., and Janczur M. K. (2021). Females restrict the position of domatia and suffer more herbivory than hermaphrodites in *Myriocarpa longipes*, a Neotropical myrmecophyte. *Journal of Tropical Ecology*. DOI: <http://dx.doi.org/10.1017/S0266467421000584>
4. Janczur, M. K., González-Camarena, E., Leon-Solano H.J., **Sandoval-Molina, M. A.**, Bartosz J. (2021). Impact of the female and hermaphrodite forms of *Opuntia robusta* on the plant defence hypothesis. *Scientific Reports* 11, 12063. DOI: <https://doi.org/10.1038/s41598-021-91524-5>
5. **Sandoval-Molina, M. A.**, Flórez-Gómez, N. A., Reyes-Tovar, J. M., Pérez-Botello, A. M., Hinojosa-Díaz, I. A., Ayala, R. (2020). Effects of floral display and abiotic environment on the foraging activity of bees on *Kallstroemia pubescens* (Zygophyllaceae). *Ethology Ecology & Evolution* 32(6), 551-571. DOI: <https://doi.org/10.1080/03949370.2020.1755371>
6. **Sandoval-Molina, M. A.**, Zavaleta-Mancera, H. A., León-Solano, H., Solache-Ramos, L., Jenner, B., Morales-Rodríguez, S., Patrón-Soberano, A. and Janczur M. (2018). First description of extrafloral nectaries in *Opuntia robusta* (Cactaceae): anatomy and ultrastructure. *PLOS ONE* 13(7). DOI: <https://doi.org/10.1371/journal.pone.0200422>

#### NON-PEER-REVIEWED PUBLICATIONS:

1. **Sandoval-Molina, M. A.**, Morales-Rodríguez, S., & Janczur, M. K. (2023). Morphological and anatomical characterization of extrafloral nectaries of *Opuntia streptacantha* and *Ferocactus recurvus* (Cactaceae). *EcoEvoRxiv preprint*. URL: <https://doi.org/10.32942/X2PW2J>
2. **Sandoval-Molina, M. A. (2021)**. tlamatini: Funciones utiles para biologxs y ecologxs confundidos con los modelos lineales. R package version 0.1. URL: <https://zenodo.org/doi/10.5281/zenodo.7765346>
3. León-Solano, H.J., Janczur, M.K., González-Camarena, E., Czarnoleski, M., Jenner, B., **Sandoval-Molina, M. A. (2021)**. Resource Allocation Among Cladodes of *Opuntia robusta* From East-central Mexico, PREPRINT (Version 1) available at Research Square [<https://doi.org/10.21203/rs.3.rs-161086/v1>]

#### PEER-REVIEWED PUBLICATIONS IN PROCESS:

1. **Sandoval-Molina, M. A.** Novel within-species mechanism and conserved evolutionary strategy mitigate pollinator-prey conflict in *Drosera* [Manuscript submitted]
2. Macotela, L., **Sandoval-Molina, M. A.**, Venebra-Muñoz, A., Anaya, M., González-Morales, J.C., Daniel E. Naya and Manjarrez, J. Histomorphological changes due to altitude in a high-altitude lizard (*Sceloporus grammicus*) from three mountain systems? *J Therm Biol* [Manuscript submitted]
3. Bata-Benitez, R, Nowakowski, J, Rosas-Sánchez, JJ, Lugo-García, BR, Fernández-Villavicencio, MJ, **Sandoval-Molina, M. A.**, Janczur, M. K. Disturbance of a deciduous tropical forest increases the competition between migratory and resident or endemic birds. *Ecological Engineering* [Manuscript in process]

## Fellowships, awards, and grants

2024	<b>Grant: Orenstein Fund</b> , Amount: \$860.00	NY, USA
2024	<b>Grant: Cornell Atkinson Center for Sustainability (SBF)</b> , Amount: \$7,264.00	NY, USA
2023	<b>Grant: Cornell Chapter of Sigma Xi</b> , Amount: \$1,000.00	NY, USA
2023	<b>Grant: Andrew W. Mellon Student Research</b> , Amount: \$1,000.00	NY, USA
2023	<b>Grant: EEB-Cornell University, Department Summer Research Support</b> , Amount: \$1,000.00	NY, USA
2022	<b>Award: EEB Book Award</b> , EEB Cornell University Annual Graduate Student Symposium	NY, USA
2022	<b>Fellowship: Graduate Education- PhD</b> , Consejo Nacional de Ciencia y Tecnología (CONACYT)	México
2017	<b>Grant: Cactus and Succulents Society of America</b> , Amount: \$2,616.21	CA, USA
2016	<b>Fellowship: Graduate Education</b> , Consejo Nacional de Ciencia y Tecnología (CONACYT)	México
2014	<b>Fellowship: Bachelor's Research</b> , Secretaría de Educación Pública and CONACYT	México

## Conferences and symposiums

- Speaker at the ESA meeting with: “Evolution of plant defenses in sensitive plants of the Mimosoid clade: Thigmonasty and physical defenses” Montreal, Baltimore, USA. August 2025.
- Speaker at the 3rd Joint Congress Of Evolutionary Biology with: “Evolución de las defensas anti-herbivoría en plantas sensitivas del clado Mimosa: Tigmonastia, y defensas físicas” Chiapas, Mexico. October 2024.
- Speaker at the 3rd Joint Congress Of Evolutionary Biology with: “Evolution of plant defenses in sensitive plants of the Mimosoid clade: Thigmonasty and physical defenses” Montreal, Canada. June 2024.
- Speaker at the EEB Annual Graduate Student Symposium with: “Negative effects of mutualisms: ants visiting extrafloral nectaries disrupt pollination in *Ferocactus recurvus*” Cornell University. December 2022.

- Speaker at the Iberoamerican Myrmecology Symposium with: “Sex is important: extrafloral nectaries and ant-plant interactions on young buds of *Opuntia robusta*”. Online version. December 2020.
- Speaker at the Iberoamerican Myrmecology Symposium with: “Effects of plant sex on domatia position and leaf herbivory in a gynodioecious population of *Myriocarpa longipes*”. Online version. December 2020.
- Speaker at the Mexican Congress of Ecology with: “Sex matters: effect of ant-plant interaction on herbivore, growth and survival in different sexes of *Opuntia robusta*”. Queretaro, México. October 2019.
- Speaker at the research seminar at the Instituto de Ecología A.C. with: “Interaction between ants, herbivore insects and extrafloral nectaries in *Opuntia robusta*: a test of the defensive function”. Xalapa, México. July 2018.
- Speaker at the symposium “Cátedras del semidesierto”, Fourth Research Forum: Weaving proposals towards action for conservation with the presentation: “Spines in development are extrafloral nectaries in *Opuntia robusta* (Cactaceae): ultrastructure, anatomy and morphology.” Queretaro, Mexico. July 2018.
- Speaker at the symposium “Cátedras del semidesierto”, Fourth Research Forum: Weaving proposals towards action for conservation with the presentation: “Effect of ants visiting the extrafloral nectaries of *Opuntia robusta* in a population of Central-Eastern Mexico.” Querétaro, México. July 2018.
- Speaker at the XXII International Course on Biological Bases of Behavior with the poster: “Defensive behavior of ants against herbivorous insects, nectar robbers and floral visitors of *Opuntia robusta*.” Tlaxcala, Mexico. October 2017.
- Speaker at the VI Mexican Congress of Ecology with the poster: “Interaction between ants, herbivorous insects and extrafloral nectaries of *Opuntia robusta*”. Guanajuato, Mexico. July 2017.
- Speaker at the XX Mexican Congress of Botany with the poster: “Morphology and anatomy of extrafloral nectaries of *Opuntia robusta* Wendl.” Mexico City, September, 2016.
- Assistant to the VIII Meeting of the Mexican Society of Astrobiology (SOMA), Universidad Autónoma del Estado de Morelos, Cuernavaca, Morelos, August 2012.
- Speaker at the 19th Exhibition of fungi and V Biodiversity Exhibition, Universidad Autónoma del Estado de México, Universidad Nacional Autónoma de México -UNAM, Instituto Mexiquense de Cultura, Toluca, Mexico, August 2008.

## Courses and workshops: \_\_\_\_\_

- International Chemical Ecology Course (ICE 2025), held in Jena, Germany, from June 23 to July 4, 2025.
- Graduate Field Course in Ecology, Department of Ecology and Evolutionary Biology, Cornell University, USA. April 2024.
- “Theoretical and practical concepts of chemical ecology of insects”, by Dr. Samuel Cruz, at the Instituto de Ecología A.C., INECOL, Xalapa, Mexico. June 2020.
- “Geometric morphometrics in R” (Morfometría geométrica en R), by Miriam Zelditch and Donald Swidersky from Michigan State University, at the Instituto de Ecología A.C., INECOL, Xalapa, Mexico. March 2019.
- “Measures of functional diversity in communities” (Medidas de diversidad funcional en las comunidades), by Dra. Claudia Moreno from UAEH, XIII Student Colloquium. Instituto de Ecología A.C., Xalapa, México. October 2018.
- “Rarefaction, diversity partitioning, and phylogenetic diversity: how to implement and interpret them” (Rarefacción, particionamiento de diversidad, y diversidad filogenética: cómo implementar e interpretarlos)” by Lou Jost, XIII Student Colloquium. Instituto de Ecología A.C., Xalapa, Mexico. October 2018.
- Intensive Field Course: Native bees from Mexico (Hymenoptera: Apoidea), diversity and plant-pollinator interactions” (Curso Intensivo de Campo: Abejas nativas de Mexico (Hymenoptera: Apoidea), diversidad e interacción planta-polinizador), by Dr. Ricardo Ayala and Dr. Ismael Hinojosa from the Graduate Program in Biological Sciences - Universidad Nacional Autónoma de México (UNAM), at the Chamela Biological Station, Jalisco. September-October, 2017.

## Teaching experience: \_\_\_\_\_

- **Teaching assistant** "BIOEE 1610 Introductory Biology: Ecology and the Environment". Department of Ecology and Evolutionary Biology, Cornell University, July 2024.
- **Teaching assistant** "BIOEE 1610 Introductory Biology: Ecology and the Environment". Department of Ecology and Evolutionary Biology, Cornell University, July 2025.
- **Instructor** "Introduction to Statistics in R: applied for Biological Sciences". Neuroscience laboratory, Universidad Autónoma del Estado de México, Mexico. Online version. July 2020.
- **Instructor** "Introduction to Statistics in R", Research Group in Ecology and Evolutionary Biology, Universidad Autónoma del Estado de México. July - August 2019.

## Professional societies and scientific associations

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**EcoEvoRxiv preprints.** Editorial Committee.

*2023 - Present.*

**The American Society of Naturalists.** Student member.

*2024 - Present.*

**Ecological Society of America.** Student member.

*2024 - Present.*

**Botanical Society of Mexico.** Student member.

*2016 - Present.*

**Mexican Scientific Society of Ecology.** Student member.

*2017 - Present.*

I'd be happy to provide more information upon request.