Phylogeography of the Laotian rock rat (Diatomyidae: Laonastes): implications for Lazarus taxa

Minh Le¹²*, Ha M. Nguyen², Ha T. Duong³, Thanh V. Nguyen³, Long D. Dinh³**, Nghia X. Nguyen⁴, Luong D. Nguyen⁵, Tri H. Dinh⁶ and Dang X. Nguyen⁴

¹ Department of Environmental Ecology, Faculty of Environmental Science, Hanoi University of Science, VNU, 334 Nguyen Trai Road, Thanh Xuan District, Hanoi, Vietnam
² Centre for Natural Resources and Environmental Studies, VNU, 19 Le Thanh Tong Street, Hanoi, Vietnam
³ Department of Genetics, Faculty of Biology, Hanoi University of Science, VNU, 334 Nguyen Trai Road, Thanh Xuan District, Hanoi, Vietnam
⁴ Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Hanoi, Vietnam
⁵ Fauna and Flora International, 340 Nghi Tam Road, Tay Ho District, Hanoi, Vietnam
⁶ Phong Nha-Ke Bang Conservation National Park, Quang Binh Province, Vietnam

The Laotian rock rat, Laonastes aenigmamus, was first described in 2005 based on specimens collected in the vicinity of Khammouan Limestone National Biodiversity Conservation Area in the northern Annamite Range (Jenkins et al. 2005). The unique morphological characters and highly divergent mitochondrial DNA of the new species, which inhabits limestone habitat exclusively, confirm its distinctiveness among all living rodent families. Jenkins et al. (2005), as a result, considered the Laotian rock rat the only surviving member of the new monotypic rodent family Laonastidae. Although subsequent morphological study supported its phylogenetic position within the existing family Diatomyidae (Dawson et al. 2006), this species has been demonstrated to be the last remaining species of an ancient clade as all of its relatives went extinct since 11 million years ago (Dawson et al. 2006; Huchon et al. 2007). Historically, the family was widely distributed in Asia, from the western part of the continent, Pakistan and India, to the eastern region, Thailand, China, and Japan (Li 1974; Flynn et al. 1986; Marivaux et al. 2002), but until recently it was known only from a small area in Laos (Fig. 1) (Jenkins et al. 2005; Rivière-Dobigny et al. 2011; Nicolas et al. 2012).

During our recent surveys conducted from 2012 to 2014 in two new sites, Phong Nha–Ke Bang National Park and two from Hin Nam No National Biodiversity Conservation Area, eastern Lao PDR (Fig. 1). We sequenced the complete cytochrome b gene of the newly acquired samples, and analyzed new sequences with those derived from the previous studies to elucidate the phylogeographic pattern of the populations. In addition, we estimated divergence time between major lineages of the Laotian rock rat using a relaxed molecular clock approach to provide insights into the evolution of this enigmatic species. We discussed the ‘Lazarus effect’ (Flessa and Jablonski 1983), referring to a large temporal gap of fossil records of this family, and the importance of the Annamites in harboring ancient and unique lineages in the context of our results.

Materials and methods

Eleven newly collected specimens of the Laotian rock rat were included in this study, nine from Phong Nha–Ke Bang National Park and two from Hin Nam No National Biodiversity Conservation Area, eastern Lao PDR (Fig. 1). We sequenced the complete cytochrome b gene from all 11 samples using five primers (Irwin et al. 1991). Additional 16 published sequences of the partial and complete cytochrome b from individuals of populations around Khammouan Limestone National Biodiversity Conservation Area (Jenkins et al. 2005; Huchon et al. 2007; Rivière-Dobigny et al. 2011) and from distinct clades G and H, whose samples were collected in Laos (Nicolas et al. 2012), were also incorporated in the analyses. Other haplotypes in Nicolas et al. (2012) were much less diver-