

## REPLY TO WIENS AND SCHOLL:

## The time dependency of diversification rates is a widely observed phenomenon

L. Francisco Henao Diaz<sup>a,b</sup>, Luke J. Harmon<sup>c</sup>, Mauro T. C. Sugawara<sup>a,b</sup>, Eliot T. Miller<sup>d</sup>, and Matthew W. Pennell<sup>a,b,1</sup>

In their comment on our recent paper (1), Wiens and Scholl (2) raise 2 points that are hard to reconcile with one another: First, they argue that one of our primary findings—of the time dependency of diversification rate estimates—was also reported by them and, second, that the methods we used to make these findings are flawed. Rather than claiming priority, we instead highlighted a number of papers that had previously documented the pattern or rate scaling (3–6), most of which predate the paper by Wiens and Scholl (7). The aim of our paper was to use a smaller set of robust and well-resolved trees to evaluate different explanations for this phenomenon. Our results

suggest this pattern is likely a property that emerges from interesting biological processes. As for Wiens and Scholl's second point regarding the appropriateness of using constant-rate estimators versus variable-rate estimators when rates are known to vary, this question has already been addressed in depth in the literature (see, e.g., refs. 8 and 9), and we have nothing to add on this point. We would especially like to draw the readers' attention to the statement from the Editorial Board of the journal *Evolution* (10) about a recent paper on these estimators published by Wiens and coworkers (11) and used to support their claims in this letter.

- 1 L. F. Henao Diaz, L. J. Harmon, M. T. C. Sugawara, E. T. Miller, M. W. Pennell, Macroevolutionary diversification rates show time dependency. *Proc. Natl. Acad. Sci. U.S.A.* **116**, 7403–7408 (2019).
- 2 J. J. Wiens, J. P. Scholl, Diversification rates, clade ages, and macroevolutionary methods. *Proc. Natl. Acad. Sci. U.S.A.* **116**, 24400 (2019).
- 3 S. Magallón, M. J. Sanderson, Absolute diversification rates in angiosperm clades. *Evolution* **55**, 1762–1780 (2001).
- 4 M. A. McPeck, J. M. Brown, Clade age and not diversification rate explains species richness among animal taxa. *Am. Nat.* **169**, E97–E106 (2007).
- 5 R. E. Ricklefs, Global variation in the diversification rate of passerine birds. *Ecology* **87**, 2468–2478 (2006).
- 6 H. P. Linder, Plant species radiations: Where, when, why? *Philos. Trans. R. Soc. Lond. B Biol. Sci.* **363**, 3097–3105 (2008).
- 7 J. P. Scholl, J. J. Wiens, Diversification rates and species richness across the Tree of Life. *Proc. R. Soc. B* **283**, 20161334 (2016).
- 8 D. L. Rabosky, BAMM at the court of false equivalency: A response to Meyer and Wiens. *Evolution* **72**, 2246–2256 (2018).
- 9 D. L. Rabosky, Phylogenies and diversification rates: Variance cannot be ignored. *Syst. Biol.* **68**, 538–550 (2019).
- 10 Anonymous, EDITORIAL COMMENT. *Evolution* **72**, 2267 (2018).
- 11 A. L. S. Meyer, C. Román-Palacios, J. J. Wiens, BAMM gives misleading rate estimates in simulated and empirical datasets. *Evolution* **72**, 2257–2266 (2018).

<sup>a</sup>Department of Zoology, University of British Columbia, Vancouver, BC, Canada V6T 1Z4; <sup>b</sup>Biodiversity Research Centre, University of British Columbia, Vancouver, BC, Canada V6T 1Z4; <sup>c</sup>Department of Biological Sciences, University of Idaho, Moscow, ID 83844; and <sup>d</sup>Cornell Lab of Ornithology, Cornell University, Ithaca, NY 14850

Author contributions: L.F.H.D., L.J.H., M.T.C.S., E.T.M., and M.W.P. wrote the paper.

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<sup>1</sup>To whom correspondence may be addressed. Email: pennell@zoology.ubc.ca.

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