

**Charles Kevin Boyce**  
Professor & Chair  
Department of Geological Sciences  
Stanford University

450 Jane Stanford Way, Bldg. 320  
Stanford, CA 94305-2115  
(650) 725-5583, fax: (650) 725-0979  
chkenboy@stanford.edu

### Education

Harvard University	Ph.D., Paleontology	2001
California Institute of Technology	B.S. (with honors), Biology	1995
California Institute of Technology	B.S. (with honors), Literature	1995

### Professional Experience

Professor of Geological Sciences	Stanford University	2018-
Professor, by courtesy, of Biology	Stanford University	2019-
Associate Professor	Stanford University	2013-2018
Associate Professor	University of Chicago	2010-2013
Assistant Professor	University of Chicago	2003-2010
National Research Council Associate	NASA Astrobiology Institute	2001-2003

### Professional Activities

Editor, Paleobiology	2018-
Associate editor, Paleobiology	2011-2018
Member, Fellows Committee, Paleontological Society (Chair, 2018, 2019)	2017-2019
Member, W. S. Cooper Award Committee, Ecological Society of America	2014-2016
Member, Strimple Award Committee, Paleontological Society	2012-2015
Member, Beamline Advisory Team, X-ray scanning microscope, NSLS II	2008-2010
Chair, Paleobotanical Section, Botanical Society of America	2006-2007
Member, Moseley Award committee, Botanical Society of America	2004-2006
Research Associate, Geology, Field Museum of Natural History	2004-2015
Member, Cookson Award committee, Botanical Society of America	2003
Predoctoral Fellow, Carnegie Geophysical Laboratory	1999-2001

### Professional Recognition

Klepser Distinguished Lectureship, University of Tennessee	2015
MacArthur Fellow, MacArthur Foundation	2013-2018
W. S. Cooper Award of the Ecological Society of America	2012
Charles Schuchert Award for excellence and promise in paleontology	2011
Fellow, Paleontological Society	2011-
Carnegie Geophysical Laboratory Postdoctoral Fellowship (declined)	2001
NSF Predoctoral Fellowship	1996-1999

### Professional Outreach

Scientific advisor, Hopscotch Girls "Science! STEM Sticker Adventure" book	2018
Scientific advisor, Dinosaur Garden, Palo Alto Junior Museum and Zoo	2017-
Extended advisor, Paleobiology Hall exhibit renovation, Smithsonian NMNH	2014-2015

## Professional Service

Reviewer for: American Journal of Botany; American Journal of Science; American Mineralogist; American Naturalist; Annals of Botany; Applications in Plant Sciences; BMC Evolutionary Biology Reviews; Chemical Geology; Current Biology; Earth & Planetary Science Letters; Ecological Monographs; Geobiology; Geochimica et Cosmochimica Acta; Geological Journal; Geological Society of America Bulletin; Geology; International Journal of Plant Science; Journal of Biogeography; Journal of Geology; Journal of the International Association of Wood Anatomists; Journal of Magnetic Resonance; Journal of Paleontology; Journal of Theoretical Biology; Nature Communications; Nature Ecology & Evolution; Naturwissenschaften; New Phytologist; Palaeogeography, Palaeoclimatology, Palaeoecology; Palaeontology; Palaios; Paleobiology; Paleontological Research; Plant, Cell & Environment; Plant Physiology; Planta; Proceedings of the National Academy of Sciences; Review of Palaeobotany & Palynology; Science.

Advanced Light Source, LBNL; American Chemical Society; NASA Exobiology; NSF Earth Sciences; NSF Geobiology and Low-Temperature Geochemistry.

## Professional Affiliations

Botanical Society of America, Geological Society of America, Paleontological Society, International Organization of Palaeobotany.

## University Service

### *Stanford University*

Chair, Geological Sciences	2020-
Director of Graduate Studies, Geological Sciences	2019-2020
Acting Chair, Geological Sciences	2019
Associate Chair, Geological Sciences	2017-2019
Faculty Search Committee (Chair), Geological Sciences	2017-2018
Committee on Graduate Studies, Stanford University	2016-2018
Undergraduate Curriculum Committee, Geological Sciences	2015-2017
Departmental seminar organizer, Geological Sciences	2014-2016
Graduate Admissions Committee, Geological Sciences	2013-2015
Geobiology Faculty Search Committee, School of Earth Sciences	2013-2014

### *University of Chicago*

Faculty Appointments Committee, Geophysical Sciences	2012-2013
Hinds Fund Fellowship Committee, Committee on Evolutionary Biology	2011-2012
Departmental Chair Search Committee (Chair), Geophysical Sciences	2011-2012
Faculty Appointments Committee, Committee on Evolutionary Biology	2011-2013
Fluids Faculty Search Committee, Geophysical Sciences	2011-2012
Chamberlin Postdoctoral Fellow Search Committee, Chair	2009-2010
Departmental Chair Search Committee, Geophysical Sciences	2008-2009
Graduate Admissions Committee, Committee on Evolutionary Biology	2005-2008
Noon Balloon Faculty Seminar (Czar), Geophysical Sciences	2004-2007
Evaluation Committee, Crerar Undergraduate Science Writing Prize	2004-2011

## Teaching Experience

### Stanford University

GS/EarthSys128/228, Bio148/228	Evolution of Terrestrial Ecosystems
GS/EarthSys 205	Fundamentals of Geobiology
GS/Bio 206	Topics in Organismal Paleobiology (Previous topics: Biological fluid flow, Vertebrate evolution, Paleobotany, Insect evolution)
GS/EarthSys 208	Topics in Geobiology

### University of Chicago

GEOS 13200	Historical Geology
GEOS 32500	Evolutionary History of Terrestrial Ecosystems
GEOS 34600	Chemical Information in the Sedimentary and Fossil Records
GEOS 39711	Paleobotany

## Student Supervision

### Stanford University

Sandra Schachat (Ph.D. candidate; co-advised with Jonathan Payne)—Insect evolution  
Michael D'Antonio (Ph.D. candidate)—Evolution of lycopsid biology  
Andrés Baresch (Ph.D. candidate)—Evolution of leaf physiology  
Thesis committee member: Ellen Schaal, Caitlin Keating-Bitonti, Jeremy Caves, Will Gearty, Matthew Winnick, Tyler Kukla, Richard Stockey  
Thesis examination chair: Simon Wong, Graham Dow, Kelli Davies, Daniel Ibarra, Hsiao-Tieh Hsu, James Russell, Taylor Martin, Max Segnitz  
Undergraduate pre-major adviser (2015-): 8 students.

### University of Chicago

Marites Villarosa Garcia (Ph.D. 2017; co-advised with Michael Foote)  
*The morphological diversity of coccolithophores across environments, geographic space, and geologic time*  
Kathryn Larson (Ph.D. 2012)  
*The evolutionary and biogeographic consequences of fruit form evolution in Fagales*  
Larson-Johnson, K. submitted. Wind variability limits the potential influence of fruit morphology and descent rate on dispersal in the winged fruits of *Carpinus* (Betulaceae).  
Larson-Johnson, K. 2016. Field observations of *Carpinus* (Betulaceae) demonstrate high dispersal asymmetry and inform migration simulations with implications for times of rapid climate change. *International Journal of Plant Sciences* 177: 389-399.  
Larson-Johnson, K. 2016. Phylogenetic investigation of the complex evolutionary history of dispersal mode and diversification rates across living and fossil Fagales. *New Phytologist* 209: 418-435.  
Hilary Christensen (Ph.D. 2012)  
*Mammalian adaptation to herbivory in the aftermath of the K/T extinction*  
Christensen, H. B. 2014. Similar associations of tooth microwear and morphology indicate similar diet across marsupial and placental mammals. *PLoS ONE* 9: e102789.  
Andrew Leslie (Ph.D. 2010)  
*Forms follow functions: Exploring the evolution of morphological diversity in seed plant reproductive structures*

Leslie, A. B. 2011. Predation and protection in the macroevolutionary history of conifer cones. *Proceedings of the Royal Society of London B* 278: 3003-3008.

Leslie, A. B. 2011. Shifting functional roles and the evolution of conifer pollen-producing and seed-producing cones. *Paleobiology* 37: 587-602.

Leslie, A. B. 2010. Flotation preferentially selects saccate pollen during conifer pollination. *New Phytologist* 188: 273-279.

Leslie, A. B. 2008. Interpreting the function of saccate pollen in ancient conifers and other seed plants. *International journal of plant sciences* 169: 1038-1045.

Mark Gorman (M.S. 2013) Earliest record of insect herbivory found on Carboniferous leaves

Andrés Baresch (M.S. 2013) Simulating water use efficiency along an altitudinal gradient

Thesis committee member: Michael Glotter, Sam Miller, Matt Nelsen, Marie Hoerner, Lauren Sallan, David Bapst, Tyler Mason, Christina Belanger, Josh Miller, Leila Zajac, Rebecca Terry, David Sunderlin, Carl Simpson

Undergraduate senior theses: Benjamin Casterline, Persephone Ma

Five high school honors theses

### Postdoctoral Supervision

Kathryn Larson (2014-2016) Evolution of wind dispersed fruits

Matthew Nelsen (2014-2016) Evolution of fungal metabolisms

Jung-Eun Lee (2009-2010) Feedbacks between plant evolution and climate

### Research Publications (\*-indicates student or postdoctoral advisee)

55. D'Antonio, M. P.\*, **C. K. Boyce**. In preparation. Arborescent lycopsid periderm production was limited.
54. Thérroux-Rancourt, G., A. B. Roddy, J. M. Earles, **C. K. Boyce**, M. A. Zwieniecki, M. E. Gilbert, D. Tholen, A. J. McElrone, K. A. Simonin, C. R. Brodersen. Submitted. Maximum CO<sub>2</sub> diffusion inside leaves is limited by the scaling of cell size and genome size.
53. Nelsen, M. P., R. Lücking, **C. K. Boyce**, H. T. Lumbsch, R. H. Ree. Submitted. Diverse ecological contributions by lichens are linked to growth form evolution and symbiotic instability.
52. Zhou, W., J. Pšenička, J. Bek, M. Wan, **C. K. Boyce**, J. Wang. Submitted. A new anachoropterid fern from the Asselian (Cisuralian) Wuda Tuff Flora. *Review of Palaeobotany & Palynology*.
51. D'Antonio, M. P.\*, **C. K. Boyce**, J. Wang. In revision. Two new species of *Sigillaria* Brongniart from the Wuda Tuff (Asselian: Inner Mongolia, China) and their implications for lepidodendrid life history reconstruction. *Review of Palaeobotany & Palynology*.
50. D'Antonio, M. P.\*, Ibarra, D. E., **C. K. Boyce**. 2020. Land plant evolution decreased, rather than increased, weathering rates. *Geology* 48: 29-33.
49. Nelsen, M. P., R. Lücking, **C. K. Boyce**, H. T. Lumbsch, R. H. Ree. 2020. Lichens were not there to shape terrestrial ecosystems and geochemical cycles prior to the evolution of vascular plants. *Geobiology* 18: 3-13.
48. Zhou, W., D. Li, J. Pšenička, **C. K. Boyce**, J. Wang. 2019. A left-handed fern twiner in an early Permian swamp forest. *Current biology*. 29: R1172-R1173.
47. Ibarra, D. E., J. K. Caves, A. Bachan, A. Baresch\*, K. V. Lau, D. L. Thomas, J. E. Lee, **C. K. Boyce**, C. P. Chamberlain. 2019. Modeling the consequences of land plant evolution on silicate weathering. *American Journal of Science* 319: 1-43.

46. **Boyce, C. K.**, M. A. Zwieniecki. 2019. The prospects for whole-plant physiology in fossils. *New Phytologist* 223: 40-49.
45. Baresch, A.\*, C. Crifò, **C. K. Boyce**. 2018. Competition for epidermal space in the evolution of leaves with high physiological rates. *New Phytologist* 221: 628-639.
44. **Boyce, C. K.**, W. A. DiMichele. 2018. Fast or slow for the arborescent lycopsids? *New Phytologist* 218: 891-893.
43. Schachat, S. R.\*, C. C. Labandeira, M. R. Saltzman, B. D. Cramer, J. L. Payne, **C. K. Boyce**. 2018. Phanerozoic  $pO_2$  and the early evolution of terrestrial animals. *Proceedings of the Royal Society of London B* 285: 20172631.
42. Thérroux-Rancourt, G., J. M. Earles, M. E. Gilbert, M. A. Zwieniecki, **C. K. Boyce**, A. J. McElrone, Andrew, C. R. Brodersen. 2017. The bias of a 2D view: Comparing 2D and 3D mesophyll surface area estimates using non-invasive imaging. *New Phytologist* 215: 1609-1622.
41. **Boyce, C. K.**, Y. Fan, M. A. Zwieniecki. 2017. Did trees grow up to the light, up to the wind, or down to the water? – How modern high productivity colors perception of early plant evolution. *New Phytologist* 215: 552-557.
40. **Boyce, C. K.**, J. E. Lee. 2017. Plant evolution and climate over geological timescales. *Annual Review of Earth & Planetary Sciences* 45: 61-87.
39. Zwieniecki, M. A., K. S. Haaning, **C. K. Boyce**, K. H. Jensen. 2016. Stomatal design principles in synthetic and real leaves. *Journal of the Royal Society Interface* 13: 20160535.
38. Nelsen, M. P.\*, W. A. DiMichele, S. E. Peters, **C. K. Boyce**. 2016. Delayed fungal evolution did not cause the Paleozoic peak in coal production. *Proceedings of the National Academy of Sciences USA* 113: 2442-2447.
37. **Boyce, C. K.**, W. A. DiMichele. 2016. Arborescent lycosid productivity and lifespan: Constraining the possibilities. *Review of Palaeobotany & Palynology* 227: 97-110.
36. Zwieniecki, M. A., **C. K. Boyce**. 2014. The role of cellulose fibers in *Gnetum gnemon* leaf hydraulics. *International Journal of Plant Sciences* 175:1054-1061.
35. Zwieniecki, M. A., **C. K. Boyce**. 2014. Evolution of a unique anatomical precision in angiosperm leaf venation lifts constraints on vascular plant ecology. *Proceedings of the Royal Society of London B* 281: 20132829.
34. Lee, J.-E., C. Frankenberg, C. van der Tol, J. A. Berry, L. Guanter, **C. K. Boyce**, J. B. Fisher, E. Morrow, J. R. Worden, S. Asefi, G. Badgley, S. Saatchi. 2013. Forest productivity and water stress in Amazonia: observations from GOSAT chlorophyll fluorescence. *Proceedings of the Royal Society of London B* 280: 20130171.
33. **Boyce, C. K.**, M. A. Zwieniecki. 2012. Leaf fossil record suggests limited influence of atmospheric  $CO_2$  on terrestrial productivity prior to angiosperm evolution. *Proceedings of the National Academy of Sciences USA* 109: 10403-10408.
32. Lee, J.-E., B. R. Lintner, J. D. Neelin, X. Jiang, P. Gentine, **C. K. Boyce**, J. B. Fisher, J. T. Perron, T. L. Kubar, J. Lee, J. Worden. 2012. Reduction of tropical land region precipitation variability via transpiration. *Geophysical Research Letters* 39: L19704.
31. **Boyce, C. K.**, A. B. Leslie. 2012. The paleontological context of angiosperm vegetative evolution. *International Journal of Plant Sciences* 173: 561-568.
30. Leslie, A. B., **C. K. Boyce**. 2012. Ovule function and the evolution of angiosperm reproductive innovations. *International Journal of Plant Sciences* 173: 640-648.
29. Lee, J.-E., B. R. Lintner, **C. K. Boyce**, P. J. Lawrence. 2011. Land use change exacerbates tropical South American drought by sea surface temperature variability. *Geophysical Research Letters* 38: L19706.

28. **Boyce, C. K.**, J.-E. Lee\*. 2011. Could land plant evolution have fed the marine revolution? *Paleontological Research* 15: 100-105.
27. Nicotra, A. B., A. Leigh, **C. K. Boyce**, C. S. Jones, K. J. Niklas, D. Royer, and H. Tsukaya. 2011. The evolution and functional significance of leaf shape in the angiosperms. *Functional Plant Biology* 38: 535-552.
26. Leigh, A., M. A. Zwieniecki, F. E. Rockwell, **C. K. Boyce**, A. B. Nicotra, N. M. Holbrook. 2011. Structural and hydraulic correlates of heterophylly in *Ginkgo biloba* L. *New Phytologist* 189: 459-470.
25. †**Boyce, C. K.**, J.-E. Lee\*, T. S. Feild, T. J. Brodribb, M. A. Zwieniecki. 2010. Angiosperms helped put the rain in the rainforests: The impact of plant physiological evolution on tropical biodiversity. *Annals of the Missouri Botanical Gardens* 97: 527-540.  
     †*Recipient of the W. S. Cooper Award of the Ecological Society of America*
24. **Boyce, C. K.**, M. Abrecht, D. Zhou, P.U.P.A. Gilbert. 2010. X-ray photoelectron emission spectromicroscopic analysis of arborescent lycopsid cell wall composition and Carboniferous coal ball preservation. *International Journal of Coal Geology* 83: 146-153.
23. Lee, J.-E.\*, **C. K. Boyce**. 2010. Impact of the hydraulic capacity of plants on water and carbon fluxes in tropical South America. *Journal of Geophysical Research* 115: D23123.
22. **Boyce, C. K.**, C. L. Hotton. 2010. *Prototaxites* was not a taphonomic artifact. *American Journal of Botany* 79: 1073.
21. **Boyce, C. K.**, J.-E. Lee\*. 2010. An exceptional role for flowering plant physiology in the expansion of tropical rainforests and biodiversity. *Proceedings of the Royal Society of London B* 277: 3437-3443.
20. **Boyce, C. K.** 2010. The evolution of plant development in paleontological context. *Current Opinion in Plant Biology* 13: 102-107.
19. Hobbie, E. A., **C. K. Boyce**. 2010. Carbon sources for the Paleozoic giant fungus *Prototaxites* inferred from modern analogues. *Proceedings of the Royal Society of London B* 277: 2149-2156.
18. **Boyce, C. K.**, T. J. Brodribb, T. S. Feild, M. A. Zwieniecki. 2009. Angiosperm leaf vein evolution was physiologically and environmentally transformative. *Proceedings of the Royal Society of London B* 276: 1771-1776.
17. **Boyce, C. K.** 2009. Seeing the forest with the leaves—clues to canopy placement from leaf fossil size and venation characteristics. *Geobiology* 7: 192-199.
16. **Boyce, C. K.** 2008. The fossil record of plant physiology and development—What leaves can tell us. *Paleontological Society Papers* 14: 133-146.
15. **Boyce, C. K.** 2008. How green was *Cooksonia*? -- the importance of size in understanding the early evolution of physiology in the vascular plant lineage. *Paleobiology* 34: 179-194.
14. **Boyce, C. K.**, C. L. Hotton, M. L. Fogel, G. D. Cody, R. M. Hazen, A. H. Knoll, F. M. Hueber. 2007. Devonian landscape heterogeneity recorded by a giant fungus. *Geology* 35: 399-402.
13. **Boyce, C. K.** 2007. Mechanisms of laminar growth in morphologically convergent leaves and flower petals. *International Journal of Plant Science* 168: 1151-1156.
12. Zwieniecki, M. A., H. Stone, A. Leigh, **C. K. Boyce**, N. M. Holbrook. 2006. Hydraulic design of pine needles: one-dimensional optimization for single-vein leaves. *Plant, Cell & Environment* 29: 803-809.
11. **Boyce, C. K.** 2005. The evolutionary history of roots and leaves. Pp. 479-499 in N. M. Holbrook & M. A. Zwieniecki, eds. *Vascular transport in plants*. Elsevier Sciences/Academic Press.
10. **Boyce, C. K.** 2005. Patterns of segregation and convergence in the evolution of fern and seed plant leaf morphologies. *Paleobiology* 31: 117-140.

9. Zwieniecki, M. A., **C. K. Boyce**, N. M. Holbrook. 2004. Functional design space of single veined leaves: role of tissue hydraulic properties in constraining leaf size and shape. *Annals of Botany* 94: 507-513.
8. **Boyce, C. K.**, M. A. Zwieniecki, G. D. Cody, C. Jacobsen, S. Wirick, A. H. Knoll, N. M. Holbrook. 2004. Evolution of xylem lignification and hydrogel transport regulation. *Proceedings of the National Academy of Sciences USA* 101: 17555-17558.
7. Zwieniecki, M. A., **C. K. Boyce**, N. M. Holbrook. 2004. Hydraulic limitations imposed by crown placement determine final size and shape of *Quercus rubra* L. leaves. *Plant, Cell & Environment* 27: 357-365.
6. **Boyce, C. K.**, G. D. Cody, M. L. Fogel, R.M. Hazen, C. M. O'D. Alexander, A. H. Knoll. 2003. Chemical evidence for cell wall lignification and the evolution of tracheids in Early Devonian plants. *International Journal of Plant Sciences* 164: 691-702.
5. Zwieniecki, M. A., P. J. Melcher, **C. K. Boyce**, L. Sack, N. M. Holbrook. 2002. Hydraulic architecture of leaf venation in *Laurus nobilis* L. *Plant, Cell & Environment* 25: 1445-1450.
4. **Boyce, C. K.**, G. D. Cody, M. Feser, C. Jacobsen, A. H. Knoll, S. Wirick. 2002. Preservation of cell wall chemistry and microstructure in plant fossils as old as 400 million years: detection by carbon X-ray absorption spectromicroscopy. *Geology* 30: 1039-1042.
3. **Boyce, C. K.**, A. H. Knoll. 2002. Evolution of developmental potential and the multiple independent origins of leaves in Paleozoic vascular plants. *Paleobiology* 28: 70-100.
2. **Boyce, C. K.**, A. H. Knoll, R. M. Hazen. 2001. Nondestructive, in situ, cellular-scale mapping of elemental abundances including organic carbon in permineralized fossils. *Proceedings of the National Academy of Sciences USA* 98: 5970-5974.
1. Kirschvink, J. L., S. Padmanabha, **C. K. Boyce**, J. Oglesby. 1997. Measurement of the threshold sensitivity of honeybees to weak, extremely low-frequency magnetic fields. *Journal of Experimental Biology* 200: 1363-1368.

#### Other Publications

3. **Boyce, C. K.** In preparation. *A wedge to lift the sky—Three billion years of life on land*. Princeton University Press.
2. **Boyce, C. K.** 2015. *Fossils*. Oxford Bibliographies in Evolutionary Biology.
1. **Boyce, C. K.** 2014. C. Kevin Boyce. Pp. 25-30. *In* M. R. Sánchez-Villagra, and N. MacLeod, eds. *Issues in Paleobiology: A global view. Interviews and Essays*. Scidinge Hall Verlag, Zürich.