Michael H. Cortez
Associate Professor
Department of Biological Science, Florida State University

Contact Information

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Professional Experience

2022–	**Associate Professor**, Department of Biological Science, Florida State University **Courtesy Appointment**, Department of Mathematics, Florida State University
2019–2022	**Assistant Professor**, Department of Biological Science, Florida State University **Courtesy Appointment**, Department of Mathematics, Florida State University
2014–2019	**Assistant Professor**, Department of Mathematics and Statistics, Utah State University **Faculty Associate**, Ecology Center, Utah State University
2012–2014	**NSF Mathematical Sciences Postdoctoral Research Fellow**, School of Biology, Georgia Institute of Technology (Mentor: Joshua S. Weitz)
2010–2012	**Postdoctoral Researcher**, School of Biology, Georgia Institute of Technology Affiliate of the School of Mathematics (Mentor: Joshua S. Weitz)

Education

Ph.D.	**Applied Mathematics**, Cornell University, 2011 (Advisor: Stephen P. Ellner)
M.S.	**Applied Mathematics**, Cornell University, 2008
B.S.	**Chemistry and Mathematics**, Hope College, 2005

Awards and Honors

2016–2020	**Early Career Fellow**, Ecological Society of America
2016	**Washington, DC Faculty Fellow**, Utah State University
2012–2014	**NSF Mathematical Sciences Postdoctoral Research Fellow**
2011	**Prize for an outstanding paper in ecological theory**, Theoretical Ecology Section of the Ecological Society of America. Awarded for 2011 *Ecology Letters* paper
2009	**Provost's Diversity Graduate Student Fellowship**, Merit-based fellowship that provided one semester of tuition and stipend
2005–2008	**Alfred P. Sloan Foundation Graduate Fellowship**, Merit-based fellowship that provided three years of tuition and stipend
2005	**summa cum laude**, Hope College, 2005
2005	**Sigma Xi**, elected at Hope College
2004	**Phi Beta Kappa**, Zeta chapter of Michigan
2001–2005	**Hope Covenant Scholarship**, Merit-based, four-year scholarship to Hope College
2001	**Eagle Scout Award**, Boy Scouts of America

Grants & Funding

Current Funding

2019–2023 National Science Foundation, Division of Environmental Biology
"Developing, unifying, and empirically testing theory for inducible and evolving defenses"
PI: Michael H. Cortez. Co-PI: Edd Hammill (Utah State University).
(Total award: $525,324)

Prior Funding

2018–2022 National Science Foundation, Division of Environmental Biology
"Collaborative Research: Development and empirical tests of a mechanistic multi-host, multi-pathogen theory"
PIs: Michael H. Cortez and Meghan A. Duffy (University of Michigan).
(Total award: $735,288; Cortez: $203,399)

2020 First Year Assistant Professor (FYAP) Program, Florida State University
"When and why does increased host biodiversity lead to more disease?"
PI: Michael H. Cortez. (Total award: $20,000)

2012–2014 National Science Foundation Postdoctoral Research Fellowship in Mathematical Sciences
"Understanding eco-coevolutionary dynamics through the use and development of fast-slow dynamical systems theory."
PI: Michael H. Cortez. (Total award: $150,00)

Proposals in Review

2023 National Science Foundation, Division of Environmental Biology
"Collaborative Research: The joint effects of interspecific and intraspecific variation on the temporal dynamics of host-parasite systems."
PIs: Michael H. Cortez, Alex T. Strauss (University of Georgia), and John P. Wares (University of Georgia).

2023 National Science Foundation, Division of Mathematical Sciences
"Collaborative Research: Advancing theory for disease dynamics across spatially heterogeneous habitats"
PIs: Michael H. Cortez, Jing Jiao (Texas Christian University), and Nina Fefferman (University of Tennessee).

Peer Reviewed Publications

Notation

(U) indicates undergraduate student author
(G) indicates graduate student author
(P) indicates postdoc author
Underlining indicates my name or individuals under my mentorship
All other authors are colleagues and individuals not under my mentorship

1. E. Hammill, K. Hancey (U), & M.H. Cortez. 2023. Changes in prey traits differentially reduce predation risk across predator and prey abundances. *Oikos*: e09933.
2. L.K. Lopez (P), M.H. Cortez, T. S. DeBlieux, I. A. Menel, B. O'Brien, C. E. Caceres, S. R. Hall, & M. A. Duffy. 2023. A healthy but depleted herd: Predators decrease prey disease and density. *Ecology*: e4063.
3. K. Hanthanan Arachchilage (P), M.Y. Hussaini, N.G. Cogan, & M.H. Cortez. 2023. Exploring how ecological and epidemiological processes shape multi-host disease dynamics using global sensitivity analysis. *Journal of Mathematical Biology* 86: 83.
4. M.H. Cortez. 2022. Using sensitivity analysis to identify factors promoting higher versus lower infection prevalence in multi-host communities. *Journal of Theoretical Biology* 534: 110959.
5. J. Jiao (P) and M.H. Cortez. 2022. Exploring how a generalist pathogen and within-host priority effects alter the risk of being infected by a specialist pathogen. *American Naturalist* 200: 815-833.

6. S. Twombly, A. Hastings, T.E.X. Miller, M.H. Cortez, K. Abbot, T. Ramiadantsoa, J. Blackwood & O. Prosper. 2022. New Theory for Increasingly Tangled Banks. *Issues in Science and Techology* 4: 39-40.
7. M.H. Cortez and M.A. Duffy. 2021. The context dependent effects of host competence, competition, and the pathogen transmission mode on disease prevalence. *American Naturalist* 198: 179-194.
8. P.A. Clay (P), M.H. Cortez, and M.A. Duffy. 2021. Dose relationships can exacerbate, mute, or reverse the impact of heterospecific host density on infection prevalence. *Ecology* 102: e03422.
9. G. Grosklos (G) and M.H. Cortez. 2021. Evolutionary and plastic phenotypic change can be just as fast as changes in population densities. *American Naturalist* 197: 47-59.
10. D.K. Sorenson (U) and M.H. Cortez. 2021. How intra-stage and inter-stage competition affect overcompensation in density and hydra effects in single-species, stage-structured models. *Theoretical Ecology* 14: 23-39.
11. P.B. Adler, E.P. White, and M.H. Cortez. 2020. Matching the forecast horizon with the relevant ecological processes. *Ecography* 43: 1729-1739.
12. M.H. Cortez and M.A. Duffy. 2020. Comparing the indirect effects between exploiters in predator-prey and host-pathogen systems. *American Naturalist* 196: E144-E159.
13. M.H. Cortez, S. Patel, and S. Schreiber. 2020. Destabilizing evolutionary and eco-evolutionary feedbacks drive eco-evolutionary cycles. *Proceedings of the Royal Society B: Biological Sciences* 287: 20192298.
14. G. Li (G), M.H. Cortez, J. Dushoff, and J.S. Weitz. 2020. When to be temperate: on the fitness benefits of lysis vs. lysogeny. *Virus Evolution* 6: veaa042
15. P.A. Clay (G), M.H. Cortez, M.A. Duffy and V.H.W. Rudolf. 2019 Priority effects within co-infected hosts alter prevalence relationships between parasites at the host population scale. *Oikos* 128: 571-583.
16. M.H. Cortez and M. Yamamichi. 2019. How (co)evolution alters predator responses to increased mortality: extinction thresholds and hydra effects. *Ecology* 100: e02789.
17. A. Doloman (G), Y. Pererva, M.H. Cortez, R.C. Sims, and C.D. Miller. 2019. Augmentation of granular anaerobic sludge with algalytic bacteria enhances methane production from microalgal biomass. *Fermentation* 5: 88.
18. J.S. Weitz, G. Li (G), H. Gulbudak, M.H. Cortez, and R.J. Whitaker. 2019. Viral fitness across a continuum from lysis to latency. *Virus Evolution* 5: vez006.
19. M.H. Cortez. 2018. Genetic variation and the drivers of eco-coevolutionary predator-prey cycles. *Ecological Monographs* 88: 353-371.
20. S. Patel (G), M.H. Cortez, and S.J. Schreiber. 2018. Partitioning the effects of ecology, evolution, and eco-evolutionary feedbacks on community stability. *American Naturalist* 191: 381-394.
21. M.H. Cortez and S. Patel (G). 2017. The effects of predator evolution and genetic variation on predator-prey population-level dynamics. *Bulletin of Mathematical Biology* 79: 1510-1538.
22. Z. Pu (G), M.H. Cortez, and L. Jiang. 2017. Predator-prey coevolution drives productivity-richness relationships in planktonic systems. *American Naturalist* 189:28-43.
23. M.H. Cortez. 2016. How the magnitude of prey genetic variation alters predator-prey eco-evolutionary dynamics. *American Naturalist* 188: 329-341.
24. M.H. Cortez. 2016. Hydra effects in discrete-time models of stable communities. *Journal of Theoretical Biology* 411: 59-67.
25. M.H. Cortez and P.A. Abrams. 2016. Hydra effects in stable communities and their implications for system dynamics. *Ecology*, 97: 1135-1145.

26. C.L. Searle (P), M.H. Cortez, K.K. Hunsberger (U), D.C. Grippi (G), I.A. Oleksy (U), C.L. Shaw (G), S. B. de la Serna (U), C.L. Lash (U), K.L.Dhir (U), and M. A. Duffy. 2016. Population density, not host competence, drives patterns of disease in an invaded community. *American Naturalist* 188: 554-566.
27. M.H. Cortez. 2015. Coevolution-driven predator-prey cycles: Predicting the characteristics of eco-coevolutionary cycles using fast-slow dynamical systems theory. *Theoretical Ecology* 8: 369-382.
28. P.A. Abrams and M.H. Cortez. 2015. The many potential indirect interactions between predators that share competing prey. *Ecological Monographs* 85: 625-641.
    Authors contributed equally
29. P.A. Abrams and M.H. Cortez. 2015. Is competition needed for ecological character displacement? Does displacement decrease competition? *Evolution* 69: 3039-3053.
30. L.F. Jover (G), C.O.G. Flores (G), M.H. Cortez, and J.S. Weitz. 2015. Multiple regimes of robust patterns between network structure and biodiversity. *Scientific Reports* 5: 17856.
31. M.H. Cortez and J.S. Weitz. 2014. Coevolution can reverse predator-prey cycles. *Proceedings of the National Academy of Sciences*, 111: 7486-7491.
32. B.P. Taylor (G), M.H. Cortez, and J.S. Weitz. 2014. The virus of my virus is my friend: ecological effects of virophage with alternative modes of coinfection. *Journal of Theoretical Biology* 354: 124-136.
33. M.H. Cortez. 2013. When does pathogen evolution maximize R_0 in well-mixed host-pathogen systems. *Journal of Mathematical Biology* 67: 1533-1585.
    – Recommended by Faculty of 1000 (F1000)
34. M.H. Cortez and J.S. Weitz. 2013. Distinguishing between indirect and direct modes of transmission using epidemiological time series. *American Naturalist* 181: E43-54.
35. L.F. Jover (G), M.H. Cortez, and J.S. Weitz. 2013. Mechanisms of multi-strain coexistence in host–phage systems with nested infection networks. *Journal of Theoretical Biology* 332: 65-77.
36. M.H. Cortez. 2011. Comparing the qualitatively different effects rapidly evolving and rapidly induced defences have on predator-prey interactions. *Ecology Letters* 14: 202-209.
37. M.H. Cortez and S.P. Ellner. 2010. Understanding the effects of rapid evolution on predator-prey interactions using the theory of fast-slow dynamical systems. *American Naturalist* 176: E109-E127.
38. T.L. Bultman, T.J. Sullivan, M.H. Cortez and T.J. Pennings. 2009. Extensions to and modulation of defensive mutualism in grass endophytes *in* Defensive mutualism in microbial symbiosis, eds. J. F. White and M. S. Torres. CRC Press, p. 301 - 317.
39. M.H. Cortez, et al. 2007. Factors contributing to the accuracy of harmonic force field calculations in water. *Journal of Chemical Theory and Computation* 3: 1267-1274.
40. B. Alleman, M.H. Cortez, et al. 2003. Take me out to/of the ball game. *Rose-Hulman Undergraduate Math Journal* 4: 2.

Submitted Manuscripts

1. M.H. Cortez. Predicting and comparing the effects of host species richness on different metrics of disease. Submitted.
2. M.H. Cortez, E. Mila (U), & E. Hammill. The characteristics of inducible defenses influence predator-prey dynamics. Submitted.
3. K.M. McIntire, M.K. Dziuba, E.B. Haywood (G), M.L. Robertson (G), M. Vaandrager, E. Baird, F. Corcoran, M.H. Cortez, & M.A. Duffy. Transgenerational virulence: Maternal pathogen exposure reduces offspring fitness. Submitted.
4. A. Barriero Felpeto, M.H. Cortez, M. Febrero-Bande, N. G. Hairston, Jr. Contrasting nutrient stoichiometric regimes have dramatic effects on the dynamics of a planktonic predator-prey system. Submitted.

Invited Presentations

2023

1. SIAM Dynamical Systems Meeting, Portland, OR
2. Advances in Mathematical Ecology, University of Pittsburgh, Pittsburgh, PA
3. School of Ecology, University of Georgia, Athens, GA

2021

1. Society of Mathematical Biology (SMB) Annual Meeting, Atlanta, GA

2020

1. Department of Biology, University of Florida, Gainsville, FL
2. Department of Mathematics, University of Florida, Gainsville, FL

2019

1. Department of Biological Science, Florida State University, Tallahassee, FL
2. Department of Biology, University of Pittsburgh, Pittsburgh, PA
3. Department of Biology, University of Cincinnati, Cincinnati, OH
4. Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, NY

2018

1. SACNAS Annual Conference, San Antonio, TX
2. ESA Annual Conference, New Orleans, LA

2017

1. SIAM Conference on applications of dynamical systems, Snowbird, UT
2. Department of Ecology and Evolutionary Biology, UCLA, Los Angeles, CA
3. Department of Ecology, Evolution, and Natural Resources, Rutgers University, New Brunswick, NJ

2016

1. Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, Ontario, Canada
2. Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI
3. Department of Biology, Indiana University, Bloomington, IN
4. Department of Mathematics, University of Utah, Salt Lake City, UT

2015 and earlier

1. Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI (2015)
2. ESA Annual Conference, Baltimore, MD (2015)
3. School of Mathematical and Statistical Sciences, Arizona State University, Tempe, AZ (2015)
4. Modeling Infectious Diseases Group, Center for Disease Control, Atlanta, GA (2014)
5. Department of Mathematics and Statistics, Utah State University, Logan, Utah (2014)
6. Department of Biology, Stanford University, Stanford, California (2014)
7. Biology Department, University of Massachusetts Boston, Boston, Massachusetts (2014)
8. Department of Applied and Computational Mathematics and Statistics, University of Notre Dame, South Bend, Indiana (2014)
9. Department of Mathematics, University of Idaho, Moscow, Idaho (2014)
10. Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, Ontario, Canada. (2014)

11. Department of Biological Science, Florida State University, Tallahassee, Florida (2014)
12. Department of Biology, University of Kentucky, Lexington, Kentucky (2013)
13. Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, Ontario, Canada (2013)
14. Department of Mathematics and Statistics, Queen's University, Kingston, Ontario, Canada (2013)
15. MBI Workshop 2: Rapid Evolution and Sustainability, Mathematical Biosciences Institute, Ohio State University, Columbus, Ohio (2013)
16. SACNAS Annual Meeting, San Antonio, Texas (2013)
17. Evo.Tech Seminar Series, Georgia Institute of Technology (2013)
18. SIAM Annual Conference, San Diego, California (2013)
19. Society of Mathematical Biology Annual Conference, Tempe, Arizona (2013)
20. 11th Annual EEID Conference, State College, Pennsylvania (2013)
21. School of Mathematics, Georgia Institute of Technology, Atlanta, Georgia (2012)
22. Society of Industrial and Applied Mathematics (SIAM) Annual Conference, Denver, Colorado (2009)

Contributed Presentations

1. Ecology and Evolution of Infectious Diseases (EEID) Annual Meeting (Posters in 2020, 2021, 2022)
2. Ecological Society of America Annual Conference (2023, 2017, 2013, 2012, 2011)
3. Society of Mathematical Biology Annual Conference (2017, 2015, 2012) & Minimeetings (2023)

Internal Presentations

1. Mathematical Biology Seminar, Department of Mathematics, FSU (2022,2020)
2. Biology Colloquium, Department of Biological Science, FSU (2021)
3. Mathematics Colloquium, Department of Mathematics and Statistics, USU (2019, 2016)
4. Climate Adaptation Science and Ecology Center Interdisciplinary Research Forum, USU (2017)
5. Biological Fontiers Course, Department of Biological Science, FSU (2021)
6. Graduate student research seminar, Department of Mathematics and Statistics, USU (3 times in 2016-2018)
7. Math Bio Group, Department of Mathematics and Statistics, USU (13 times in 2014-2019)
8. USU Applied Math Club, Department of Mathematics and Statistics, USU (2017, 2014)

Mentorship

Postdoctoral Researchers

Jing Jiao. November 2020-2023.
Current position: Assistant professor at Texas Christian University.

Graduate Students

Ben Daniel. 2021-present. USU Ecology MS
Co-advised with E. Hammill

Elizabeth (Brooke) Haywood. 2021-present. FSU MathBio PhD
First author on paper in prep.

Miles Robertson. 2021-present. FSU Biology PhD
Awarded a graduate fellowship through the NSF GRFP

Guen Grosklos. F2016-F2018. USU Applied Math PhD
First author paper in *American Naturalist*

Luis Jover. F2011-F2014. Georgia Tech Physics PhD
Co-advised with Joshua Weitz.

Two first author papers in *Journal of Theoretical Biology* and *Scientific Reports*

Bradford Taylor. F2012-F2014. Georgia Tech Physics PhD
Co-advised with Joshua Weitz
First author paper in *Journal of Theoretical Biology*

Cesar Garcia Flores. 2014. Georgia Tech Physics PhD
Co-advised with Joshua Weitz
Co-author on paper in *Scientific Reports*

Undergraduate Students

Sophia McDonough. Fa2023-present. FSU Mathematical Biology Major

Charles Gannon. Fa2021-Sp2023. FSU Mathematical Biology Major
Co-author on paper in prep.

Emily Mila. S2020-S2021. FSU Mathematical Biology Major
Co-author on paper in review

Darian Sorenson. F2018-S2020. USU Mathematics Major
First author paper in *Theoretical Ecology*

Miles Roberston. S2019. USU Biology Major and Math-Stats Composite Major

Yido Yang. F2012-S2013. Georgia Tech Biomedical Engineering Major

REU Undergraduate Students. Summer 2008. Hope College
Three Mathematics Majors Co-mentored with Tim J. Penning

Graduate Student Committees

Abigail Dittmar. FSU Biology PhD candidate

Ally Dubel. FSU Biology PhD candidate

Laurel Field. FSU Biology PhD candidate

Monica Paniagua Montoya. FSU Biology PhD candidate

Matthew Schumm. FSU Biology PhD candidate

Guen Grosklos. USU Applied Mathematics PhD. Defended in 2021

Lacy Smith. USU Natural Resources PhD. Defended in 2020

Ian McGahan. USU Applied Mathematics PhD. Defended in 2020

Eden Furtak-Cole. USU Applied Mathematics PhD. Defended in 2017

Graduate Student Committees (external member)

Faith Rovenolt. University of Pittsburgh Biology PhD candidate

Teaching

Undergraduate Courses

Biological Science II (BSC 2011)
Florida State University, Fa2023, Sp2022 (Honors section), S2020 (Honors section)

Ordinary Differential Equations (Math 2280)
Utah State University, Fa2018

Linear Algebra (Math 2270)
Utah State University, Fa2017, Sp2016, Fa2016, Fa2015

Calculus 2 (Math 1220)
Utah State University, Sp2015.

Theoretical Ecology (Bio 4422/6422)
Co-taught with Joshua S. Weitz, Georgia Institute of Technology, Sp2012

Graduate Courses

Theoretical Ecology (BSC 4933 & 5936)
Florida State University, Sp2023, Sp2021

Graduate special topics course (BSC 5936)
Florida State University
Intro to PDEs (Fa2023), Mathematical Ecology (Fa2022), Linear Algebra and ODEs (Fa2022)

Graduate Ordinary Differential Equations (Math 6910)
Utah State University, Sp2019

Methods in Applied Mathematics (Math 5410)
Utah State University, Fa2018, Fa2017, Fa2016

Modeling Predator-Prey Interactions (Bio 4230 & Math 6910)
Utah State University, Sp2016

Analysis of biological models using fast-slow dynamical systems (Math 6910)
Utah State University, Sp2016

Service

Internal Service - Florida State University

Department of Biological Science Committees:
Equal Opportunity and Community Committee, member (2020-present) Ecology & Evolution Area Leader (Fa2023-Sp2024)
Executive Committee, member (Fa2023-Sp2024, Fa2021-Sp2022)
Elections Committee, member (Fa2022-Sp2023, Fa2020-Sp2021)
Faculty Evaluation Committee, member (Sp2021)
Cell Biology Faculty Search Committee, member (Fa2019-Sp2020)

Seminar Organizer
Ecology and Evolution Seminar (Fa2020-Sp2021)

University Committees:
Ad hoc member for academic honor hearings (Sp2021)

Internal Service - Utah State University

Department of Mathematics and Statistics Committees:
Research Committee, member (2017-2019)
Numerical Analyst Faculty Search Committee, member (Fa2016-Sp2017)
Department Scholarship Review Committee, member (2017)
Applied Mathematics Graduate Curriculum Committee, member (2015)

Faculty Advisor
USU Men's Ultimate Frisbee Club (2014-2019)

External Service

Associate editor (2017– present)
The American Naturalist

Conference local organizing committee
Society of Mathematical Biology annual meeting, member (2017)

Organized session
Society of Mathematical Biology Annual Conference, Tempe, Arizona (2013)

Grant reviewer
NSF Division of Mathematical Sciences, panelist (2018)
NSF Division of Environment Biology, ad hoc reviewer (2019)
University of Missiouri University System, ad hoc reviewer (2014)

Manuscript reviewer
Advances in Computational Mathematics, American Naturalist, Bulletin of Mathematical Biology, Differential Equations and Dynamical Systems, Ecological Monographs, Ecology, Ecology and Evolution, Ecology Letters, Epidemics, Evolution, F1000, Interface, Journal of Biological Systems, Journal of Mathematical Biology, Journal of Theoretical Biology, Methods in Ecology and Evolution, Nature Microbiology, Natural Resource Modelling, Oikos, PLoS Computational Biology, PLoS ONE, PNAS, Scientific Reports, Theoretical Ecology, Theoretical Population Biology, Theory in Biosciences

Mentorship
EEB Mentor Match Program (2022-present)
ESA Theory Section mentoring chain (2017)
ESA Theory Section mentor (2015)

Volunteer poster and presentation judge
Society of Mathematical Biology annual conference (2017)
Ecological Society of American annual conference (2011-2013)