

# Zachary Stephen Morris

NSF Earth Science Postdoctoral Fellow  
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## Education

Harvard University, Cambridge, Massachusetts

Ph.D., Organismic and Evolutionary Biology, November, 2020

**Thesis title:** Developmental and evolutionary origins of the crocodylian snout and amniote face.

**Thesis committee:** Stephanie Pierce (advisor), Arkhat Abzhanov (co-advisor), Elena Kramer (Chair), James Hanken, Clifford Tabin

The University of Texas, Austin, Texas

M.S., Geologic Sciences, December 2013

**Thesis title:** Skeletal ontogeny of *Monodelphis domestica* (Mammalia: Didelphidae): quantifying variation, variability, and technique bias in ossification sequence reconstruction.

**Thesis committee:** Timothy Rowe (Supervisor), Matthew Colbert, David Cannatella, Christopher Bell

University of California, Berkeley, California

B.A., Integrative Biology, May 2011, with Highest Distinction; Japanese Minor, May 2011

**Honors Thesis title:** Differences in the ontogeny of epiplastral shape among species of *Echmatemys* (Testudinoidia) from the Eocene of western North America.

**Thesis advisor:** Kevin Padian

## Professional Appointments

Yale University

2020 - 2022 *NSF Earth Science Postdoctoral Fellow*      **Supervisor:** Bhart-Anjan Bhullar  
Unraveling the Convergent Origins of Secondary Palates in Amniotes

Harvard University

2019 *GSAS Merit Fellow*

Blunt snouts, slender snouts: developmental mechanisms of crocodylian facial elongation

2019 *Teaching Fellow in Organismic and Evolutionary Biology*

The Fishy Aspects of the Human Body (1 semester - Bok Center Certificate of Distinction)

Helped curate and run specimen based labs for interdisciplinary seminar course

2018 *Teaching Fellow in Science of Living Systems*

Understanding Darwinism (1 semester)

Ran discussions of course readings and helped students design term projects

2015 - 2017 *Teaching Fellow in Organismic and Evolutionary Biology*

Biology of Mammals (2 semesters - Bok Center Certificate of Distinction)

Helped curate and run specimen based labs for large majors' course

Vertebrate Evolution (1 semester, *Head TF* - Bok Center Certificate of Distinction)

Designed, wrote, and ran exciting new specimen based labs

Organized field trip to Petrified Forest National Park, AZ

2014 - 2015 *Research Assistant in Organismic and Evolutionary Biology, PI: Arkhat Abzhanov*

National Parks Service

2013 *Summer Paleontology Intern - Petrified Forest National Park*

The University of Texas at Austin, Jackson school of Geosciences  
2011 - 2013 *Geological Sciences TA, Department of Geological Sciences*  
Age of Dinosaurs (3 semesters, *Head TA* 2 semesters); Age of Mammals (1 semester)

### Peer-reviewed Publications

- Morris, Z.S.** and A. Abzhanov. 2021. Heading for higher ground: Developmental origins and evolutionary diversification of the amniote face. *Current Topics in Developmental Biology* 141:241–277.  
10.1016/bs.ctdb.2020.12.003
- Tomiya S. and **Z. S. Morris**. 2020. Reidentification of Late Middle Eocene “Uintacyon” from the Galisteo Formation (New Mexico, U.S.A) as an early beardog (Mammalia, Carnivora, Amphicyonidae). *Breviora* 567(1):1–13.
- Morris Z. S.**, K. A. Vliet, A. Abzhanov, S. E. Pierce. 2019. Heterochronic shifts and conserved embryonic shape underlie crocodylian craniofacial disparity and convergence. *Proceedings of the Royal Society B: Biological Sciences* 286:20182389-10.
- Fabbri, M., N. M. Koch, A. C. Pritchard, M. Hanson, E. Hoffman, G. S. Bever, A. M. Balanoff, **Z. S. Morris**, D. J. Field, J. Camacho, T. B. Rowe, M. A. Norell, R. M. Smith, A. Abzhanov, and B.-A. S. Bhullar. 2017. The skull roof tracks the brain during the evolution and development of reptiles including birds. *Nature Ecology & Evolution* 1:1–8.
- Bhullar, B.-A. S., **Z. S. Morris**, E. M. Sefton, A. Tok, B. Namkoong, J. Camacho, and A. Abzhanov. 2015. A molecular mechanism for the origin of a key evolutionary innovation, the bird beak and palate, revealed by an integrative approach to major transitions in vertebrate history. *Evolution* 69(7):1665–1677. DOI: 10.1111/evo.12684.
- Burroughs, R., **Z. S. Morris**, and A. Marsh. 2014. *Trachemys scripta* (Red-Eared Slider), *Pseudemys texana* (Texas River Cooter), *Chelydra serpentina* (Snapping Turtle), Feeding Behavior and Scavenging. *Herpetological Review* 45(2):321-322.

### Grants and Fellowships

- 2020 Earth Sciences Postdoctoral Fellowship, National Science Foundation (\$174,000)  
Unraveling the Convergent Origins of Secondary Palates in Amniotes  
Zachary Morris (P.I.), Bhart-Anjan Bhullar (Advisor, Yale University); Award #1952888
- 2017 Doctoral Dissertation Improvement Grant, National Science Foundation (\$21,970)  
Dissertation Research: The Evolution of Crocodylian Cranial Development  
Stephanie Pierce (P.I.), Zachary Morris (Co-P.I.); Award #1701745
- 2015 Wood Student Research Award, The Society of Vertebrate Paleontology (\$1200)
- 2014 Jackson Student Travel Grant, The Society of Vertebrate Paleontology (\$600)
- 2013 Ernest L. and Judith W. Lundelius Endowment in Vertebrate Paleontology Fellowship, The University of Texas at Austin, Department of Geological Sciences (\$700)
- 2012 Ernest L. and Judith W. Lundelius Endowment in Vertebrate Paleontology Fellowship, The University of Texas at Austin, Department of Geological Sciences (\$700)

### Published Abstracts

- Morris, Z. S., A. Abzhanov, and S. E. Pierce. 2020. Developmental mechanisms shaping crocodylian snouts. *Society of Integrative and Comparative Biology, 2020 Annual Meeting*.
- Morris, Z. S., A. Abzhanov, and S. E. Pierce. 2019. Correlations between Developmental, Ecological, and Evolutionary Axes of Cranial Shape Variation in Extant Crocodylians and the Pseudosuchian Fossil Record. *Journal of Morphology* 280: S186-187. DOI: 10.1002/jmor.21003

- Morris, Z. S., S. E. Pierce, and A. Abzhanov. 2019. The role of craniofacial growth zones in shaping crocodylian snouts. *Society of Integrative and Comparative Biology, 2019 Annual Meeting*.
- Morris, Zachary S., S. E. Pierce, and A. Abzhanov. 2017. Craniofacial growth zones and modularity in Amniota: insight from the model crocodylian, *Alligator mississippiensis*. Symposia and Oral Abstracts. *Integr Comp Biol* 2017; 57 (suppl\_1): e1-e187. doi: 10.1093/icb/ix002
- Morris, Z. S., A. Abzhanov, and S. E. Pierce. 2016. Developmental trajectories of convergence, recapitulation, and evolutionary novelty in the crocodylian skull. Program & Abstracts of the 11th International Congress of Vertebrate Morphology, Washington, DC 2016, *Anatomical Record* 299: 197-198.
- Morris, Zachary, and A. Abzhanov. 2015. Embryos reveal novel developmental trajectories in the evolution of crocodylian cranial shape. *Programs and Abstracts, 75th Annual Meeting, Society of Vertebrate Paleontology*: 185.
- Morris, Zachary. 2014. Variation and variability in the development of the skeleton of *Monodelphis domestica*: implications for assessing maturity in extinct and extant organisms. *Programs and Abstracts, 74th Annual Meeting, Society of Vertebrate Paleontology*: 191.
- Morris, Zachary S. 2014. Variation and variability in developmental studies: An analysis of skeletal ontogeny in *Monodelphis domestica*. Society for Integrative and Comparative Biology 2014 Annual Meeting: abstract 123.6.
- Burroughs, Robert, Zachary Morris, and Matthew Colbert. 2013. Use of a network algorithm to rapidly generate ontogenetic sequences. *Programs and Abstracts, 73rd Annual Meeting, Society of Vertebrate Paleontology*: 97.
- Colbert, Matthew and Zachary Morris. 2013. Accounting for sample size biases in analyses of ontogenetic sequences. *Programs and Abstracts, 73rd Annual Meeting, Society of Vertebrate Paleontology*: 108.
- Morris, Zachary, Robert Burroughs, and Matthew Colbert. 2013. Developmental variation complicates reconstructions of skeletal ontogeny of extinct vertebrates: a lesson from *Triceratops* and *Torosaurus*. *Programs and Abstracts, 73rd Annual Meeting, Society of Vertebrate Paleontology*: 181.
- Morris, Zachary S. 2013. Determining the onset of ossification and reconstructing ontogeny in vertebrates: A comparison of clearing and staining, histological and computed tomography methods. Society for Integrative and Comparative Biology 2013 Annual Meeting: abstract P1.128.
- Morris, Zachary and Sarah Werning. 2012. Histological variation suggests unusual levels of developmental plasticity in the stem archosaur *Vancleavea*. *Programs and Abstracts, 72nd Annual Meeting, Society of Vertebrate Paleontology*: 146.
- Morris, Zachary and Elizabeth Ferrer. 2011. Ontogenetic variation in epiplastral shape among Eocene Testudinoid turtles (*Echmatemys*) of western North America. *Programs and Abstracts, 71st Annual Meeting, Society of Vertebrate Paleontology*: 162.

### **Outreach Activities**

- 2019 *What makes a dinosaur?*  
Discussion of paleontology and archosaurs with students at HMNH summer program
- 2018 *Paleontology: ancient forms & new discoveries*  
Lecture on ethical fieldwork for Martha's Vineyard Film Society's "Science on Screen" series
- 2017 *Part 1 - Archosaur diversity through time: radiation, convergence, and extinction*  
*Part 2 - Evolution of the bird beak and crocodylian snout*  
Two lectures and gallery activities as part of the educator workshop "From *Haikouichthys* to

*Homo sapiens*: the amazing stories of vertebrate evolution and paleontology” at the HMNH.

2016 *Evolution and Development of the Crocodylian Skull*

Lecture for teachers in association with the HMNH “Evolution Matters” series

2014 - 19 Paleontology outreach for National Fossil day & “I heart science” festival run by the HMNH

2014 Paleontology outreach for National Fossil day run by the HMNH

2011 Outreach about fossil collections and reptile paleontology for Cal Day at the UCMP

### **Field Experience**

2014 Kayenta Formation, AZ; UT Austin, Vertebrate Paleontology Lab; Jurassic stratigraphy

2013 Chinle Formation, AZ; Petrified Forest National Park; Triassic vertebrates

2012 Chinle Formation, NM; University of California Museum of Paleontology; Triassic archosaurs

2011 Chinle Formation, NM; University of California Museum of Paleontology; Triassic archosaurs

2011 AZ and NM; Museum of Vertebrate Zoology, University of California Berkeley; extant herpetofauna

### **Invited Presentations**

2015 *Development and Evolution of Specialized Teeth in Cats and Convergence in Dental Morphology*

Guest Lecture for the class “What Makes a Cat?” (Harvard OEB 217)

2013 *Developmental variation and variability in the ossification sequence of *Monodelphis domestica*.*

Texas Academy of Science, 116<sup>th</sup> Annual Meeting.

### **Laboratory Experience**

Histological thin-section preparation of vertebrate fossils

Digital preparation of CT datasets

*In situ* hybridization (probe construction, whole-mount, and section specimen preparation)

Gene expression manipulation in avian embryos using bead implantation and viral transfection methods

Molecular sequencing (PCR, gel electrophoresis, cycle sequencing, etc.)

Two-piece silicone molding of fossil vertebrates

Specimen casting using polyurethane resin

Phylogenetic methods (parsimony, maximum-likelihood, and bayesian inference)

### **Professional Workshops**

2015 Undergraduate mentoring workshop; Harvard University, Cambridge, MA

2014 Tip-dating: Estimating dated phylogenies using fossils and terminal taxa; Society of Vertebrate Paleontology 74th Annual Meeting, Berlin, Germany

2011 Geometric morphometrics short-course, taught by Drs. Zelditch and Swiderski; University of California at Berkeley, Berkeley, CA

2011 Phylogenetic comparative methods workshop; Society of Vertebrate Paleontology 71st Annual Meeting, Las Vegas, NV

### **Language Proficiency**

Japanese (Read, Write, Speak)

### **Professional Affiliations**

International Society of Vertebrate Morphology (2016-present)

Society of Vertebrate Paleontology (2010-present)

Society for Integrative & Comparative Biology (2012-present)

Herpetologists League (2012-present)

Texas Herpetological Society (2011-present)

Texas Academy of Science (2012-2014)

**Honors and Awards**

Bok Center Certificate of Distinction in Teaching - Fall 2015, Spring 2016, Fall 2017, Spring 2019

Invited Graduate Student Speaker - Jackson School of Geosciences (UT Austin), Fall 2013

Departmental Citation - Department of Integrative Biology (UC Berkeley), Spring 2011

UC Berkeley Dean's List: Spring 2008, Fall 2008, Fall 2009, Spring 2010, Fall 2010

Phi Beta Kappa - Alpha California chapter, Spring 2010 - Present

Golden Key International Honour Society, Spring 2010 - Present

National Society of Collegiate Scholars, Fall 2009 - Present

**Research Interests**

Evolution of developmental patterns and processes

Skeletal ontogeny in vertebrates

Integrating evolutionary and developmental hypotheses to understand novel features of clades

**Older Positions**

University of California at Berkeley

2011                    *Undergraduate Research Assistant, Department of Integrative Biology*

Organized vertebrate paleontology teaching collections

Performed image analysis of vertebrate limb bone histological slides