

Julien F. Ayroles, Ph.D.

ayroleslab.com [Scholar](#) jayroles@princeton.edu Phone: (609) 258-8422

Research Scope: My group studies the biological basis for individual variation. We seek to understand how genes interact with each other and their environment to shape variation between individuals. The genetic architecture of complex traits is proving to be far more dynamic and context-dependent than previously thought. This has major implication for our ability to understand how populations evolve, how we study the genetic basis for complex traits and our ability to predict phenotype from genotype. We address this problem by developing experimental and analytical approaches aimed at improving our understanding of the genotype - phenotype map.

APPOINTMENTS

- | | |
|--------------|---|
| 2015-present | Assistant professor
Princeton University, Princeton, NJ
Department of Ecology and Evolutionary Biology and Lewis-Sigler Institute for Integrative Genomics |
| 2011-2015 | Harvard Junior Fellow
Cambridge, MA
Harvard Society of Fellows, Harvard University |
| 2003-2005 | Research and Field Assistant
Champaign, IL (Under Dr. Ken Paige)
University of Illinois, Department of Zoology |

EDUCATION

- | | |
|------|---|
| 2011 | Ph.D. in Genetics
North Carolina State University, Raleigh, Department of Genetics
Title: <i>A Systems Genetics Approach to the Dissection of Complex Traits in Drosophila melanogaster.</i> |
| 2005 | Master of Sciences in Natural Resources and Environmental Sciences
University of Illinois, Urbana-Champaign, Department of Animal Behavior |
| 2002 | Maîtrise (equivalent B.S.) in Organismal and Population Biology with honors
Paul Sabatier Université, Toulouse, France (Exchange program TASSEP) |
| 2001 | General degree in Biological Sciences (DEUG) with honors
Paul Sabatier Université, Toulouse, France |

PUBLICATIONS

Preprints

- | | |
|------|---|
| 2023 | AJ Lea, IV Caldas, K Garske, J Echwa, M Gurven, C Handley, J Kamau, M Kiboi, P Kinyua, F Lotukoi, A Lopurudoi, S Lowasa, R Mallarino, D Martins, P Messer, CMiano, B Muhoya, J Peng, T Phung, R Siford, A Stone, A Taravella Oill, SMathew, M Wilson, JF Ayroles (2022) Adaptations to heat and pastoralism in the Turkana of northwest Kenya. bioRxiv (Under review at Science) |
| 2022 | Pettie, KP, Mumbach, M, Lea, AJ, Ayroles, JF , Chang, HY, Kasowski, M, & Fraser, HB. (2022). Chromatin activity identifies differential gene regulation across human ancestries. bioRxiv (under review Genome Biology). |
| 2022 | Wolf, S*, Melo, D*, Garske, KM, Pallares, LF, & Ayroles, JF . (2022). Characterizing the landscape of gene expression variance in humans. bioRxiv. (Under review at Plos Genetics) |
| 2022 | Henry, L. P., Fernandez, M., Wolf, S., & Ayroles, JF . (2022). Wolbachia interacts with the microbiome to shape fitness-associated traits during seasonal adaptation in Drosophila melanogaster. bioRxiv (under review at mBio) |
| 2022 | Lea A, Clark A, Dahl A, Devinsky O, Garcia A, Golden C, Kamau J, Kraft T, Martins D, Mogoi D, Pajukanta P, Perry G, Pontzer H, Trumble B, Urlacher S, Venkataraman V, Wallace I, Gurven M, Lieberman D, Ayroles, JF . (2022). Evolutionary mismatch and the role of GxE interactions in human disease. bioRxiv (under revision at Plos Biology). |

- 2022 Bruijning M, **Ayroles JF**, Henry LP, Koskella B., Meyer KM, Metcalf JM. (2022). **Relative abundance data can misrepresent heritability of the microbiome**. bioRxiv (doi.org/10.1101/2022.04.26.489345) (under revision at [BMC microbiology](#)).
- 2022 Henry L, Fernandez M, **Ayroles JF**. (2022) **The environment modulates the effects of the microbiome on host adaptive potential**. [bioRxiv doi.org/10.1101/2020.09.21.306779](#) (under review [Science Advances](#))
- 2021 Akhund-Zade J, Yoon D, Bangerter A, Polizos N, Campbell M, Soloshenko A, Zhang T, Wice E, Albright A, Narayanan A, Schmidt P, Saltz J, **Ayroles JF**, Klein M, Bergland B, de Bivort B. (2021) **Wild flies hedge their thermal preference bets in response to seasonal fluctuations**. bioRxiv. (under revision [Evolution](#))
- Published
- 2022 Golden, C. D.*, **Ayroles, JF***, Eurich, J. G., Gephart, J. A., Seto, K. L., Sharp, M. K., ... & Timeon, E. (2022) **Study Protocol: Interactive dynamics between coral reef fisheries and the nutrition transition in Kiribati**. *Frontiers in Public Health*, 1639. (*equal contribution)
- 2022 Lea, AJ, Peng, J, & **Ayroles, JF**. (2021). **Diverse environmental perturbations reveal the evolution and context-dependency of genetic effects on gene expression levels**. [Genome Research](#), 32(10), 1826-1839.
- 2022 Henry, LP, & **Ayroles, JF**. (2022). **Drosophila melanogaster microbiome is shaped by strict filtering and neutrality along a latitudinal cline**. [Molecular ecology](#), 31(22), 5861-5871.
- 2022 Lea AJ, Garcia A, Arevalo J, **Ayroles JF**, Buetow K, Cole SW, Rodriguez DE, Gutierrez M, Highland HM, Hooper P, Justice A, Kraft T, North KE, Stieglitz J, Kaplan H, Trumble BC, Gurven MD. (2022) **Natural selection of immune and metabolic genes associated with health in two lowland Bolivian populations**. [PNAS](#) 120 (1) e2207544120.
- 2022 Pallares LF, Lea AJ, Han C, Filippova EV, Andolfatto P, **Ayroles JF**. (2022) **Diet unmasks genetic variants that regulate lifespan in outbred Drosophila**. [Nature Genetics](#) 55, 123–129.
- 2022 de Bivort, B, Buchanan, S, Skutt-Kakaria, K, Gajda, E, **Ayroles, JF**, O'Leary, C, & Smith, M. A. Y. (2022). **Precise quantification of behavioral individuality from 80 million decisions across 183,000 flies**. [Frontiers in Behavioral Neuroscience](#), 16.
- 2022 Bruijning M, Henry LP, Forsberg SK, Metcalf CJ, **Ayroles JF**. (2022) **When the microbiome defines the host phenotype: selection on vertical transmission in varying environments**. [Nature ecology & evolution](#), 1-11.
- 2021 Henry LP, and **Ayroles JF**, 2021. **Meta-analysis suggests the microbiome responds to Evolve and Resequencing experiments in Drosophila melanogaster**. [BMC microbiology](#), 21(1):1-14.
- 2021 Choi JY, Dai X, Peng JZ, Rughani P, Hickey S, Harrington E, Juul S, **Ayroles JF**, Purugganan M, Stacy E. (2020) **Selection on ancient variations drives the adaptive radiation of *Metrosideros* across the Hawaiian archipelago**. [Proceedings of the National Academy of Sciences](#) 118(37)
- 2021 Lea, A.J., Waigwa, C., Muhoya, B., Lotukoi, F., Peng, J., Henry, L., Abhyankar, V., Kamau, J., Martins, D., Gurven, M. and **Ayroles, J.F.** (2021). **Socioeconomic status effects on health vary between rural and urban Turkana**. [Evolution, medicine, and public health](#) 9 (1), 406-419.
- 2021 Werkhoven Z, Bravin A, Skutt-Kakaria K, Reimers P, Pallares LF, **Ayroles JF**, De Bivort BL*. (2020) **The structure of behavioral variation within a genotype**. [eLife](#) 10, p.e64988.
- 2021 Akhund-Zade, J., Lall, S., Gajda, E., Yoon, D., **Ayroles, J.F.**, & de Bivort, B. L. (2021). **Genetic basis of offspring number-body weight tradeoff in Drosophila melanogaster**. *G3 Genes Genomes Genetics*.

- 2020 Rau CD, Gonzales NM, Bloom JS, Park D, **Ayroles J.F.**, Palmer AA, Lusi AJ, Zaitlen N. (2020) **Modeling Epistasis in Mice and Yeast Using the Proportion of Two or More Distinct Genetic Backgrounds: Evidence for Polygenic Epistasis.** *Plos Genetics* 16(10), e1009165.
- 2020 Lea AJ., Martins D., Kamau, J., Gurven, M., **Ayroles, J.F.** (2020). **Urbanization and market integration have strong, nonlinear effects on cardiometabolic health in the Turkana.** *Science advances*, 6(43), eabb1430
- 2020 Pallares LF, Picard S, **Ayroles J.F.** (2020) **TM3'seq: a tagmentation-mediated 3'sequencing approach for improving scalability of RNAseq experiments.** *G3: Genes, Genomes, Genetics* 10(1), 143-150
- 2019 Bruijning M, Metcalf J, Jongejans E and **Ayroles JF.** (2019). **Exploring the fitness consequences of intra-genotypic variation.** *Trends in Ecology and Evolution* 35(1): 22-33.
- 2020 Henry LP., Bruijning M., Forsberg KGS., **Ayroles JF.** (2020). **The microbiome extends host evolutionary potential** *Nature Communications* 12(1), 1-13.
- 2019 Lea AJ, Subramaniam M, A Ko, T Lehtimäki, E Raitoharju, MikaKähönen, I Seppälä, N Mononen, O Raitakari, M Ala-Korpela, P Pajukanta, N Zaitlen, **Ayroles JF.** (2019). **Genetic and environmental perturbations lead to regulatory decoherence.** *eLife* 8, e40538
- 2019 Musharoff S, Park DS, A Dahl, JM Galanter, X Liu, S Huntsman, C Eng, Burchard EG, **Ayroles JF ***, Zaitlen N* (2019) **Existence and implications of population variance structure.** bioRxiv, 439661 (in revision to *AJHG*). (*equal contribution)
- 2018 Schrider DR, **Ayroles JF**, Matute DR, AD Kern AD. (2018). **Supervised machine learning reveals introgressed loci in the genomes of *Drosophila simulans* and *D. sechellia*.** *PLoS genetics* 14 (4), e1007341
- 2018 Dumitrascu B, Darnell G, **Ayroles JF**, Engelhardt BE. (2018). **Statistical tests for detecting variance effects in quantitative trait studies.** *Bioinformatics* 35(2): 200-210.
- 2015 Zwarts L, Broeck LV, Cappuyns E, **Ayroles JF**, Magwire MM, Vulsteke V, Clements J, Mackay TF, Callaerts P. (2015) **The genetic basis of natural variation in mushroom body size in *Drosophila melanogaster*.** *Nature communications* 11(6).
- 2015 **Ayroles JF**, Buchanan SM, O'Leary C, Skutt-Kakaria K, Grenier JK, Clark AG, Hartl DL, de Bivort BL. (2015). **Behavioral idiosyncrasy reveals genetic control of phenotypic variability.** *Proceedings of the National Academy of Sciences* 112(21): 6706-11
- 2014 Matute DR*, **Ayroles JF***. (2014) **Hybridization occurs between *Drosophila simulans* and *D. sechellia* in the Seychelles archipelago.** *Journal of evolutionary biology.* 27(6):1057-68
- 2013 Corbett-Detig RB, Zhou J, Clark AG, Hartl DL, **Ayroles JF** . (2013). **Genetic Incompatibilities Within Species are Widespread.** *Nature* 504, 135–137. *Faculty of 1000. Biology*
- 2012 Huang W, Richards S, Carbone MA, Zhu D, Anholt RRH, **Ayroles JF**, et al. (2012) **Epistasis Dominates The Genetic Architecture Of *Drosophila* Quantitative Traits.** *Proceedings of the National Academy of Sciences* 109:15553-15559
- 2012 Massouras A, Waszak SM, Albarca M, Hens K, Holcombe K, **Ayroles JF**, Dermitzakis ET, Eric A Stone EA, Jensen J D, Mackay T.F.C, Deplancke B. (2012) **Genomic Variation And Its Impact On Gene Expression In *Drosophila Melanogaster*.** *Plos Genetics* 8 (11): e1003055
- 2012 Mackay TFC*, Richards S*, Barbadilla A *, Stone EA*, Ayroles JF*, Zhu D, Sònia Casillas. et. al. (2012) **The *Drosophila* Genetics Reference Panel:A Community Resource for Analysis of Population Genomics and Quantitative Traits.** *Nature* 482(7384):173-8. *Faculty of 1000. Biology*

- 2011 Ober U, Ayroles JF, Stone EA, Richards S, Zhu D, Gibbs RA, Stricker C, Gianola D, Schlather M, Mackay TFC, Simianer H. (2011) **Using Whole Genome Sequence Data to Predict Quantitative Trait Phenotypes in *Drosophila melanogaster***. *PLoS Genetics* 8(5): e1002685. [Faculty of 1000. Biology](#)
- 2011 Rowe K, Singhal S, MacManes M, Ayroles JF, Morelli TL, Rubidge E, Bi K, Moritz C (2012). **Museum Genomics: Low Cost And High Accuracy Genetic Data From Historical Specimens**. *Molecular Ecology Resources* 11(6): 1082–1092
- 2011 Ayroles JF, Laflamme B, Wolfner MA, Mackay TFC. (2011) **Sifting Through The Data: Identifying Top Candidates For Novel seminal Protein Genes From *Drosophila* Whole Genome Expression Data**. *Genetics Research* 93(6): 387-395
- 2010 Jumbo-Lucioni P*, Ayroles JF*, Chambers MM, Jordan KW, Leips J, Mackay TF, De Luca M. (2010) **Systems Genetics Analysis Of Body Weight And Energy Metabolism Traits In *Drosophila Melanogaster***. *BMC Genomics* 11(11): 297. (* Contributed equally)
- 2009 Edwards, A, Ayroles JF, Stone EA, Mackay TFC. (2009) **A Transcriptional Network Associated With Natural Variation In *Drosophila* Aggressive Behavior**. *Genome Biology* 10(7): R76.
- 2009 Mackay TFC, Stone EA, Ayroles JF. (2009) **Quantitative Genetics: Prospects And Challenges**. *Nature Review Genetics* 10(8): 565-577
- 2009 Morozova TV*, Ayroles JF*, Jordan KW, Duncan LH, Carbone MA, Lyman RF, Stone EA, Govindaraju DR, Ellison RC, Mackay TF, Anholt RR. (2009) Alcohol Sensitivity In *Drosophila*: Translational Potential Of Systems Genetics. *Genetics* 183(2): 733-745 (* Contributed equally)
- 2009 Harbison ST, Carbone MA, Ayroles JF, Stone EA, Lyman RF, Mackay TFC (2009) **Co-Regulated Transcriptional Networks Contribute to Natural Genetic Variation in *Drosophila* Sleep**. *Nature Genetics* 41(3): 371-375
- 2009 Ayroles JF, Carbone MA, Stone EA, Jordan KW, Lyman RF, Magwire MM, Rollman SM, Duncan LH, Lawrence F, Anholt RH, Mackay TFC. (2009) **Systems genetics of complex traits in *Drosophila melanogaster***. *Nature Genetics* 41(3): 299-307. [Faculty of 1000. Biology](#)
- 2009 Kocher SD, Ayroles JF, Stone EA, Grozinger CM. (2009) **Genomics Of Pheromone Response: Cooperation And Conflict In Honey Bees**. *PLoS ONE* 5(2): e9116
- 2009 Stone EA, Ayroles JF. (2009) **Modulated Modularity Clustering As An Exploratory Tool For Functional Genomic Inference**. *PLoS Genetics* 5(5): e1000479
- 2009 Ayroles JF, Hughes KA, Reedy MM, Rodriguez-Zas SL, Drnevich JM, Rowe KC, Cáceres CE, Paige KN. (2009) **Genome-Wide Assessment Of Inbreeding Depression In *Drosophila Melanogaster***. *Conservation Biology* 23(4): 920-930
- 2009 Carbone MA, Ayroles JF, Yamamoto A, Morozova TV, West SA, Magwire MM, Mackay TF, Anholt RR. (2009) **Overexpression Of Myocilin In The *Drosophila* Eye Activates The Unfolded Protein Response: Implications For Glaucoma**. *PLoS ONE* 4(1): e4216
- 2006 Ayroles JF, Gibson G. (2006) **Analysis Of Variance Of Microarray Data**. *Methods Enzymol* 411: -33
- 2006 Ayroles JF, Hughes KA, Reedy MM, Drnevich JM, Rowe KC, Ruedi EA, Cáceres CE, Paige KN. (2006) **Segregating Variation In The Transcriptome: Cis Regulation And Additivity Of Effects**. *Genetics* 173(3): 1347-1355.
- 2005 Dejean A, Solano PJ, Ayroles JF, Corbara B, Orivel J. (2005) **Insect Behaviour: Arboreal Ants Build Traps to Capture Prey**. *Nature* (434):973

BOOK CHAPTER

2020 Metcalf CJE*, Ayroles JF*. (2020). Chapter: **"Why does intra-genotypic variance persist?"** In book titled "Unsolved Problems in Ecology". Princeton University Press. (*equal contribution)

GRANTS

2023-2027 **NIH- NIGMS R35 (renewal)** - A path to personalized phenotypic prediction: unlocking the context-dependency of allelic effects

2022-2024 **HMEI Grand Water Challenge** - Characterizing the health, cultural and ecological impact of borehole water dependence in Pastoralist communities

2019 - 2021 **Mpala Funds** - Evolutionary functional genomics of the Turkana: signatures of past selection an responses to modern urbanization

2018 - 2023 **NIH NIEHS - R01-**

2017 - 2022 **NIH- NIGMS R35** - A path to personalized phenotypic prediction: unlocking the context-dependency of allelic effects

2018 **San Diego Zoo Exploration funds**

2017 **New Ideas in the Natural Sciences, Princeton University**

2015 **Banff International Research Station**

2015 **Foundation les Treilles**

2014 **3CPG – Cornell University**

2014 **Broad Institute SPARC (collaboration with Norbert Perrimon)**

2012 **Milton Research Award – Harvard University**

TEACHING

2020 EEB309 "Introduction to Evolutionary Biology"

2020 - 2022 EEB521 "Tropical Ecology" (graduate Students)

2020 - 2022 EEB388 "Genomics in the wild"

2019 EEB380 "Ecology & Conservation of Africa"

2017 EEB409 "Understanding the evolution of adaptive systems"

2016 - 2021 ISC326 "Past, present and future of the human genome"

HONORS & AWARDS

2017 NIH Maximizing Investigators Research Award for young investigator

2016 Richard B. Fisher Preceptor in Integrative Genomics

2015 Kavli Fellow, National Academy of Science

2013 Faculty of the 1000 (Genomics & Genetics, Evolutionary/Comparative Genetics)

2011 Junior Fellowship, Harvard Society of Fellows, Harvard University

2011 Kenneth R. Keller Award for Excellence in Doctoral Dissertation Research

SELECTED TALKS

2022 Population, Evolutionary and Quantitative Genetics Meeting: Dietary stress unmasks cryptic genetic variation regulating lifespan in outbred *Drosophila*.

2022 Biology of Genomes CSHL: Studying adaptation to desert living and pastoralism in the Turkana.

2022 UCLA (Bioinformatics seminar series series): Leveraging Evolutionary Mismatches to Study G-by-E Interactions.

- 2020 [Harvard/MIT Evolutionary Genomics seminar series](#): Leveraging Evolutionary Mismatches to Study Genotype by Environment Interactions
- 2020 [Cornell](#): Leveraging Evolutionary Mismatches to Study Genotype by Environment Interactions
- 2019 [EEFG Gordon Conference](#): A Novel, Massively Parallel Mapping Framework to Unlock Genotype-Dependent Environmental Response
- 2019 [Vienna Veterinärmedizinische Universität](#): The genetics of disruption: studying the genetic basis of environmental sensitivity.
- 2018 [Duke University](#): From individual variation to the genetic basis of environmental sensitivity
- 2018 [UT Austin](#): From individual variation to the genetic basis of environmental sensitivity
- 2018 [Uppsala University](#): The complex Genetics of Complex Traits
- 2017 [U Pennsylvania](#): Heritability and Prediction in Human Genetics
- 2017 [Workshop](#): Latin-American School on Evolution (Sao Paolo)
- 2017 [UCLA \(Human Genetics\)](#): The genetics of disruption: studying the genetic basis for phenotypic covariance
- 2017 [Foundation les Treilles \(organizer\)](#)
- 2016 [Banff International Research Station](#)
- 2016 [American Society for Human Genetics](#)
- 2016 [Broad Institute](#): Behavioral individuality reveals genetic control of phenotypic variability