

ZACHARY M. LAUBACH

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University of Colorado, Boulder
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RESEARCH INTERESTS

Behavior • Evolution • Physiology • Genomics (gene expression) • Life Course Epidemiology

APPOINTMENTS

Postdoc	<i>University of Colorado, Boulder</i> Department of Ecology and Evolutionary Biology Mentors: Dr. Rebecca Safran (CU Boulder), Dr. Kim Hoke (CSU), and Dr. Kay E. Holekamp (MSU)	2019 - present
Asst. Res. Scientist	<i>Michigan Technological University</i> Michigan Technological Research Institute	2012 - 2013
Res. Asst.	<i>Michigan State University</i> Mara Hyena Project	2010 - 2011

EDUCATION

PhD	<i>Michigan State University</i> (Dual degree PhD) Department of Integrative Biology Program in Ecology, Evolution, and Behavioral Biology Advisor: Dr. Kay E. Holekamp	2019
MS	<i>University of Michigan</i> School of Natural Resources and Environment Conservation Biology Advisors: Dr. Johannes Foufopoulos and Dr. Bobbi Low	2010
BS	<i>Juniata College</i> Environmental Science Advisor: Dr. Uma Ramakrishnan	2007

GRANTS

NSF Postdoctoral Research Fellowship Biology (PRFB), DBI 2010607 (2021 - 2023) Longitudinal and experimental tests of a Rule of Life in animals: Variation in parental care establishes lifelong patterns of DNA methylation associated with physiological stress. PI: Z. M. Laubach Mentors: R. J. Safran, K. L. Hoke	\$138,000
Morris Animal Foundation Postdoctoral Fellowship D19ZO-411 (2019 - 2021) Pastoralist communities as a potential source of <i>Toxoplasma gondii</i> infection in a wild carnivore and effects on host behavior and survival. PI: Z. M. Laubach Mentor: K. E. Holekamp	\$100,000
BEACON - NSF DBI 0939454 (2018 – 2019) Impacts of brain-manipulating parasites on host fitness and social behavior. PI: C. Adami Co-PIs: E. Gering, T. Getty, A. Hintze, Z. M. Laubach	\$90,132
NSF Doctoral Dissertation Improvement Grant (DDIG) 1701384 (2017 - 2019) Early social experience and epigenetic mediation of adult phenotypes. PI: Z. M. Laubach Mentor: K. E. Holekamp	\$20,151
BEACON - NSF DBI 0939454 (2015 - 2016) Trans-generational epigenetic inheritance in living and digital hyenas PI: K. E. Holekamp Co-PIs: R. Miikkulainen, Z. M. Laubach , A. Hintze, E. Meyerson	\$161,326

PUBLICATIONS (* Indicates authors contributed equally)

In review or revision

12. **Laubach, Z. M.**, Murray, E. J., Hoke, K. L., Safran, R. J. Perng, W. (in review). EIC (Expert Information Criterion) not AIC: the cautious biologist's guide to model selection. *Proceedings of the Royal Society B*. arXiv:2010.07506
11. **Laubach Z. M.**, Greenberg J. R., Turner J. W., Montgomery T. M., Pioon M. O., Smale L., Cavalcante R., Padmanabhan K. R., Lalancette C., vonHoldt B., Faulk C. D., Dolinoy D. C., Holekamp K. E., Perng, W. (in review) Associations of early social experience with offspring DNA methylation and later life stress phenotype. *Nature Communications*. DOI: 10.1101/2020.08.26.268805
10. Gering, E. *, **Laubach, Z. M. ***, Weber, P., Hussey, G. S., Lehmann, K. D. S., Montgomery, T. M., Turner, J. W., Perng, W., Pioon, M. O., Holekamp, K. E., and Getty, T. (in review). *Toxoplasma gondii* infections are associated with boldness towards lions in wild hyena hosts. *Nature Communications*. DOI: 10.1101/2020.08.26.268805

Published

9. Spagnuolo, O. S. B., Jarvey, J. C., Battaglia, M. J., **Laubach, Z. M.**, Miller, M. E., Holekamp, K. E., Bourgeau-Chavez, L. L. 2020. Mapping Kenyan grassland heights across large spatial scales with combined optical and radar satellite imagery. *Remote Sensing*. DOI: 10.3390/rs12071086
8. **Laubach, Z. M.***, Perng, W.* , Cardenas, A., Rifas-Shiman, S. L., Oken, E., DeMeo, D., Litonjua, A. A., Duca, R. C., Godderis, L., Baccarelli, A., Hivert, M. F. 2019. Socioeconomic status and DNA methylation from birth through mid-childhood: A prospective study in Project Viva. *Epigenomics*. DOI: 10.2217/epi-2019-0040
7. **Laubach, Z. M.**, Faulk, C. D., Dolinoy, D. C., Montrose, L., Jones, T. R., Ray, D., Pioon, M. O., Holekamp, K. E. 2019. Early life social and ecological determinants of global DNA methylation in wild spotted hyenas. *Molecular Ecology*. DOI: 10.1111/mec.15174
6. **Laubach, Z. M.**, Perng, W., Dolinoy, D. C., Faulk, C. D., Holekamp, K. E., Getty, T. 2018. Epigenetics and the maintenance of developmental plasticity: extending the signaling theory framework. *Biological Reviews*. DOI: 10.1111/brv.12396
5. Bourgeau-Chavez, L., Lee, Y. M., Battaglia, M., Endres, S., **Laubach, Z. M.**, Scarbrough, K. 2016. Identification of woodland vernal pools with seasonal change PALSAR data for habitat conservation. *Remote Sensing* 8 (6): 490. DOI: 10.3390/rs8060490
4. **Laubach, Z. M.**, Perng, W., Lombardo, M., Murdock, C. C., & Foufopoulos, J. 2015. Determinants of parental care in Mountain white-crowned sparrows (*Zonotrichia oriantha*). *The Auk: Ornithological Advances* 132: 893-902. DOI: 10.1642/AUK-15-9.1
3. Bourgeau-Chavez, L., Endres, S., Battaglia, M., Miller, M., Banda E., **Laubach, Z. M.**, Higman, P., Chow-Fraser, P., and Marcaccio, J. 2015. Development of a bi-national Great Lakes coastal wetland and land use map using three-season PALSAR and Landsat imagery. *Remote Sensing* 7: 8655-8682. DOI: 10.3390/rs70708655
2. **Laubach, Z. M.**, Sampson, G., Blumstein, D. T., Romero, L. M., & Foufopoulos, J. 2013 Are white-crowned sparrow badges reliable signals? *Behavioral Ecology and Sociobiology* 67: 481-492. DOI: 10.1007/s00265-012-1468-3.
1. Bourgeau-Chavez, L. L., Kowalski, K. P., Carlson Mazur, M. L., Scarbrough, K. A., Powell, R. B., Brooks, C. N., Huberty, B., Jenkins, L. K., Banda, E. C., Galbraith, D. M., **Laubach, Z. M.**, and Riordan, K. 2013 Mapping invasive *Phragmites Australis* in the coastal Great Lakes with ALOS Palsar satellite imagery for decision support. *Journal of Great Lakes Research* 39: 65-77. DOI: 10.1016/j.jglr.2012.11.001

BOOK CHAPTERS AND INVITED REVIEWS / COMMENTARIES

Book Chapters

2. **Laubach, Z. M.**, Faulk, C. D., Cardenas, A., Perng, W. 2017. Nutrition, DNA methylation, and developmental origins of cardiometabolic disease: A signal systems approach. Chapter 6 in *Handbook of Nutrition, Diet and Epigenetics*. Vinood Patel and Victor Preedy, Editors. Springer Publishers. DOI: 10.1007/978-3-319-31143-2_107-1

1. Bourgeau-Chavez, L. L., **Laubach, Z. M.**, Battaglia, M. J., Landon, A. J., Banda E. C., Endres, S. L., Macleod, R., Miller, M. E., and Brooks, C. N. 2015. Great Lakes Coastal Wetland Mapping. Chapter 15 in *Remote Sensing of Wetlands: Applications and Advances*. R. Tiner, V. Klemas and M. Lang, Editors. Taylor and Francis Publishers. DOI: 10.1201/b18210-19

Invited Reviews / Commentaries

1. Gering, E. *, Laubach, **Z. M.***, Weber, P., Hussey, G. S., Turner, J., Holekamp, K. E., and Getty, T. 2020. Time makes you older, parasites make you bolder: *Toxoplasma gondii* infections predict hyena boldness toward definitive lion hosts in a human-altered landscape. In *Evolution in action: Past, present and future: A Festschrift in honor of Erik D. Goodman*. Wolfgang Banzhaf, Betty Cheng, Kalyanmoy Deb, Kay Holekamp, Richard Lenski, Charles Ofria, Robert Pennock, Bill Punch, Danielle Whittaker, Editors. Springer International Publishing. DOI: 10.1007/978-3-030-39831-6

PRESENTATIONS

Platform presentations

- Laubach, Z. M.** Murray, E. J., Hoke, K. L., Safran, R. J. Perng, W. 2021. A biologist's guide to model selection and causal inference. *American Society of Naturalists, Virtual Asilomar*.
- Laubach, Z. M.** 2020. Early social experiences contribute to DNA methylation and development of future stress phenotype. *Early Life Adversity, Virtual Conference*.
- Laubach, Z. M.**, Cavalcante, R., Dolinoy, D. C., Faulk, C., Greenberg, J., Lalancette, C., Montgomery, T., Padmanabhan, K., Perng, W., Pioon, M., Smale, L., Turner, J., vonHoldt, B., & Holekamp, K. E. 2020. Early social experiences contribute to DNA methylation and development of future stress phenotype. *Animal Behavior Society, Virtual Conference*.
- Laubach, Z. M.**, Faulk, C., Dolinoy, D. C., Montrose, L., & Holekamp, K. E. 2019. Associations of early life environment and DNA methylation in wild spotted hyenas. *Animal Behavior Society*. Chicago, IL.
- Laubach, Z. M.**, Faulk, C., Montrose, L., Greenberg, J., Dolinoy, D. C., & Holekamp, K. E. 2017. Associations of early-life social experience with DNA methylation in free-living spotted hyenas. U.S. *DOHaD*. Detroit, MI.
- Laubach, Z. M.** 2017. Epigenetics and phenotypic plasticity: An extension of a signal detection problem. MSU, EEBB Colloquium, East Lansing, MI.
- Laubach, Z. M.**, Faulk, C., Dolinoy, D. & Holekamp, K. E. 2015. Measuring glucocorticoid receptor DNA methylation in Spotted Hyenas. *BEACON Congress*. Michigan State University, East Lansing, MI.
- Laubach, Z. M.**, Faulk, C., Dolinoy, D., Sant, K., & Holekamp, K. E. 2014. Social environment, epigenetics and stress response: an ethological extension in Spotted Hyenas. *Animal Behavior Society (51st Anniversary Meeting)*. Princeton University, Princeton, NJ.

- Laubach, Z. M.**, Faulk, C., Dolinoy, D., & Holekamp, K. E. 2014. Social environment, epigenetics and stress physiology in Spotted Hyenas. *Fish and Wildlife Graduated Student Organization Research Symposium*. Michigan State University, Lansing, MI.
- Laubach, Z. M.**, Blumstein, D. T., Romero, L. M., & Foutopoulos, J. 2013. A test of status badge reliability in Mountain white-crowned sparrows. *Animal Behavior Society (50th Anniversary Meeting)*. University of Colorado Boulder, CO.
- Laubach, Z. M.**, Sampson, G., Blumstein, D. T., Romero, L. M., & Foutopoulos, J. 2010. Functional importance of a plumage badge in intraspecific signaling in white-crowned sparrows. *Ecological Society of America Conference (95th ESA Annual Meeting)*. Pittsburgh, PA.
- Laubach, Z. M.**, Sampson, G., Blumstein, D. T., Romero, L. M., & Foutopoulos, J. 2010. Functional importance of plumage characteristics (design and costs) as intraspecific signals in mountain white-crowned sparrows (*Zonotrichia leucophrys oriantha*). *Midwest Ecology and Evolution Conference*. Ames, IA.
- Laubach, Z. M.**, Blattenberg, C., Pelkey, N. & Ramakrishan, U. 2007. An Evaluation of Nocturnal and Diurnal Behavior by Male White-tailed Deer using GPS Collar Data. *Northeast Fish and Wildlife Conference*. Mystic, CT.
- Laubach, Z. M.**, Blattenberg, C., Pelkey, N. & Ramakrishan, U. 2007. An Evaluation of Nocturnal and Diurnal Behavior by Male White-tailed Deer using GPS Collar Data. *Juniata Liberal Arts Symposium*. Huntingdon, PA.
- Laubach, Z. M.** & Ramakrishan, U. 2005. Applications in Wildlife Research: Deer Density and Habitat Monitoring. *Appalachian GIS Convention*. California University of Pennsylvania. California, PA.

Poster presentations

- Laubach, Z. M.**, Perng, W., Holekamp, K., Faulk, C., Dolinoy, D. C., Getty, T. 2017. The role of epigenetics in phenotypic plasticity: an extension of signal detection theory. *1st Annual Research Symposium (Ecology, Evolutionary Biology and Behavior Program)*. Michigan State University, East Lansing, MI
- Laubach, Z. M.**, Perng, W., Holekamp, K., Faulk, C., Dolinoy, D. C., Getty, T. 2017. The role of epigenetics in phenotypic plasticity: an extension of signal detection theory. *13th Annual Early Career Scientists Symposium (Ecology and Evolutionary Biology of Phenotypic Plasticity)*. University of Michigan, Ann Arbor, MI
- Laubach, Z. M.**, Walker, A. & Ramakrishan, U. 2007. GIS Application in Wildlife Research: A Comparison between Home Range Extension and Hawth's Analysis Tools. *Pennsylvania Wildlife Society Conference*. State College, PA.

INVITED SEMINARS

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|---|--------------------------------|------|
| North Carolina State University
<i>Spotted hyena research and health.</i> | College of Veterinary Medicine | 2020 |
| Eastern Michigan University
<i>The Developmental Origins of Health and Disease (DOHaD) hypothesis:
A step into the wild.</i> | Department of Biology | 2018 |

Michigan Tech. Research Institute <i>Random Forests: An Overview of What, Why, How, and When</i>	2012
Michigan Tech. Research Institute <i>MSU Hyena Research Project: A Slice from a Long-term Study in the Masai Mara Kenya</i>	2012

TEACHING

Behavioral Ecology of African Mammals (IBio 490)	Instructor (MSU)	2017 - 2018
Evolution (IBio 445)	TA (MSU)	2017 - 2018
Ecological Aspects of Animal Behavior (IBio 415)	TA (MSU)	2016
Organismal and Population Biology Laboratory (Bio 172)	TA (MSU)	2013 - 2014
Animal Physiology Laboratory (Bio 226)	TA (U Mich.)	2008 - 2009

Guest Lectures

University of Colorado, Boulder <i>Social biology and sex roles: A case study in spotted hyenas.</i>	The biology of Sex and Gender	2020
University of Colorado, Anschutz <i>Evolutionary perspectives in public health.</i>	Advanced Epidemiology	2019, 2020
Nova Southeastern University <i>Epigenetics and behavioral ecology of spotted hyenas.</i>	Biology	2020
Michigan State University <i>Evolution of social behavior and group living</i>	Evolution	2017, 2018
Michigan State University	BrInC Club	2017
Michigan State University <i>Associations of early-life social experience with DNA methylation in free-living spotted hyena</i>	Ecological Aspects of Animal Behavior	2016, 2017
Juniata College <i>The Evolution of Spotted Hyena Sociality: Lessons from a Long Term Field Study</i>	Animal Behavior	2013
University of Michigan <i>MSU Hyena Research Project: A Slice from a Long Term Study in the Masai Mara Kenya</i>	Field Mammalogy	2012

Mentorship

Graduate Students

Timothy Ikime	MS, Michigan State University	2014 - 2015
*provided one-on-one analytical consulting for 2 additional graduate students at MSU		

Undergraduate students

Mariana J. Ayala	University of Colorado	2020 - present
Genevieve Redgate	Michigan State University	2017 - 2019
Karee Lesko	Michigan State University	2017 - 2018
Lila Afifi	Michigan State University	2017 - 2018
Emily Bernhardt	Michigan State University	2015 - 2018
Alyse Maksimoski	Michigan State University	2017
Caroline Titel	Michigan State University	2016 - 2017
Jessica Sattler	Michigan State University	2016 - 2017
Haley Fulco	Michigan State University	2016
Katherine Steinfield	Michigan State University	2016
*oversaw research experience for 20 additional students while at MSU		

PROFESSIONAL SOCIETY MEMBERSHIPS

American Society of Naturalists (ASN)	2020 - present
Animal Behavior Society (ABS)	2013 - present
Society for Integrative and Comparative Biology (SICB)	2014 - present
U.S. Developmental Origins of Health and Disease (DOHaD)	2017 - 2018

AWARDS / FELLOWSHIPS

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| • Animal Behavior Society Student Research Grant (2019) | \$1500 |
| • BEACON Travel Award, Michigan State University (2014, 2018, 2019) | \$600 |
| • College of Natural Science Dissertation Completion Fellowship, Michigan State University (2019) | \$6000 |
| • Dr. Marvin Hensley Endowed Scholarship in Zoology, Michigan State University (2018) | \$8700 |
| • Graduate School Research and Travel Fellowship, Michigan State University (2018) | \$1500 |
| • Ecology, Evolutionary Biology and Behavior Program Travel Fellowship, Michigan State University (2018) | \$1000 |
| • Society for Integrative and Comparative Biology (SICB), Grants-in-aid of Research (2016) | \$1000 |
| • Ecology, Evolutionary Biology and Behavior Summer Fellowship, MSU (2014 - 2017) | \$1800 |
| • Dr. Marvin Hensley Endowed Scholarship in Zoology, Michigan State University (2014) | \$9165 |
| • BEACON Science and Technology Center Top Up Fellowship, Michigan State University (2013-2018) | \$3000/yr |
| • School of Natural Resources Travel Grant, University of Michigan (2010) | \$200 |

• Midwest Ecology and Evolution Conference (MEEC) Travel Grant (2010)	\$200
• Rackham Conference Travel Grant (received twice), University of Michigan (2010)	\$600
• Dr. Lee R. G. Snyder Memorial Research Fellowship, Rocky Mountain Biological Laboratory (2009)	\$1,440
• Harold and Vivian Shapiro/John Malik Awards, University of Michigan (2009)	\$600
• Robbins/Shuman Award, Fulton Financial Advisors (2008-2009)	\$4,500
• Rackham Graduate Student Research Grant, University of Michigan (2008)	\$1,500
• School of Natural Resources and Environment Practicum/Thesis Research Award, University of Michigan (2008)	\$1,000
• Calvert Ellis Award, Juniata College (2003 - 2007)	\$40,000

Service

Diversity, Equity and Inclusion

Workshop developer and director for an <i>Introduction to Data Management And Analysis for Biologists and Behavioral Scientists</i> , a collaboration with The African Graduate Student Association and MasterCard Foundation Scholars at Michigan State University; a workshop series attended by 16 Graduate students representing multiple Sub-Saharan African countries as well as 5 undergraduate women in science. https://github.com/laubach/data_mangmnt_analysis_tutorial	2018
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National/International Service

Session Organizer for American Society of Naturalist Asilomar virtual conference	2020
Session Moderator for Animal Behavior Society Meeting	2019
Reviewer for: <i>Global Ecology and Conservation</i> , <i>Evolutionary Ecology</i> , <i>The Northeastern Naturalist</i> , <i>The Wilson Journal of Ornithology</i> , <i>Ethology</i>	

Institutional Service

Judge Michigan State University Undergraduate Research and Arts Forum (UURAF)	2017, 2018
Judge Michigan State University Integrative Biology undergraduate award applications	2018
Course Developer/Instructor Michigan State University R workshop African Graduate Student Association: Introduction to Data Management and Analysis for Biologists and Behavioral Scientists	2018
Blog Authorship: <i>BEACON: An NSF Center for the Study of Evolution in Action</i> , <i>Notes From Kenya: MSU Hyena Research</i>	
Session Moderator for BEACON Congress	2015
Judge Mid-Michigan Symposium for Undergraduate Research Experiences (Mid-SURE)	2015

Career Panelist	MSU Integrative Biology of Social Behaviors (IBSB) REU Students	2015
Graduate Student Representative	MSU Zoology Graduate Affairs Committee	2013 - 2014
Public Outreach Volunteer	Michigan State University Darwin Day at the Museum	2014