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Associate Research Scholar

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Education

2015	Ph.D. Ecology & Evolutionary Biology, University of Michigan Dissertation: The Drivers of Acute Seasonal Infectious Diseases Committee: Pejman Rohani, Aaron A. King, Mercedes Pascual, & Betsy Foxman
2009	B.S. in Biology, University of Alaska Southeast, Magna Cum Laude
2009	B.S. in Mathematics, University of Alaska Southeast, Magna Cum Laude

Personal Statement

I deconstruct epidemics. The shape, frequency, and magnitude of epidemics collectively contain information about host-to-host transmission, immunity in the population, and importation of infection; I use cutting-edge statistical methods and dynamic models to extract that information. I work at the intersection of epidemiology, computational biology, chronobiology (the study of biological rhythms), and ecology. My traditional training in biology, coupled with my research in computational and applied mathematics and statistical inference, has allowed me to develop **my unique expertise: leveraging epidemiological data to unmask population-level biological processes that impact human health**. My current research focuses on computational biology and I am expanding my program to also include clinical research on cross-systems biological rhythms (i.e., high temporal resolution immunology, endocrinology, metabolomics, and transcriptomics). **My ongoing research falls into four themes: (1) seasonal disease transmission, (2) maternal immunity, (3) the realized effects of vaccines, and (4) interactions between biological rhythms and disease**. First, I have quantified the transmission seasonality for both polio and measles and have now expanded my studies to include herpesviruses. The quantification of seasonal transmission is of practical importance because it can be used to identify windows of time when pathogens are vulnerable to being driven to extinction by vaccination and containment. Second, I am developing a novel mathematical modeling framework for integrating serology data with disease incidence data to better understand maternal immunity and disease in infants. Maternal immunity in infants has significant public health implications, since the duration of maternally-derived antibodies shapes the infant vaccination schedule. Third, I have constructed a statistical inference pipeline for quantifying vaccine modes of action using disease incidence data that span vaccine-free periods and continue through licensing and vaccine roll-out. I am currently using this pipeline to measure the efficacy of inactivated and live polio vaccines. Fourth, I have developed a clinical study, funded through the NIH Early Independence Award, to characterize functional seasonal rhythms in the human immune system. Overall, my long-term goal is to study the extent to which the human immune response is integrated with biological clocks and to understand the impact of clocks on infectious disease dynamics to improve medical interventions and disease control.

*formerly Micaela Elvira Martinez-Bakker

Publications

- in submission Samuel Rund and Micaela Elvira **Martinez**. Creating a National Vector Surveillance System: Integrated Mosquito Trap Data and Digital Epidemiology. Preprint available at <http://biorxiv.org/content/early/2017/01/06/096875>. *under review*.
- 2016 Micaela Elvira **Martinez**. Preventing Zika Virus Infection during Pregnancy using a Seasonal Window of Opportunity for Conception. Available at <http://dx.doi.org/10.1371/journal.pbio.1002520>. *PLoS Biology*
- 2016 Kevin Bakker, Micaela Elvira **Martinez-Bakker**, Barbara Helm, and Tyler Stevenson. Digital Epidemiology Reveals Global Childhood Disease Seasonality and the Effects of Immunization. Available at <http://www.pnas.org/cgi/content/long/113/24/6689>. *Proceedings of the National Academy of Sciences*, page 201523941
- 2015 Micaela **Martinez-Bakker**, Aaron A King, and Pejman Rohani. Unraveling the Transmission Ecology of Polio. Available at <http://dx.doi.org/10.1371/journal.pbio.1002172>. *PLoS Biology*, 13(6):e1002172
- 2015 Micaela **Martinez-Bakker** and Barbara Helm. The Influence of Biological Rhythms on Host-Parasite Interactions. Available at <http://dx.doi.org/10.1016/j.tree.2015.03.012>. *Trends in Ecology and Evolution*, 30(6):314–326
- 2015 TJ Stevenson, ME Visser, W Arnold, P Barrett, S Biello, A Dawson, DL Denlinger, D Domononi, FJ Ebling, S Elton, N Evans, H Ferguson, RG Foster, M Hau, DT Haydon, DG Hazlerigg, P Heideman, JGC Hopcraft, NN Jonsson, N Kronfeld-Schor, V Kumar, GA Lincoln, R MacLeod, S Martin, M **Martinez-Bakker**, RJ Nelson, T Reed, JE Robinson, D Rock, WJ Schwartz, I Steffan-Dewenter, E Tauber, SJ Thackeray, C Umstatter, T Yoshimura, and B Helm. Disrupted Seasonal Biology Impacts Health, Food Security, and Ecosystems. Available at <http://rspb.royalsocietypublishing.org/content/282/1817/20151453>. *Proceedings of the Royal Society B: Biological Sciences*, 282(20151453):1–10
- 2015 Jessica Metcalf, Andrea L Graham, Micaela **Martinez-Bakker**, and Dylan Childs. Opportunities and Challenges of Integral Projection Models for Modeling Host-parasite Dynamics. Available at <http://onlinelibrary.wiley.com/doi/10.1111/1365-2656.12456/full>. *Journal of Animal Ecology*
- 2014 Micaela **Martinez-Bakker**, Kevin Bakker*, Aaron A King, and Pejman Rohani. Human Birth Seasonality: Latitudinal Gradient and Interplay with Childhood Disease Dynamics. Available at <http://rspb.royalsocietypublishing.org/content/281/1783/20132438>. *Proceedings of the Royal Society B: Biological Sciences*, 281(1783):20132438, *shared first author
- 2013 Micaela E **Martinez-Bakker**, Stephanie K Sell, Bradley J Swanson, Brendan P Kelly, and David Tallmon. Combined Genetic and Telemetry Data Reveal High Rates of Gene Flow, Migration, and Long-Distance Dispersal Potential in Arctic Ringed Seals (*Pusa hispida*). Available at <http://dx.doi.org/10.1371/journal.pone.0077125>. *PLoS One*, 8(10):e77125
- 2010 Brendan P Kelly, Oriana H Badajos, Mervi Kunnasranta, John R Moran, Micaela **Martinez-Bakker**, Douglas Wartzok, and Peter Boveng. Seasonal Home Ranges and Fidelity to Breeding Sites Among Ringed Seals. Available at <http://www.springerlink.com/index/10.1007/s00300-010-0796-x>. *Polar Biology*, 33(8):1095–1109

Book Chapters & Manuscripts in Preperation

- 2013 | Micaela **Martinez-Bakker**. The Low Arctic Tundra, book chapter in Encyclopedia of Biomes and Ecosystems, Salem Press. ISBN: 978-1-4298-3813-9.
- 2013 | Micaela **Martinez-Bakker**. The High Arctic Tundra, book chapter in Encyclopedia of Biomes and Ecosystems, Salem Press. ISBN: 978-1-4298-3813-9.

Manuscripts in Preperation

- in prep | Micaela E **Martinez**, Liubov Kozlovskaya, Pejman Rohani, and Aaron A. King. Both Salk and Sabin Vaccines Effectively Reduce Polio Transmission in Epidemic Settings. (Published in dissertation, in preparation for peer-reviewed publication). Available at <https://deepblue.lib.umich.edu/handle/2027.42/113643>
- in prep | Micaela E **Martinez**, Rob van Binnendijk, Hayley Gans, Andrea Graham, and Jacco Wallinga. Flipping the Infant Measles Vaccination Schedule.
- in prep | A Winter, ME **Martinez**, FT Cutts, M Ferrari, A McKee, AJ Lessler, K Hayford, J Wallinga, WJ Moss, and CJE Metcalf. Serological Surveys for Measles and Rubella Elimination: Strengths and Challenges.

Grants & Fellowships

- 2016–2021 | NIH Director's Early Independence Award. (\$1,802,109)
- 2015–2017 | National Science Foundation Postdoctoral Fellowship in Biology (\$120,000)
- 2010–2015 | National Science Foundation GRPF (\$135,000)
- 2010–2015 | University of Michigan, Rackham Merit Fellowship (\$70,400)

International Collaborations

- 2016–current | **University of Surrey Clinical Research Centre (Surrey, United Kingdom)**. I am the PI on a funded grant in collaboration with colleagues from the University of Surrey. We will be conducting a clinical investigation of unprecedented scope to advance our understanding of seasonal biological rhythms in the human immune system.
- 2015–current | **Chumakov Institute for Poliomyelitis & Viral Encephalitides (Moscow, Russia)**. The Chumakov Inst. conducted the trials for the live polio vaccine (OPV) in 1959. I am working with the Chumakov Inst. to improve estimates of the efficacy of OPV in epidemic settings (using their vaccine trial data). This research is timely because worldwide withdrawal of trivalent OPV began in 2016, and OPV will be reserved for epidemic response.
- 2015–current | **Netherlands National Institute for Public Health and the Environment, RIVM (Bilthoven, Netherlands)**. I am working with scientists at RIVM to determine the optimal dose timing of the measles, mumps, and rubella vaccine (MMR) with regard to maternally-derived antibodies in infants. I am using RIVM's extensive cross-sectional immunological survey, which contains the antibody profiles for ~ 8000 individuals, including over 400 infants.
- 2014–current | **University of Glasgow (Glasgow, Scotland)**. I established a collaboration with an expert chronobiologist, Barbara Helm. We have co-authored three manuscripts together, including a manuscript recently published in PNAS.

International Presentations

- 2016 Netherlands National Institute for Public Health and Environment (RIVM), Epidemiology Seminar. Dynamics of maternal antibodies against measles, consequences for an optimal vaccination schedule.
- 2016 University of Groningen, Biology Seminar. Biological Rhythms & Infection Dynamics Across Scales.
- 2016 ETH Zurich Theoretical Biology Seminar. Biological Rhythms & Infection Dynamics Across Scales.
- 2015 Center for Immunity, Infection and Evolution Winter Symposium: Circadian Rhythms in Health & Disease, invited talk (Edinburgh, Scotland). The Seasonality of Infectious Diseases: Disease Ecology meets Chronobiology.
- 2015 Chumakov Institute of Poliomyelitis and Viral Encephalitides, Seminar (Moscow, Russia). Polio from Past to Present: Ecology Informs the Polio Endgame.
- 2014 University of Glasgow, Institute of Biodiversity, Animal Health and Comparative Medicine, Seminar (Glasgow, Scotland). The Role of Demography, Seasonality, and Spatial Structure in Disease Dynamics: Unraveling the Ecology of Polio.
- 2014 Imperial College London, Department of Infectious Disease Epidemiology, Seminar (London, England). Using Historical Epidemics to Unravel the Transmission Dynamics of Polio.

Presentations

- scheduled Sep 2017 University of Alaska Southeast, Evening-at-Egan Lecture Series. The Clockwork of Epidemics, Health & Disease.
- scheduled May 2017 Harvard School of Public Health. The Finest Tuned Clocks: Biological Rhythms & Epidemics.
- scheduled Apr 2017 The Hutchinson Institute. The Finest Tuned Clocks: Biological Rhythms & Epidemics.
- scheduled Mar 2017 Department of Ecology and Evolutionary Biology at Princeton University, Colloquium on the Biology of Populations Seminar Series. The Finest Tuned Clocks: Biological Rhythms & Epidemics.
- Mar 2017 Department of Public Health at Columbia University. The Finest Tuned Clocks: Biological Rhythms & Epidemics.
- Feb 2017 American Mosquito Control Association Annual Meeting. Reconstructing Spatiotemporal Patterns of Vector Abundance via Online Data Sources.
- 2016 Princeton Strategic Partnership Grant Workshop in collaboration with the University of Tokyo. Seasonality of Infectious Diseases: Individuals to Populations.
- 2016 Harvard University T.H. Chan School of Public Health, Outreach Conference to Increase Diversity in Mathematical Modeling & Public Health. Seasonality of Infectious Diseases: Individuals to Populations.
- 2016 Harvard University T.H. Chan School of Public Health, Outreach Conference to Increase Diversity in Mathematical Modeling & Public Health. Navigating Grad School and Beyond.
- 2015 University of Michigan School of Public Health MAC-EPID Symposium Workshop: Eradicating Polio: Scientific Opinion and Political Will. The Efficacy of Salk and Sabin Polio Vaccines during Vaccine Roll-out in the US and USSR.

Presentations Continued...

- 2015 US Centers for Disease Control and Prevention (CDC) Division of Viral Diseases. The Efficacy of Salk and Sabin Polio Vaccines during Vaccine Roll-out in the US and USSR.
- 2015 University of Georgia, Odum School of Ecology, Computational Ecology and Epidemiology Group. When Google got Chickenpox.
- 2015 Princeton Dept. of Ecology and Evolutionary Biology Disease Group. Digital Epidemiology Reveals Global Childhood Disease Seasonality and the Effects of Immunization.
- 2015 University of Michigan Department of Ecology and Evolutionary Biology. Polio from Past to Present: Ecology Informs the Polio Endgame (Dissertation Defense).
- 2015 Ecology and Evolution of Infectious Diseases (EEID) Conference. Both Salk and Sabin Vaccines Effectively Reduce Polio Transmission in Epidemic Settings.
- 2014 Ecology and Evolution of Infectious Diseases (EEID) Conference. Perpetuation of Polio: Silent Infections and Source-Sink Dynamics.
- 2014 Princeton University Ecology and Evolution Department. Human Phenology in the Context of Infectious Disease Dynamics.
- 2014 Princeton University Ecology and Evolution Department. Using Historical Epidemics to Inform Polio Eradication.
- 2014 University of Michigan Ecology & Evolutionary Biology Theory Group Lunch Seminar. Using Historical Epidemics to Inform Polio Eradication.
- 2013 Ecology and Evolution of Infectious Diseases (EEID) Conference. Seasonality of Births in the US & Worldwide and its Role in Childhood Disease Dynamics. Co-presented with Kevin M. Bakker.
- 2013 University of Michigan Early Career Scientist Symposium. Can Human Phenology Drive Infectious Disease Dynamics?
- 2012 EEID Conference. Can Human Phenology Drive Infectious Disease Dynamics?
- 2012 University of Michigan Ecology & Evolutionary Biology Lunch Seminar. Seasonality in Human Ecology as the Force Behind Polio Epidemics.
- 2011 EEID Conference. Spatiotemporal Dynamics of Polio Virus: Epidemics of the Past and Eradication for the Future.
- 2010 Ecological Society of America National Conference. Disease Emergence in a Changing World: Ecological Dynamics of Polio in the US 1910–1980.
- 2010 Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) National Conference. Disease Emergence in a Changing World: A Historical Investigation of the Ecological Dynamics of Polio in the US 1910-1980.
- 2010 University of Michigan Ecology & Evolutionary Biology Theory Group Lunch Seminar. The Dynamics of Polio in the US 1910–1980.
- 2009 SACNAS National Conference. Population Structure of an Arctic Ice Seal.
- 2009 University of Georgia Odum School of Ecology, Computational Ecology Luncheon. The Dynamics of Polio in the US 1951–1980.
- 2009 American Society of Mammalogists. Population structure of an Arctic Ice Seal: Support for Conservative Management

Presentations Continued...

- 2008 NIH Intramural NIAID Research Opportunities 2008 Summer Student Research Symposium. A Survey of Relapsing Fever near Flathead Lake, MT.
- 2008 Ecological Society of America Annual Conference. Impact of Climate Change on Ice-associated Seals: Breeding Site Fidelity and Philopatry in Ringed Seals (*Phoca hispida*).
- 2008 American Institute of Biological Sciences Annual Conference. Seasonal Haulout Patterns of Ringed Seals and the Possible Impacts of Climate Change.
- 2008 West Coast Biological Sciences Annual Undergraduate Research Conference. Breeding Site Fidelity and Philopatry in Ringed Seals (*Phoca hispida*).
- 2007 North Slope Borough Fish & Wildlife Management Annual Meeting. Ringed Seal Population Structure; Impacts of Diminishing Snow Cover.
- 2007 A Joint Meeting of the Alaska Chapter of the Wildlife Society and the 12th Northern Furbearer Conference. Breeding Site Fidelity and Philopatry in Ringed Seals (*Phoca hispida*).
- 2007 University of Alaska Southeast Global Information Systems Student Research Showcase. Breeding site Fidelity and Philopatry in Ringed Seals (*Phoca hispida*).
- 2007 University of Alaska Southeast 50th Anniversary Faculty Research Showcase. Breeding Site Fidelity and Philopatry in Ringed Seals (*Phoca hispida*).
- 2006 National Oceanic and Atmospheric Administration Educational Partnership Program Annual Meeting. Breeding Site Fidelity and Philopatry in Ringed Seals (*Phoca hispida*).
- 2006 University of Alaska Southeast Fall Convocation Faculty Research Showcase. Breeding Site Fidelity and Philopatry in Ringed Seals (*Phoca hispida*).
- 2006 University of Alaska Southeast NSF REU Program Research Showcase. Satellite Tracking of Ringed Seals (*Phoca hispida*).
- 2005 National Institutes of Health & the University of Colorado Cancer Center Student Fellowship Forum. P-element Mutagenesis in *Drosophila melanogaster* for the study of Segregation Distortion.
- 2005 Colorado State University Pueblo Student Research Symposium. P-element Mutagenesis: Identifying Mutations that Interact with Segregation Distortion in *Drosophila melanogaster*.

Students Mentored

- current Jesus Cantu, Aria Alexander, Daniel Navarrete, Annalise Russo, and Mallika Viswanath. Princeton University. Research students working on childhood infectious diseases.
- 2013 Emilia Iglesias, University of Michigan, Summer Research Student. Characterizing the Seasonality of Alzheimer's Disease. (Graduating class of 2016)
- 2011 Busola Alabi, University of Michigan, Summer Research Student. The Seasonality of Contemporary Polio Epidemics in Africa. (Now a 1st year PhD student)

Outreach

- 2016 On-film interviews with Contagion Live on topics relating to poliovirus and Zika virus <http://www.contagionlive.com/>.
- 2016 Interviews with reporters regarding publication Preventing Zika Virus Infection during Pregnancy Using a Seasonal Window of Opportunity for Conception. Article covered by 20+ news outlets, including Vogue.
- 2016 Volunteer with The Last Mile Code.7370 coding school for inmates in San Quentin Prison. The group I work with recently developed interactive disease maps for Project Tycho: Data for Health. <https://www.tycho.pitt.edu/resources/lastmile/>
- 2016 Volunteer with Black Girls Code New York City Chapter.
- 2015 Interviews with reporters from multiple news outlets regarding publication Unraveling the Transmission Ecology of Polio. Article appeared in 5+ news outlets and 142 individuals tweeted about the publication.
- 2015 Taught scientific inquiry workshop attended by 240 6th grade students at DeWitt, Michigan Junior High School.
- 2015 Live Webcast Interview for the The Ellis School Monthly Learning Innovation Institute Panel Discussion on How to Engage Girls in Engineering and Computer Science.
- 2014 Interviews with Fox News, Slate Magazine, LiveScience, Vice, and University of Michigan News on Human Birth Seasonality: Latitudinal Gradient and Interplay with Childhood Disease Dynamics. Articles appeared in 25+ news outlets.
- 2011 University of Michigan Women in Science and Engineering, Girls in Science and Engineering Summer Workshop for High School Students. Modeling Human Papilloma Virus Transmission to Help Stop Cervical Cancer.

Awards

- 2015 Rackham Graduate Student Research Grant (\$3000)
- 2015 University of Michigan AGEP Research Travel Award (\$500)
- 2014 University of Michigan Ecology and Evolutionary Biology Dept. Best Student Paper Award (\$500)
- 2014 Rackham Graduate Student Research Grant (\$3,000)
- 2012–2013 University of Michigan, Rackham Travel Grant
- 2011 NSF Ecology and Evolution of Infectious Disease Workshop Scholarship
- 2009 SACNAS National Conference Undergraduate Poster Award for Polar Sciences
- 2009 Alaska EPSCoR Landscape Genetics Scholarship, American Society of Mammalogists Annual Meeting
- 2009 University of Alaska Southeast Outstanding Graduate in Natural Sciences
- 2009 University of Alaska Southeast, Graduated Magna Cum Laude
- 2007–2009 Cooperative Institute for Arctic Research: International Polar Year Fellowship
- 2007–2009 University of Alaska Southeast Arts & Science Student Scholarship
- 2008 NIH, Intramural NIAID Research Opportunities Program Travel Award
- 2006–2007 National Science and Mathematics Access to Retain Talent (SMART) Grant
- 2005–2007 Hispanic Scholarship Fund Scholarship
- 2007 Southeast Alaska Conference Scholarship
- 2007 University of Alaska Student Government Scholarship
- 2007 University of Alaska TRIO Program Grant Recipient

Research & Professional Experience

current	Princeton University, Ecology & Evolution, Associate Research Scholar Professional researcher appointment.
current	Reviewer Ad hoc reviewer for PNAS, Proceedings of the Royal Society B: Biological Sciences, Journal of the Royal Society Interface, Emerging Infectious Diseases, Methods in Ecology & Evolution, The American Naturalist, Molecular Ecology, and the Journal of Infection.
2015–2016	Princeton University, Ecology & Evolution, Postdoctoral Fellow NSF postdoctoral fellow. Research project: "Effects of maternal antibodies on offspring survival and health."
2010–2015	University of Michigan, Ecology & Evolution, PhD Program Graduate student under the advisement of Pejman Rohani and Aaron A King. Dissertation committee members: Pejman Rohani, Aaron A King, Mercedes Pascual, and Betsy Foxman.
2013–2014	University of Michigan, Ecology & Evolution, Grad Student President President of EEB graduate students for the 2013–2014 academic year.
2011–2012	University of Michigan, Ecology & Evolution, Admissions Committee Student representative on the EEB PhD admission committee.
2011	University of Michigan, Graduate Student Instructor EEB/ENVIRON 315: Ecology and Evolution of Infectious Diseases
2010	University of Michigan, Graduate Student Instructor BIOL 130: Animal Behavior
2009–2010	Research Assistant, University of Georgia & University of Michigan Lab of Pejman Rohani University of Georgia Odum School of Ecology, followed by the University of Michigan Ecology & Evolutionary Biology Department.
2010	Summer Field Assistant Assisted Daniel Streicker (University of Georgia) with field research on vampire bat rabies in Peru.
2006–2009	Research Assistant, University of Alaska Southeast Labs of David Tallmon and Brendan P. Kelly, Department of Biology.
2008	Summer Research Assistant, National Institutes of Health Lab of Tom Schwan, Medical Entomology Section of the Laboratory of Zoonotic Pathogens, Rocky Mountain Laboratories, National Institutes of Allergies and Infectious Diseases, National Institutes of Health
2008	Field Research Course, Interdisciplinary Sea-Ice Research, University of Alaska Fairbanks Field techniques in geophysical, biological, and biogeochemical sea-ice research
2007	Research Assistant, National Oceanic & Atmospheric Administration NOAA Living Marine Resources Cooperative Science Center biodiversity research cruise in the North Atlantic Ocean, NOAA Vessel Albatross IV.
2007	Field Assistant Assisted Andrew Whiteley (University of Alaska) with field research on phenotypic plasticity in coast range sculpin in Glacier Bay National Park.
2006	NSF REU Summer Research Student, University of Alaska Southeast Lab of Brendan P. Kelly
2005–2006	Research Assistant, Colorado State University - Pueblo Lab of Janna McLean
2004	Summer Research Student, Colorado State University - Pueblo National Institutes of Health Bridges to Biomedical Careers Program