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A study in contrasts: two extensive Neotropical radiations

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A commentary on

Rodent diversity in South America: transitioning into the genomics era
by Lessa, E. P., Cook, J. A., D'Elía, G., and Opazo, J. C. (2014). Front. Ecol. Evol. 2:39. doi: 10.3389/fevo.2014.00039

Lessa et al. (2014) make a compelling case for systematic exploration of genomes in the diverse South American rodent fauna. Not only do the caviomorph and sigmodontine rodents comprise a sizable portion of the continental fauna, but they have radiated into virtually all available habitats and have adopted practically all of the life modes exploited by rodents elsewhere. Both are diverse and demonstrably monophyletic, offering great insights into the evolutionary transitions underlying these presumably adaptive radiations. Here we comment on the non-South American portions of these radiations, as well as the broader phylogenetic context of these rodents, recent work on Caribbean taxa, and historical biogeography.

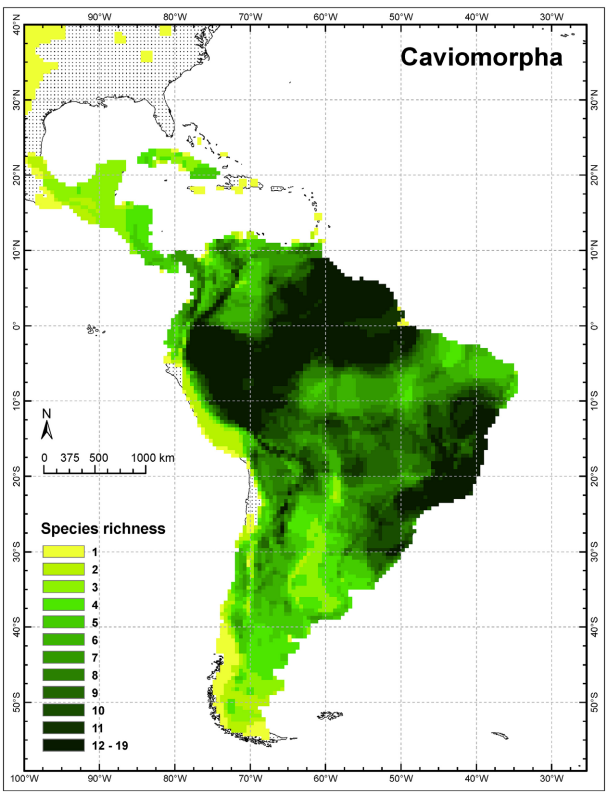

FIGURE 1 | Species richness of caviomorph rodents in the New World tropics (modified from Upham and Patterson, in press).

Although both rodent radiations flourished in South America, neither is confined there, as clearly noted by the authors. Both groups extend far into North America, reaching the Arctic Ocean in the case of the caviomorph *Erethizon* and the central Great Plains in the cases of the sigmodontines *Sigmodon* and *Oryzomys* (IUCN, 2014), although only these three genera range north of Mexico (see Caviomorpha distribution in **Figure 1**). Both also underwent important, endemic radiations in the Caribbean, mainly on the Greater Antilles (Dávalos and Turvey, 2012). The Caribbean region constitutes one of three principal regions of endemism for the entire Neotropical Region and has been an important evolutionary theater (Morrone, 2014). Antillean caviomorphs, which are all endemic, included 9 genera of hutias (Capromyidae) and 6 genera of giant hutias (Heptaxodontidae and incertae sedis), totaling 45 species, 31 of them now extinct. Antillean sigmodontines included 4 genera (2 of which were endemic) and perhaps 18 species of rice rats, all now extinct. Of course, the extent of Quaternary and human-caused extinctions complicates attempts to document the genetics and ecology of these radiations (see also Morgan and Woods, 1986). Nevertheless, genomic tools offer greater insights into phylogenies than were available via Sanger sequencing (McCormack et al., 2013). A recent analysis using target enrichment and next-generation sequencing of mitochondrial and nuclear genes greatly clarified the phylogeny and historical biogeography of capromyids (Fabre et al., 2014). Hutias are

confidently recovered as a subclade of the largely South American Echimyidae, and sister to forms from eastern Brazil (see also Upham and Patterson, in press). This case highlights the importance of studying monophyletic groups, and not geographic partitions of them, in any evolutionary analysis. The utility of next-generation sequencing for dried tissue "museomics" also opens the door for studying such rare or recently extinct taxa in a genetic context (Rowe et al., 2011).

The groups in question belong to two of the three major lineages of Rodentia (Blanga-Kanfi et al., 2009; Fabre et al., 2012). Caviomorphs represent the largest group of Ctenohystrica, and the only one found in the Western Hemisphere; they are sister to the African Phiomorpha (Honeycutt, 2009). Sigmodontines constitute the second-largest group of the "mouse-related" clade, a New World counterpart to the explosive murine radiation that took place in the Eastern Hemisphere. Caviomorph rodents colonized South America an estimated 42 Mya, in the midst of its extended Cenozoic isolation (Rowe et al., 2010; Upham and Patterson, in press), and began diversifying in the Oligocene. At this time, South America lacked other rodents (including squirrels, gophers, beavers, voles, and muskrats), as well as deer and other extant ungulates. This ecological impoverishment prompted a remarkable Cenozoic radiation, including truly giant herbivores (Rinderknecht and Blanco, 2008) and many dozens of extinct lineages (Pérez and Pol, 2012). At least for the Octodontoidea, the most speciose superfamily of caviomorph, this radiation was rooted in the Southern Andes and Patagonia and unfolded south-to-north (Upham and Patterson, 2012). On the other hand, the sigmodontines are sister to the Central American tylomyines—their divergence began in the mid-to-late Miocene (9–12 Mya), and they colonized South American landscapes north-to-south, as a leading element of the Great American Biotic Interchange that also brought squirrels, pocket gophers and pocket mice, deer, and peccaries (Parada et al., 2013; Leite et al., 2014). These differences in historical, geographic, and ecological context pose numerous interesting questions for transcriptomic analysis.

Enrique Lessa and company have done evolutionary biologists in general, and students of Neotropical mammals in particular, a great service in identifying the status and potential value of concerted action to fill knowledge gaps regarding the genomics of these rodents. One can only hope that their call is answered, enthusiastically.

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