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Dear Editors of Current Biology,

We would like to gauge your interest in our manuscript *Evolutionary bursts drive morphological novelty* with this presubmission inquiry. Our paper addresses a fundamental question in biology: how do new morphologies evolve? At macroevolutionary scales most hypotheses of morphological evolution rely either on a gradualist view proposed by Charles Darwin or an episodic view presented by G.G. Simpson. Typically, these evolutionary modes are at odds with one another. However, using a novel high-dimensional morphological dataset paired with genome-scale genetic data we find common ground between these two opposing views. Our investigation of the lizard body plan suggests that while the prevailing process of evolutionary change is gradual (following Darwin), novel morphologies emerge through evolutionary bursts (Simpsonian "jumps"). Further, we align these bursts with the axes of morphological change, allowing us to distinguish between periods of elaboration—change along the morphological path of least resistance—and innovation—change resulting in new forms. We believe our framework will be of broad interest to biologists seeking to study the tempo and mode of evolution.

On behalf of myself and coauthors we thank you for your time and consideration,

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Evolutionary bursts drive morphological novelty

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*Extended Abstract*:

Animals come in all shapes and sizes. From mundane to bizarre, their features are the result of millions of years of evolution and mutation accumulating differences and adjusting designs. As a result of differing selective pressures, drift, and functional constraints phenotypes evolve and diverge. However there is little consensus about the evolutionary mode of most traits and if novel morphologies evolve from prolonged (Darwinian gradualist) or episodic (Simpsonian jump) divergences. Here we use novel exon-capture and linear morphological datasets to investigate the tempo and mode of morphological evolution in Australo-Melanesian Tiliquini skinks. We generate a well-supported time-calibrated phylogenomic tree from 400 single-copy nuclear markers for 77 specimens including undescribed diversity, and provide unprecedented resolution of the rapid Miocene diversification of these lizards. By collecting a morphological dataset that encompasses the lizard body plan (21 traits across the head, body, limb, and tail) we are able to identify that most traits evolve conservatively but infrequent evolutionary bursts result in morphological novelty. These phenotypic discontinuities occur via rapid rate increases along individual branches, inconsistent with both gradualistic and punctuated equilibrial evolutionary modes. Instead, this 'punctuated gradualism' has resulted in the rapid evolution of blue-tongued giants and armored dwarves in the ~20 million years since colonizing Australia. These results outline the evolutionary pathway towards new morphologies and highlight the heterogeneity of evolutionary tempo and mode, reconciling Darwinian and Simpsonian evolution.

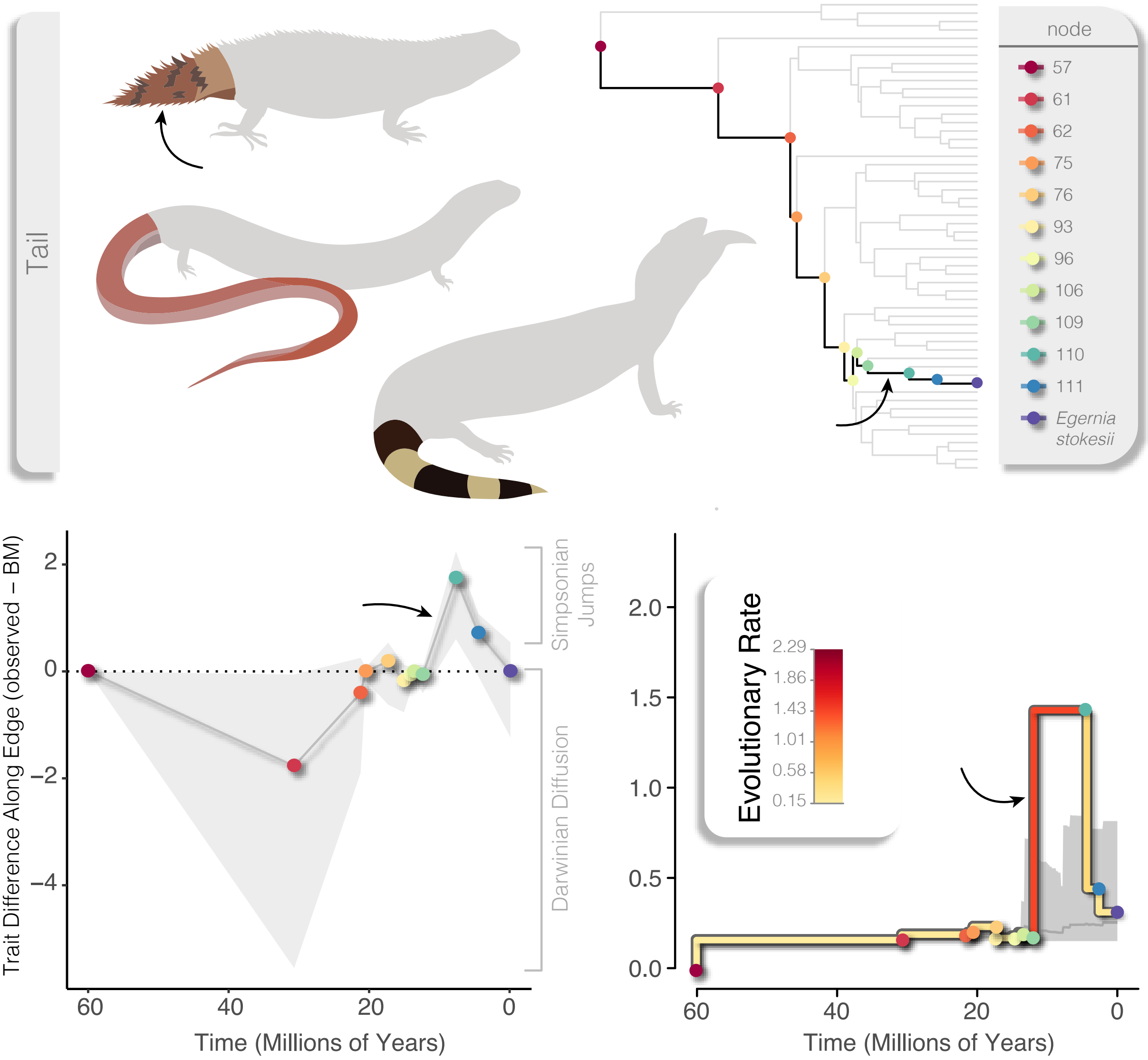


*Figure*. Composite figure outlining our methodology for inferring evolutionary mode of novel morphologies, using the lizard tail as an example. (top left) Representative illustrations of some Tiliquin lizards showing body form diversity, focusing on different tail morphologies. (top right) Phylogeny of this group of lizards with the path from root to a single tip noted, for interpreting following figures. (bottom left) Evolution of the tail from the ancestral form (root) to a single tip, illustrating the trait variance along each individual branch, comparing the inferred evolutionary path to a diffusion process under Brownian Motion. Values near zero indicate an adherence to Darwinian diffusion, whereas values significantly above zero indicate relatively large leaps in trait evolution akin to Simpsonian jumps. (bottom right) Evolutionary rates of the tail from the ancestral form (root) to a single tip, illustrating the variation in rates along individual branches, and the coincident jump in evolutionary rate and trait variance between nodes 109 and 110. Black arrows throughout highlight a focal branch which contributes disproportionately to the evolution of the short, wide, and spinose tail of the *Egernia stokesii* group.