

Samuel H. Church, PhD

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1 Appointments & Education

Yale University, Department of Ecology and Evolutionary Biology

Associate Research Scientist

Postdoctoral Associate

NSF Postdoctoral Fellow

Postdoctoral advisor: Dr. Casey Dunn

July 2024 - Present
August 2023 - July 2024
August 2021 - August 2023

Harvard University, Department of Organismic and Evolutionary Biology

PhD in Organismic and Evolutionary Biology

Thesis advisor: Dr. Cassandra Extavour

Graduated May, 2021

Brown University, Department of Ecology and Evolutionary Biology

BS in Biology, with honors

Graduated May, 2015

2 Funding & Awards

Postdoctoral Research Fellowship in Biology, NSF

2021

Student Sustainability Grant, Office of Sustainability, Harvard University

2019

Certificate of Distinction in Teaching, Derek Bok Center, Harvard University

2016, 2018

Graduate Student Research Fellowship, NSF

2016

James Mills Peirce Fellowship for Academic Excellence, Harvard University

2015

Maria L. Caleel Memorial Award for Academic Excellence, Brown University

2015

Summer Undergraduate Research Fellowship, NSF

2014

Undergraduate Travel Award, SMBE

2014

EPSCoR Rhode Island for Undergraduate Research, NSF

2013

LINK Award for Undergraduate Research, Brown and Marine Biological Laboratory at Woods Hole

2013

3 Publications

†corresponding author

*equal contribution

Featured

1. **Church, SH^{†*}**, Donoughe, S*, De Medeiros, BA and Extavour, CG[†], 2019. Insect egg size and shape evolve with ecology but not developmental rate. *Nature*, 571(7763). 58-64. Cited by: 95
2. **Church, SH[†]**, and Extavour, CG[†], 2020. Null hypotheses for developmental evolution, *Development*, 147(8). 1-6. Cited by: 22
3. **Church, SH[†]**, de Medeiros, BA, Donoughe, S, Reyes, NLM and Extavour, CG[†], 2021. Repeated loss of variation in insect ovary morphology highlights the role of development in life-history evolution. *Proceedings of the Royal Society B*, 288(1950). 1-9. Cited by: 34
4. **Church, SH[†]**, Ryan, JF and Dunn, CW, 2015. Automation and evaluation of the SOWH test with SOWHAT. *Systematic Biology*, 64(6). 1048-1058. Cited by: 57

5. Zapata, F[†], Goetz, FE, Smith, SA, Howison, M, Siebert, S, **Church, SH**, Sanders, SM, Ames, CL, McFadden, CS, France, SC and Daly, M, Collins, AG, Haddock, SHD, Dunn, CW, and Cartwright, P, 2015. Phylogenomic analyses support traditional relationships within Cnidaria. *PLoS One*, 10(10). p.e0139068. Cited by: 225

Additional publications

6. Kim, BY, Gellert, HR, **Church, SH**, *et al.*, Petrov, DA, 2023. Single-fly assemblies fill major phylogenetic gaps across the Drosophilidae tree of life. *PLOS Biology*, 22(7): e3002697
7. **Church, SH**[†], Mah, JL and Dunn, CW, 2024. Integrating phylogenies into single-cell RNA sequencing analysis allows comparisons across species, genes, and cells. *PLOS Biology*, 22(5). e3002633
8. **Church, SH**[†], Mah, Jasmine L, Wagner, Günter, and Dunn, CW, 2023. Normalizing need not be the norm: count-based math for analyzing single-cell data. *Theory in Biosciences*, 1-18.
9. **Church, SH**[†], Munro, C, Dunn, CW, and Extavour, CG, 2022. The evolution of ovary-specific gene expression in Hawaiian Drosophilidae. *PLOS Genetics*, 19(1). e1010607
10. **Church, SH**[†] and Extavour, CG, 2022. Phylotranscriptomics reveals discordance in the phylogeny of Hawaiian *Drosophila* and *Scaptomyza* (Diptera: Drosophilidae). *Molecular Biology and Evolution*, 39(3). 1-18.
11. **Church, SH**[†], Donoughe, S[†], and Extavour, CG[†], 2021. JEZB special issue on eggs: editorial. *Journal of Experimental Zoology Part B: Molecular and Developmental Evolution*, 336(8). 593-594.
12. **Church, SH**^{*†}, Donoughe, S*, De Medeiros, BA and Extavour, CG[†], 2019. A database of egg size and shape from more than 6,700 insect species. *Scientific Data*, 6(104). 1-11.
13. Sarikaya, DP[†], **Church, SH**, Lagomarsino, LP, Montgomery, S, Magnacca, KN, Price, DK, Kaneshiro, KY and Extavour, CG, 2019[†]. Reproductive capacity evolves in response to ecology through common developmental mechanisms in Hawaiian *Drosophila*. *Current Biology*, 29(11). 1877-1884.
14. Munro, C[†], Siebert, S, Zapata, F, Howison, M, Damian-Serrano, A, **Church, SH**, Goetz, FE, Pugh, PR, Haddock, SH and Dunn, CW, 2018. Improved phylogenetic resolution within Siphonophora (Cnidaria) with implications for trait evolution. *Molecular Phylogenetics and Evolution*, 127. 823-833.
15. **Church, SH**[†], Siebert, S, Bhattacharyya, P and Dunn, CW, 2015. The histology of *Nanomia bijuga* (Hydrozoa: Siphonophora). *Journal of Experimental Zoology Part B: Molecular and Developmental Evolution*, 324(5), 435-449.
16. Siebert, S[†], Goetz, FE, **Church, SH**, Bhattacharyya, P, Zapata, F, Haddock, SH and Dunn, CW, 2014. Stem cells in a colonial animal with localized growth zones. *Developmental Biology*. 275. 215-224.

In review

17. **Church, SH**, *et al.*, and Dunn, CW, 2014. Global genomics of the man-o'-war (*Physalia*) reveals biodiversity at the ocean surface. *bioRxiv*. doi: 10.1101/2024.07.10.602499 (in review at *Science*).

In progress

Phylogeny of Drosophilidae using Nanopore genomics, with Bernard Kim, Stanford University.
Evolution of dipteran larval size, shape, and habitat, with Bruno de Medeiros and Ellie Hecksher, University of Chicago
Comparative spatiotemporal dynamics of *Physalia* in relation to ocean currents and prevailing winds.
In silico PCR from raw sequencing reads for species identification, quality control, and phylogenetics.

4 Software

countland: python and R package for using count-based algebra to analyze and visualize single-cell transcriptome data, available via pip (pypi.org/project/countland) and CRAN (cran.r-project.org/web/packages/countland)

SOWHAT: command-line tool (perl) for automating the SOWH test, a statistical test for comparing phylogenetic hypotheses. github.com/josephryan/sowhat

insect egg data visualization: interactive graph (javascript, d3) for exploring the diversity of insect egg shapes and sizes shchurch.github.io/dataviz/index.html

github: github.com/shchurch

5 Presentations

Symposium organizer

1. Church, SH and Donoughe, SD. Insect Eggs: Ecology, Morphology, and Applied Entomology. Organized at Entomological Society of America, 2017, Denver, CO

Oral presentations

1. Church, SH, and Dunn, CW. Population structure on the high seas: global diversity of the Portuguese man o' war. Presented at the *Advances in Marine Evolutionary Biology* Symposium at Evolution, 2024, Montreal, Canada. [[Recording available](#)]
2. Church, SH, Mah JM, and Dunn, CW. Evolutionary thinking for big developmental datasets from single-cell sequencing. Yale devo-evo day, 2023, New Haven, CT.
3. Church, SH. Insect eggs, evo-devo, and single-cell analysis. Brown University, invited seminar speaker, 2023, Providence, RI.
4. Church, SH, Munro, C, Dunn, CW, and Extavour, CG. Gene expression evolution across organs and species of Hawaiian *Drosophila* Presented at Evolution, 2022, Cleveland, OH.
5. Church, SH, Extavour, CG. Comparing gene expression data across species using evolutionary methods. Presented at Models, Inference, and Algorithms, Broad Institute of MIT and Harvard, 2022, Cambridge, MA. [[Recording available](#)]
6. Church, SH, Donoughe, SD, De Medeiros, B, and Extavour, CG. Assembling a database of egg morphologies from 6,500+ insect species to test long-standing questions about the evolution of life history strategies. Presented at Entomological Society of America, 2017, Denver, CO
7. Church, SH, Donoughe, SD, De Medeiros, B, and Extavour, CG. An eggcellent adventure: The eggs from (almost) every insect species you've ever heard of. Presented at Cambridge Entomological Society, 2017, Cambridge, MA
8. Church, SH, Donoughe, SD, De Medeiros, B, and Extavour, CG. The evolution of insect egg shape across eight orders of magnitude, Presented at Evolution, 2017, Portland, OR
9. Church, SH. SOWHAT? The Swofford-Olsen-Waddell-Hillis (SOWH) test of topologies. Presented at the CCV/Bioinformatics Workshop at Brown University with the Marine Biological Laboratory at Woods Hole, 2013, Providence, RI.

Poster presentations

1. Church, SH, Munro CM, Dunn CW, and Extavour, CG. How much variation in gene expression do we expect to observe across species? Genetics Society of America, 2023, Chicago, IL.

2. Church, SH and Extavour, CG. Ancestral states, null hypotheses, and phylogenetic comparative methods for developmental genetics. The Pan-American Society for Evolutionary Developmental Biology, 2019, Miami, FL.
3. Church, SH and Extavour, CG. Genetic and taxonomic concordance in a comprehensive phylogeny of Hawaiian Drosophilidae flies. *Evolution*, 2019, Providence, RI.
4. Church, SH, Donoughe, SD, De Medeiros, B, and Extavour, CG. The Evolution of Gene Expression in the Island Radiation of Hawaiian *Drosophila*. Presented at the Second Joint Congress on Evolutionary Biology, 2018, Montpellier, France.
5. Church, SH, Donoughe, SD, De Medeiros, B, and Extavour, CG. The Evolution of Insect Egg Size. Presented at The Allied Genetics Conference, 2015, Orlando, FL.
6. Church, SH, Donoughe, SD, De Medeiros, B, and Extavour, CG. The Evolution of Insect Egg Size. Presented at Evolution, 2016, Austin, TX.
7. Church, SH. Automation and Evaluation of the SOWH test of Phylogenetic Topologies. Presented at the Society for Molecular Biology and Evolution, 2014, San Juan, Puerto Rico.

6 Teaching Experience

Summer short course instructor, Yale Peabody Museum, Invertebrate Zoology

Gelatinous Zooplankton

Summer, 2023

Co-taught with Ramdhan Firdhaus, BRIN Indonesia

Seminar on planktonic invertebrates; developed course materials; lectured, led discussions, guided museum visits.

Graduate teaching fellow, Harvard University

Biology of Insects

Fall, 2018 & Fall, 2019

Instructor of record: Dr. Naomi Pierce

Led collection-based lab section for upper-level seminar; taught insect diversity, identification, diagnosis, collection, and preservation; utilized museum collections; guided field trips; created and graded assessments.

The Developmental Basis for Evolutionary Change

Fall, 2016

Instructors of record: Dr. Mansi Srivastava, Dr. Matthew Harris, and Dr. Cliff Tabin

Developed lab component on animal development for first iteration of upper-level course at Harvard; led discussion section, presented papers, and fostered engagement; course followed principles of an ungrading philosophy.

English teacher to adults

Free adult education in beginner, intermediate, and conversational English

New Haven English Class

2023 - 2024

Boston-Cambridge English Class

2015 - 2019

Founded and directed English education programs in two cities; recruited students and teachers; developed course materials; coordinated multiple classes; and taught hundreds of adult learners in English, Spanish, and Portuguese.

Undergraduate teaching assistant, Brown University

Diversity of Life

Fall, 2014

Instructor of record: Dr. James Kellner

led discussion and study section for first iteration of freshmen introductory biology seminar at Brown University; developed TA materials; graded assessments

Plant Physiological Ecology

Fall, 2013

Instructor of record: Dr. Erika Edwards

led lab section for upper-level seminar; advised students to design and execute seminar-long experiments in eco-physiology

7 Mentorship

Research mentor

Diego Ramirez, undergraduate student, Yale University

2023 - present

River Abedon, undergraduate student, Yale University

2023 - 2024

Ramadhan Firdhaus, visiting scholar, BRIN Indonesia

Summer, 2023

Anna Simbolon, visiting scholar, BRIN Indonesia

Summer, 2023

Wendy Shi, undergraduate student, Yale University

Summer, 2023

Nicole Márquez, undergraduate summer intern, Harvard E3 REU program

Summer, 2019

Rebecca Izen, graduate rotation student

Summer, 2018

Peer mentor,

Alexangel Hernández, undergraduate student, Rutgers University

2021 - 2023

Macy Petrula, undergraduate summer intern, Harvard E3 REU program

Summer, 2019

STEM and fellowships tutor

Adams House, Harvard College

2016 - 2020

8 Editing & Peer Review

Guest associate editor

Journal of Experimental Zoology: Part B

2019 - 2020

Reviewer

Development

2024

Wellcome Open Research

2024

Ecology Letters

2023

Diversity

2023

Insects

2023

Scientific Reports

2023

The Canadian Entomologist

2023

Frontiers in Physiology

2023

The American Naturalist

2022

Systematic Biology

2022

Ecology

2022

Science Advances

2022

Functional Ecology

2021

Methods in Ecology and Evolution

2021

Journal of Biogeography

2019

PeerJ

2019

9 Additional Leadership & Service

Red Cliffs Audubon Society BirdFest tour leader, UT

2022

Spanish language free youth code camp, UT

2021

Bilingual mentoring program, Evolution	2021
Native plants at Harvard, funded project with the Office of Sustainability, Harvard	2019 - 2020
Graduate student council member, Society for Systematic Biology	2018 - 2020
Evo-ally, Evolution	2019, 2022
Founder, program director, and English teacher, Boston Cambridge English Class, MA	2015 - 2019
Head coordinator, Graduate Professional Development Seminar, Harvard	2016 - 2019
Graduate student representative, OEB Seminar Committee, Harvard	2015 - 2016
English teacher for adults, Olneyvill ESOL, RI	2012 - 2015
Latter-Day Saint service missionary to Sonora, Mexico	2010 - 2012

10 Additional Training

<i>Advanced Teaching Workshop: Course Design</i> , Poorvu Center for Teaching, Yale University	2023
<i>Writing + Editing for Wikipedia</i> , Harvard University J-term course	2020
<i>Workshop for EvoAllies with Dr. Sherry Marts</i> , Evolution	2019
<i>Breaking the Ice: Building an Inclusive Classroom from Day One</i> , Bok Center, Harvard University	2019
<i>Gender Pronouns Workshop</i> , Bok Center, Harvard University	2019

11 Media Coverage

- NewScientist (UK & Australia).** New species of Portuguese man o' war discovered in the Tasman Sea. [[link](#)]
- Infobae (Argentina).** Un profundo análisis genético sacude conocimientos sobre la biodiversidad marina: descubrieron una nueva especie de aguaviva. [[link](#)]
- Mundiaro (Spain).** Descubren una nueva especie de carabela portuguesa en el mar de Tasmania. [[link](#)]
- ZAP.aeiou (Portugal).** Nova espécie de caravela-portuguesa encontrada em águas australianas [[link](#)]
- TheScientist (USA).** Ecology, Not Physics, Explains Diversity of Insect Eggs. [[link](#)]
- Science&Vie (France).** Entomologie : c'est le lieu de ponte qui détermine la forme de l'œuf. [[link](#)]
- ScienceNews (USA).** Why some insect eggs are spherical while others look like hot dogs. [[link](#)]

12 Skills

Languages: Fluent in English, Spanish, and Portuguese

Bioinformatics: R, python, d3+javascript, html, perl, bash, and Adobe Illustrator